CORROSION RESISTANT MATERIALS HANDBOOK

Fourth Edition

Edited by

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NOTICE

Foreword

The fourth edition of the *Corrosion Resistant Materials Handbook* has been completely revised and vastly expanded, based on the latest available technical data. This well-established and successful reference volume, first published in 1966, will provide useful information which will enable the concerned engineer or manager to cut losses due to corrosion by choosing suitable *commercially available* corrosion resistant materials for a particular application. It would also be useful to equipment designers and others as a valuable screening guide in choosing materials for equipment having specific corrosion resistance requirements.

The great value of this outstanding reference work lies in the extensive cross-indexing of thousands of substances. The more than 160 detailed tables in the book are arranged by types of **corrosion resistant materials.** The **Corrosive Material Index** is organized by *corrosive chemicals* and other *corrosive substances.* It refers the reader to specific recommendations in the tables. A separate **Trade Name Index** and a **Company Name and Address Listing** are also included.

The various sections in the book cover selected categories of corrosion resistant materials, such as synthetic resins and polymers; rubbers and elastomers; cements, mortars, and asphalt; ferrous alloys; nonferrous metals and alloys; and glass, ceramics, and carbon-graphite. A separate section presents a group of 13 tables which compare the anticorrosive merits of a cross section of commercial engineering and construction materials essential to industry. The tables in the book represent selections taken directly from manufacturers' literature made at no cost to, nor influence from, the makers or distributors of these materials.

The vast amount of information contained in the book is evidenced at once in the extensive table of contents and the exhaustive indexes.

Advanced composition and production methods developed by Noyes Data Corporation are employed to bring this durably bound book to you in a minimum of time. Special techniques are used to close the gap between "manuscript" and "completed book." In order to keep the price of the book to a reasonable level, it has been partially reproduced by photo-offset directly from the original material and the cost savings passed on to the reader. Due to this method of publishing, certain portions of the book may be less legible than desired.

Contents

Synthetic Resins and Polymers

TABLE 1.1: ABS JACKETS AND COVERS—CEEL-CO

Typical Resistance Features of CEEL-TITE 100 Series

Acetic Acid, 1%, 30 days	S
Acetic Acid, 50%, 30 days	S
*Acetic Acid, concentrate	U
Acetone, 10%	S
Aluminum Sulfate, 25%	S
Ammonia Gas	S
Ammonium Hydroxide	S
Beer (over 3.2% alcohol)	S
*Benzaldehyde Concentrate	U
*Benzene	U
*Benzyl Ether	U
*Bromine	U
*Bromoethane	U
Butane	S
*Butyric Acid	U
Calcium Chloride, 25%	S
Calcium Sulfate, 25% solution	S
Carbon Dioxide	S
*Carbon Tetrachloride	U
*Chlorobenzene	U
*Chloropropane	U
Chromic Acid, 30%	S
Citric Acid, 25%	S
Cod Liver Oil	S
Colloidal Sulfur, 30 days, 140°F	S
Corn Oil	S
Cyclohexanol	S
*Cyclohexanone	U
Detergent	S
Diethanolamine, 30 days, 140°F	S
Diethylene Glycol	S
*Diethyl Ether	U
*Diethyl Ketone	U
*Ethyl Acetate	U
Ethyl Alcohol, 50%	S
Ethylene Glycol, 30 days, 140°F	S
Ferrous Sulfate, 25%	S
Formaldehyde, 30%, 30 days	S
*Freon 11	U
Freon 12	S
*Gasoline	U
Glucose, 30 days, 30%, 140°F	S
Glycerin, 30 days, 140°F	S
Grapefruit Juice, 30 days	S
Heptane, 30 days	S
*Hexane	U
Hydrochloric Acid, 30 days	S
Hydrogen Peroxide, 3%	S
Kerosene, 30 days	S
Light Process Oil, 30 days 140°F	S
Liquid Wrench®	S
*Methyl Ethyl Ketone	U
Mineral Spirits, 18 months	S
Motor Oil, 6 months	S
Naphtha (lighter fluid), 3 months	S
Paraffin, 30 days	S
*Pentane	U
*Phenol	U
Phosphoric Acid, 30 days	S
*Phosphoric Acid, 30 days 140°F	U
Potassium Chloride, 25%	S
Potassium Hydroxide, Saturated solution, 30 days, 140°F	S
Red Copper Oxide, 30 days, 140°F	S
Sodium Bicarbonate Solution, 30 days, 140°F	S
Sodium Chloride Solution, 30 days, 140°F	S
Sulfuric Acid, 50%, 30 days	S
Syrup, Simple Sugar	S
Tomato Juice	S
Trisodium Phosphate	S
Ucon M-1® Hydraulic Fluid, 7 days, 160°F	S
Uric Acid, 30 days	S
Vinegar	S
Film Remover	S

S — Satisfactory
U — Unsatisfactory

Test Method ASTM D — 543 — 72

*Satisfactory for use under atmospheric conditions

® — Registered Trademark

TABLE 1.2: ABS/PVC ALLOYS—A. SCHULMAN

A special outdoor rigid polymer alloy, POLYMAN 507 retains more impact strength after UV exposure than any competitive material according to UL recognition tests. It is rated UL Bulletin 94 V-0 and carries 95°C continuous use temperature rating. In addition it offers the good electrical properties and tensile strength needed for wiring devices and small tool housings. A rigid polymer alloy, POLYMAN 509 exhibits low shrinkage (0.0045 in/in) and combines a 212°F heat distortion temperature with a superior 430,000 flexural modulus to mold and hold strict dimensional tolerances in critical fit applications such as printed circuit card holders. Its high arc track resistance and compressive strength, along with a good balance of other properties, qualifies for applications in severe electrical service such as junction boxes and connectors. POLYMAN 511 offers the highest impact strength (83.5 tensile impact; 320 in lb Gardner impact) of the POLYMAN UL V-0 rated rigid polymer alloys. It also has excellent UV color stability along with the exceptional stiffness and flatness required for large business machine and consumer appliance housings.

POLYMAN 507, 509, 511 Chemical Resistance

Class S—Satisfactory (only minor absorption)
Class A—Surface affected only slightly; still performs mechanically
Class P—Poor resistance; not recommended exposure

CLASS S

Linseed Oil	Brine Solution
Mineral Oil	Clorox
Motor Oil	Citric Acid 2N
Nitric Acid, 40%	Gasoline
Olive Oil	Glacial Acetic Acid
Potassium Hydroxide, 50%	Hexane
Sodium Carbonate	Hydrochloric Acid, 30%
Sodium Hydroxide, 50%	Hydrochloric Acid 2N
Sulphuric Acid, 97%	Igepal
Ammonia, 30%	Lactic Acid 20%

CLASS A	CLASS P
Chloroform	Acetone
Chromic Acid 30%	Benzene
Ethyl Alcohol	Carbon Bisulfide
Formaldehyde, 35%	Carbon Tetrachloride
Formic Acid (Anhydrous)	Ethyl Acetate
Glycol	Methyl Ethyl Ketone
Isopropyl Alcohol	Toluene
Oxalic Acid 50%	Xylene
Phosphoric Acid, 85%	
Silicone Oil	
Turpentine	

NOTE: For solvent welding, use such solvents as:
Perchlorethylene with Cyclohexanone
Tetra Hydrofurane with M.E.K.
For vapor degreasing, use such agent as:
Freon TE with Alcohol

TABLE 1.3: ACETAL COPOLYMERS—CELANESE PLASTICS

CELCON is a registered trademark of the Celanese Corporation used for its crystalline acetal copolymer based on trioxane. CELCON acetal copolymer can be injection molded, blow molded, extruded, rotationally cast and easily machined. CELCON acetal copolymer offers high mechanical strength, stiffness, toughness, and practical impact strength through broad ranges of temperature and environment.

Celcon Grade Range

Formulation	Melt Index	Description	Application
U10-11	1.0	Excellent processability in extrusion blow molding, injection blow molding and extrusion. High melt strength. Low odor grade for aerosols.	Aerosols, containers, industrial articles, rod, tube, slab, profiles.
M25-01	2.5	Excellent processability in extrusion. Not lubricated.	Rod, tube, sheet, slab, wire coating.
M25-04	2.5	Good processability for injection molding in easy-to-fill molds. Possesses greater toughness and elongation than materials with 9.0 melt index. Same as M25-01 except that it is internally lubricated.	Injection molded parts requiring optimum toughness and elongation.
M90-04	9.0	Excellent moldability due to high flow characteristics and stability in processing. High surface gloss and good dimensional stability. Internally lubricated.	General injection molding.
M90-08	9.0	Ultraviolet stabilized. Good maintenance of physical properties and resistance to chalking in outdoor exposures.	Injection molded seasonal outdoor applications.
M270-04	27.0	Highest flow. Superior moldability for hard to fill molds with somewhat less toughness than M90. Internally lubricated.	High speed injection molding for multicavity parts.
M90-07	—	Celcon color Concentrates are provided in a wide range of standard colors for letdown into natural Celcon via extrusion or screw injection molding machines.	To obtain body colored injection molded or extruded products at cost savings.
GC-25A	2.5	M90 Resin reinforced with 25% by weight of glass fibers together with a unique coupling agent. Provides increased stiffness, tensile strength and creep resistance.	Windshield wiper pivots, gears, pulleys and other parts requiring the maximum in stiffness and strength.

(continued)

TABLE 1.3: ACETAL COPOLYMERS—CELANESE PLASTICS (continued)

Chemical Resistance of Celcon M90, M25, M270

Material	Time Months	Temp. F	% Change[1] Yield Strength	Tensile Modulus	Length	Weight	Visible Effect[3]
Control (Air)	12	73	0	0	0	0.22	N.C.
INORGANIC CHEMICALS							
10% Ammonium Hydroxide	6	73	0	0	0.3	0.88	Disc.
	12	73	0.7	−16	0.3	1.03	Disc.
	6	180	−0.3	−12	0.4	0.74	Disc.
3% Hydrogen Peroxide	6	73	2	−15	0.3	0.97	N.C.
	12	73	3	−12	0.3	0.88	N.C.
10% Hydrochloric Acid	6	73	X	X		X	
10% Nitric Acid	6	73	X	X		X	
10% Sodium Chloride	6	73	2	−12	0.2	0.59	N.C.
	12	73	3	−15	0.2	0.71	Sl. Disc.
	6	180	4	−10	0.2	0.49	Sl. Disc.
2% Sodium Carbonate	6	73	0	−9	0.2	0.77	N.C.
	12	73	6	−9	0.2	0.78	N.C.
	6	180	3	−2	0.4	0.96	N.C.
20% Sodium Carbonate	6	180	3	−2	0.2	0.61	N.C.
1% Sodium Hydroxide	6	73	1	2	0.2	0.80	N.C.
	12	73	2	2	0.2	0.84	N.C.
10% Sodium Hydroxide	6	73	1	−8	0.2	0.49	N.C.
	12	73	−2	−6	0.2	0.73	N.C.
	6	180	−3	−8	0.2	0.83	Sl. Disc.
60% Sodium Hydroxide	6	180	−3	−6	−0.1	−0.18	Sl. Disc.
4-6% Sodium Hypochlorite	6	73	−6	−7	0.1	−3.29	Pitted
26% Sodium Thiosulfate	6	180	3	−12	0.2	0.61	N.C.
3% Sulfuric Acid	6	73	0	−8	0.4	0.81	N.C.
	12	73	2	−14	0.2	0.82	N.C.
30% Sulfuric Acid	6	73	X	X	X	X	
Buffer, pH 7.0	6	180	2	−15	0.3	0.94	Sl. Disc.
Buffer, pH 10.0	6	180	4	−12	0.3	0.89	Sl. Disc.
Buffer, pH 4.0	4	180	X	X	X	X	
Water (Distilled)	6	73	0	−12	0.2	0.83	N.C.
	12	73	4	−12	0.2	0.84	N.C.
	12	180	0	−18	−0.1	−3.32	Disc.
ORGANIC CHEMICALS							
5% Acetic Acid	6	73	−1	−15	0.3	1.05	N.C.
	12	73	0.6	−16	0.2	1.13	N.C.
Acetone	6	73	−4	−20	0.7	3.60	N.C.
	12	73	−17	−48	1.6	3.68	N.C.
	6	120	−19	−48	2.1	4.45	N.C.
Aniline	6	180	−26	−73	4.8	12.1	Reddish Tint
Benzene	6	120	−17	−43	1.8	3.93	N.C.
Carbon Tetrachloride	6	73	−1	−4	0.2	0.86	N.C.
	12	73	2	−6	0.1	1.39	N.C.
	6	120	−11	−32	1.2	5.23	N.C.
10% Citric Acid	6	73	0	−12	0.3	0.74	N.C.
	12	73	3	−10	0.2	1.93	N.C.
Diethyl Ether	6	73	−15	−26	1.1	2.09	N.C.
Dimethyl Formamide	6	180	−19	−63	3.1	7.7	N.C.
Ethyl Acetate	6	73	−5	−20	0.6	3.62	N.C.
	12	73	−17	−46	1.6	4.25	N.C.
	6	120	−22	−50	2.1	5.23	N.C.

(continued)

TABLE 1.3: ACETAL COPOLYMERS—CELANESE PLASTICS (continued)

Material	Time Months	Temp. F	% Change[1] Yield Strength	Tensile Modulus	Length	Weight	Visible Effect[3]
Ethylene Dichloride	6	120	−23	−68	3.2	10.05	N.C.
50% Ethylene Glycol	6	180	0	−18	0.4	1.33	Sl. Disc.
95% Ethanol	6	73	−4	−19	0.6	1.43	N.C.
	12	73	−6	−35	0.7	2.19	N.C.
	6	120	−17	−31	1.3	2.54	N.C.
50% Ethanol	6	73	−4	−24	0.6	1.62	N.C.
	12	73	−5	−32	0.7	1.98	N.C.
	6	120	−13	−34	1.0	2.27	N.C.
Heptane	6	73	−2	−13	0.2	0.04	N.C.
	12	73	3	4	−0.07	0.09	N.C.
	6	180	−6	−9	0.2	0.35	N.C.
Oleic Acid	6	73	−1	−15	0.3	1.05	N.C.
	12	73	3	31	−0.04	−1.26	N.C.
	6	180	0	−9	0.5	1.04	N.C.
5% Phenol	6	73	−15	−45	2.1	9.34	N.C.
	12	73	−10	−46	1.4	4.70	Disc.
Toluene	6	73	− 7	−17	0.4	1.12	N.C.
	12	73	− 7	−19	0.7	1.87	N.C.
	6	180	−14	−43	1.6	3.80	N.C.
OTHER MATERIALS							
Automatic Transmission Fluid	6	180	5	5	−0.07	−0.15	N.C.
Anti-Freeze (Telar)	6	180	0	−23	0.6	1.53	N.C.
Brake Fluid, "Super 9"	6	73	0	−12	0.3	0.34	N.C.
	12	73	3	−1	0.2	0.53	N.C.
Brake Fluid, Lockheed "21"	6	73	−3	−13	0.3	0.70	N.C.
	12	73	−0.5	−9	0.2	1.05	N.C.
	6	180	−11	−41	1.4	3.60	N.C.
Brake Fluid, "Delco 222"	6	180	−5	−33	1.3	3.18	N.C.
Detergents							
"Acclaim"	6	180	2	−11	0.2	0.85	Sl. Disc.
"Calgonite"	6	180	3	−15	0.3	1.00	Sl. Disc.
"Electro-Sol"	6	180	3	−10	0.3	1.04	N.C.
50% Igepal	6	73	18	−14	0.4	0.75	N.C.
	12	73	3	−15	0.4	0.84	N.C.
	6	180	0	−18	0.7	1.62	N.C.
Detergent Solution[2]	6	180	−3	−20	0.4	1.04	Sl. Disc.
1% Soap Solution	6	180	−2	−15	0.5	1.32	N.C.
Gasolines							
Mobil Regular (93/5 Octane)	6	120	−11	−12	0.7	1.30	N.C.
Mobil "Hi-Test" (99.0 Octane)	6	120	−12	−12	0.7	1.50	N.C.
Sunoco "280" (103 Octane)	6	120	−6	−10	0.7	1.43	N.C.
Kerosene	6	180	0	−7	0.3	0.34	N.C.
Linseed Oil	6	180	8	11	0.2	−0.13	N.C.
Lubricating Grease	6	180	4	3	0.2	−0.03	N.C.
Mineral Oil ("Nujol")	6	73	−3	−14	0.2	−0.03	N.C.
	12	73	3	−1	−0.06	0.05	N.C.
	6	180	8	7	0.0	−0.18	N.C.
Motor Oil (10W30)	6	73	−1	−9	0.2	0.02	N.C.
	12	73	5	7	−0.06	0.04	N.C.
	6	180	5	0	−0.06	−0.14	N.C.

1. Type 1 Tensile bars used in these tests measure 8½ x ½ x ⅛ inches; initial yield strength is 8800, tensile modulus 410,000; weight 13 grams.

2. Consists of 0.5 grams of an alkyl sulfonate + 0.20 grams of trisodium phosphate per liter of water.

3. X = Not recommended; N.C. = No Change; Disc = Discoloration; Sl. Disc. = Slight discoloration.

TABLE 1.4: ACRYLIC RESINS—ROHM AND HAAS

PLEXIGLAS is the registered trademark for acrylic plastic sheet produced by Rohm and Haas Company. In its natural form, PLEXIGLAS acrylic sheet is an optically clear, transparent, lightweight material having outstanding weatherability, high impact resistance, good chemical resistance, and excellent thermoformability and machinability.

Chemical Resistance of PLEXIGLAS Sheet*

PROPERTY				ASTM METHOD	UNITS	TYPE OF ACRYLIC PLASTICS: Plexiglas G II UVA, II-UVT, G-UVT	Plexiglas K	Plexiglas 55	Plexiglas IA UVA	Plexiglas MC
Thickness					inches	.0250	0.250	0.250	0.250	0.250
CHEMICAL RESISTANCE				D543						
WEIGHT GAIN AFTER 7 DAYS IMMERSION AT 77°F. (WEIGHT GAIN OR LOSS OF 1% OR LESS IS CONSIDERED NEGLIGIBLE)					%					
COMPOUND CLASS	NAME	TYPE	CONCENTRATION, %							
ACIDS	Acetic Acid	Glacial	100			R-S	R-S	R-S	—	DL
	Acetic Acid		5			0.4	0.4	0.5	0.4	0.5
	Chromic Acid		40			0.2	0.2	0.2	—	4-D
	Citric Acid		10			0.3	0.3	0.4	0.3	0.4
	Hydrochloric Acid	Concentrated	38			0.2	0.2	A-D-S	—	A
	Hydrochloric Acid		10			0.3	0.3	0.4	0.3	0.4
	Hydrofluoric Acid		40			8.5E	8.5E	13E	—	—
	Nitric Acid	Concentrated	70			A-D	A-D	D-R	—	A
	Nitric Acid		40			2.8	2.8	5.3D	—	5-A
	Nitric Acid		10			0.3	0.3	0.4	0.3	0.4
	Oleic Acid					0.0	0.0	0.0	0.0	-0.1
	Sulfuric Acid	Concentrated	98			D-R-S	D-R-S	D-R-S	—	DL
	Sulfuric Acid		30			0.2	0.2	0.3	0.2	0.3
	Sulfuric Acid		3			0.4	0.4	0.5	0.4	0.5
BASES	Ammonium Hydroxide	Concentrated	28			0.2	0.2	0.3	—	0.3
	Ammonium Hydroxide		10			0.4	0.3	0.5	0.3	0.5
	Sodium Carbonate		20			0.2	0.2	0.3	—	0.3
	Sodium Carbonate		2			0.4	0.4	0.5	0.3	0.5
	Sodium Hydroxide		60			-0.2	-0.2	-0.2	—	-0.4
	Sodium Hydroxide		10			0.3	0.3	0.4	0.3	0.4
	Sodium Hydroxide		1			0.4	0.4	0.5	0.4	0.5

(continued)

TABLE 1.4: ACRYLIC RESINS—ROHM AND HAAS (continued)

COMPOUND CLASS	NAME	TYPE	CONCENTRATION, %	TYPE OF ACRYLIC PLASTICS: Plexiglas G II UVA, II-UVT, G-UVT	Plexiglas K	Plexiglas 55	Plexiglas IA UVA	Plexiglas MC
COMMERCIAL PRODUCTS	Cottonseed Oil	Edible Grade		<0.1	<0.1	<0.1	—	0.1
	Detergent Solution	Heavy Duty	0.25	0.3	0.3	0.4	—	0.5
	Kerosene	No. 2 Fuel Oil (ASTM D396)		<0.1	<0.1	<0.1	—	0.1
	Lacquer Thinner			DL	DL	0.3	DL	DL
	Mineral Oil	White, USP		<0.1	<0.1	<0.1	—	0.1
	Olive Oil	Edible Grade		<0.1	<0.1	<0.1	—	0.1
	Soap Solution	White Flakes	1	0.3	0.3	0.4	—	0.5
	Transformer Oil	(ASTM D1040)		<0.1	<0.1	<0.1	—	0.1
	Turpentine	Distilled Spirit (ASTM D13)		<0.1	<0.1	0.1	—	0.1-C
INORGANIC COMPOUNDS	Distilled Water			0.4	0.4	0.5	0.4	0.6
	Hydrogen Peroxide		28	0.4	0.4	0.7	—	0.8
	Hydrogen Peroxide		3	0.4	0.4	0.6	0.4	0.6
	Sodium Chloride		10	0.3	0.3	0.4	0.3	0.5
	Sodium hypochlorite		5	0.3	0.3	0.3	—	0.4
ORGANIC COMPOUNDS	Acetone			DL	DL	R-S	DL	DL
	Aniline			DL	DL	12R-S	—	DL
	Benzene			DL	DL	0.1	—	DL
	Carbon Tetrachloride**			<0.1	<0.1	0.0	-3.0	-5-A-E
	Dibutyl Sebacate			-0.1	-0.1	0.0	0.0	0.1
	Diethyl Ether			<0.1C	<0.1C	-0.1	—	R-S
	Dimethyl Formamide			DL	DL	A-S	—	DL
	Ethyl Acetate			DL	DL	R-S	DL	DL
	Ethyl Alcohol		95	1.4	1.4	1.1	7.5	4.0
	Ethyl Alcohol		50	0.8	0.8	1.7	2.2	2.0

(continued)

TABLE 1.4: ACRYLIC RESINS—ROHM AND HAAS (continued)

COMPOUND CLASS	NAME	TYPE	CONCEN-TRATION, %	TYPE OF ACRYLIC PLASTICS: Plexiglas G II UVA, II-UVT, G-UVT	Plexiglas K	Plexiglas 55	Plexiglas IA UVA	Plexiglas MC
ORGANIC COMPOUNDS	Ethylene Dichloride			DL	DL	R-S	DL	DL
	2-Ethylhexyl Sebacate			<0.1	<0.1	<0.1	—	0.1
	Heptane			0.0	0.0	0.0	0.0	0.1
	Isooctane			<0.1	<0.1	<0.1	—	0.1
	Isopropyl Alcohol		99	0.1	0.1	-0.2	-0.1	C
	Methyl Alcohol			5.8S	5.8S	14S	—	A
	Phenol (Aqueous)		5	A-C	A-C	A-C	A-C	A
	Toluene			DL	DL	0.0	DL	DL

Chemical Resistance Code:
A = Attacked
C = Crazed
D = Discolored
DL = Dissolved
E = Edge Swelling
R = Rubbery
S = Swollen

*Weight change is affected by the thickness of the material. Values given are for the thickness noted in the column heading.

**Although carbon tetrachloride causes negligible weight change in contact with PLEXIGLAS sheet, it does cause optical distortion of the surface. Carbon tetrachloride should not be used with PLEXIGLAS.

TABLE 1.5: ACRYLIC RESIN—SOHIO CHEMICAL

BAREX 210 Resin is an acrylonitrile-methyl acrylate-butadiene polymer.

Chemical Resistance of Barex 210® Resin

	°F/°C	Observed Change
ACIDS		
10% Hydrochloric	73/23	None
	100/38	None
30% Sulfuric	73/23	None
	100/38	None
100% Acetic	73/23	None
	100/38	Frosted, Softened
30% Phosphoric	73/23	None
	100/38	None
10% Nitric	73/23	None
	100/38	Yellowed
BASES		
10% Ammonium Hydroxide	73/23	None
	100/38	Softened
Barium Hydroxide	73/23	None
	100/38	None
Calcium Hydroxide	73/23	None
	100/38	None
10% Potassium Hydroxide	73/23	Slight Frost
	100/38	Frost, Softened
10% Sodium Hydroxide	73/23	Slight Frost
	100/38	Frost, Softened
HYDROCARBONS		
Benzene	73/23	None
	100/38	None
Toluene	73/23	None
	100/38	None
Xylene	73/23	None
	100/38	None
Carbon Tetrachloride	73/23	None
	100/38	None
1,1,1, Trichloroethane	73/23	None
	100/38	None
Trichloroethylene	73/23	None
	100/38	None
Methylene Chloride	73/23	Frosted, Rubbery
	100/38	Frosted, Rubbery
KETONES		
Acetone	73/23	Softened
	100/38	Softened
Methyl Ethyl Ketone	73/23	Frosted, Softened
	100/38	Frosted, Softened
Methyl Isobutyl Ketone	73/23	None
	100/38	None
ALCOHOLS		
Ethyl Alcohol	73/23	None
	100/38	None
Isopropyl Alcohol	73/23	None
	100/38	None
Glycol	73/23	None
	100/38	None
ESTERS		
Butyl Acetate	73/23	None
	100/38	None
Cellosolve Acetate	73/23	None
	100/38	None
Ethyl Acetate	73/23	None
	100/38	Frosted, Softened

Exposure time in all testing was one year.

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES–EASTMAN CHEMICAL

TENITE esters are cellulose derivatives of acetate, butyrate, and propionate. Tenite plastics for molding and extrusion are supplied in the form of pellets. These thermoplastic resins have good processability and finished articles may be resoftened by heat and reshaped by the application of suitable forces.

Effect of Various Chemicals and Reagents on TENITE® Acetate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
CHEMICALS				
Acids				
*Acetic, 5%	1 year	5.53	3.19	Slightly softened, surface attacked
*Acetic, 10%	1 week	5.44	3.03	Slightly softened, surface attacked
*Acetic, 30%	1 week	17.03	22.57	Softened
*Chromic, 6%	8 days (100°F)			Softened and swollen
Citric, 10%	1 year	2.83	1.67	Unchanged
*Citric, 10%	2 months (140°F)			Decomposed
*Citric, 30%	1 week (140°F)			Decomposed
*Fluosilicic, 10%	2 months	−1.30	2.03	Slightly warped
*Fluosilicic, 28%	2 months	−1.67	0.00	Slightly warped
Formic, 3%	20 days			Unchanged
Hydrochloric, 6%	2 days	1.28	0.05	Unchanged
*Hydrochloric, 8%	2 days	0.08	−0.81	Softened
*Hydrochloric, 10%	1 month	2.06	1.49	Softened and swollen
*Hydrofluoric, 10%	1 month			Softened and swollen
*Hydrofluoric, 48%	1 month			Decomposed
Lactic, 10%	2 days	3.14	1.50	Unchanged
*Lactic, 50%	2 days	6.80	4.34	Slightly softened, surface attacked
*Nitric, 10%	1 week			Decomposed
Oleic	1 year	−3.33	−0.83	Unchanged
*Phosphoric, 30%	2 months	2.03	0.83	Unchanged
*Phosphoric, 50%	2 months	1.63	−0.42	Brittle, surface attacked
*Phosphoric, 75%	1 week			Decomposed
Pyrogallic, 4%	1 week	7.88	3.55	Stained yellow
Stearic	1 week			Unchanged
*Sulfuric, 3%	1 month	3.04	2.19	Softened
*Sulfuric, 10%	1 year			Decomposed
*Sulfuric, 20%	8 months			Decomposed
*Tannic, 10%	4 months (140°F)	7.62	1.83	Softened
Tartaric	2 days	2.93	1.60	Unchanged
*Trichloroacetic	1 month			Decomposed

Indicates that material is generally unsatisfactory for use in contact with TENITE Acetate under the conditions of this test.

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Alcohols, monohydric				
n-Amyl	2 days	−0.36	0.26	Unchanged
tert-Amyl	2 days	−0.17	0.19	Unchanged
n-Butyl	2 days	1.41	1.40	Unchanged
sec-Butyl	2 days	0.36	0.78	Surface bleached slightly
tert-Butyl	2 days	−2.00	0.26	Unchanged
*Diacetone				Dissolved
*Ethyl	2 days	12.70	27.90	Swollen and softened
*Ethyl, 50%	1 week	14.48		Swollen and softened
2-Ethylhexyl	1 week			Unchanged
Isoamyl	2 days	−0.36	0.14	Unchanged
Isobutyl	2 days	−1.70	0.42	Unchanged
*Isopropyl	2 days	10.90	18.40	Swollen
*Methyl	2 days	22.60	51.00	Blushed, softened, and swollen
*Methyl, 5%	1 year	3.98	2.59	Blushed and softened
*n-Propyl	2 days	2.20	4.22	Blushed
*Tetrahydrofurfuryl	3 days			Softened and swollen
Alcohols, di- and tri-hydric				
Glycerin	1 year	−0.66	−0.15	Unchanged
Ethylene Glycol	1 year	1.29	1.39	Very slightly softened
*Diethylene Glycol	4 months	20.78	15.94	Warped and softened; surface attacked
*Triethylene Glycol	4 months	25.40	22.89	Warped and softened; surface attacked
Propylene Glycol	2 days	0.39	0.42	Unchanged
Bases				
*Ammonium Hydroxide, 10%	1 month	2.99	12.41	Softened; surface attacked
*Sodium Hydroxide, 1%	1 month	−1.94	−0.12	Softened and warped
*Sodium Hydroxide, 10%	1 week			Decomposed
*Trimethylbenzyl Ammonium Hydroxide, 5%	17 days	−4.87	5.85	Swollen and checked
Esters				
*n-Butyl Acetate	2 days	7.24	9.75	Surface attacked
*sec-Butyl Acetate	2 days	3.74	3.62	Surface attacked
*Ethyl Acetate				Dissolved
*Ethyl Lactate				Dissolved

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Acetate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Esters (Cont.)				
*Ethylene Glycol Monoethyl Ether Acetate (**EKTASOLVE®** EE Acetate; **Cellosolve** Acetate)	2 days			Surface attacked
*Ethylene Glycol Monomethyl Ether Acetate (**EKTASOLVE** EM Acetate; Methyl **Cellosolve** Acetate)				Dissolved
*Isoamyl Acetate	2 days	1.89	0.61	Surface attacked
*Isobutyl Acetate	2 days	7.82	4.32	Surface attacked
*Isopropyl Acetate	2 days	7.32	8.44	Surface attacked
*Methyl Acetate				Dissolved
Tetra(2-ethylbutyl) silicate	1 month (122°F)	−2.39	−0.83	Unchanged
Ethers				
*Diethyl Ether	2 days	1.38	11.20	Blushed and swollen
*Di-Isopropyl Ether	2 days	−9.31	−0.15	Unchanged
*1,4-Dioxane				Dissolved
Ether Alcohols				
*Diethylene Glycol Monobutyl Ether (**EKTASOLVE** DB; Butyl **Carbitol**)	2 days	1.02	1.63	Surface attacked slightly
*Diethylene Glycol Monoethyl Ether (**EKTASOLVE** DE; **Carbitol**)	2 days	11.20	12.30	Swollen; surface attacked
*Diethylene Glycol Monomethyl Ether (**EKTASOLVE** DM; Methyl **Carbitol**)				Dissolved
*Ethylene Glycol Monobutyl Ether (**EKTASOLVE** EB; Butyl **Cellosolve**)	2 days	1.95	2.84	Surface attacked slightly
*Ethylene Glycol Monoethyl Ether (**EKTASOLVE** EE; **Cellosolve**)	2 days	23.10	25.30	Swollen and slightly softened
*Ethylene Glycol Monomethyl Ether (**EKTASOLVE** EM; Methyl **Cellosolve**)				Dissolved
Hydrocarbons				
*Benzene	1 week	5.94	17.47	Softened and swollen
*Butadiene-1,3, liquid	1 year	−9.42	8.85	Warped and shrunken
*Butadiene-1,3, gas	1 month	4.21	2.77	Showed exudation
Heptane	1 year	−5.36	−1.20	Unchanged
Hydrocarbons (Cont.)				
*Naphthalene (Moth balls)	48 hours (100°F, 80% R.H.)	1.01	0.94	Showed considerable plasticizer exudation
*Naphthalene (Moth balls)	24 hours (140°F, 88% R.H.)	8.58	2.02	Showed considerable plasticizer exudation
Propane, gas	2 months	−0.76	0.00	Unchanged
Propane, liquid	1 month	−3.88	0.00	Unchanged
*Toluene	1 year	−1.72	8.92	Swollen and slightly softened
Xylene	1 year	−5.64	2.12	Unchanged
Hydrocarbons, Halogenated				
*Carbon Tetrachloride	2 months	14.92	4.12	Unchanged
*Chlorobenzene				Dissolved
*Chlorobromomethane				Dissolved
*Chloroform				Dissolved
*o-Dichlorobenzene	3 days	9.80	4.44	Slightly swollen
p-Dichlorobenzene	3 days	2.24	0.73	Unchanged
*p-Dichlorobenzene	3 days (100°F, 80% R.H.)	6.57	4.03	Showed some plasticizer exudation
*Ethylene Chloride				Dissolved
*Methylene Chloride				Dissolved
*Propylene Chloride	2 days	25.30	2.06	Blushed and blistered
*s-Tetrabromoethane	3 days	5.36	3.45	Slightly swollen
*Tetrachloroethane				Dissolved
Tetrachloroethylene	2 weeks			Unchanged
*Trichloroethylene	16 hours	32.20		Surface attacked
Ketones				
*Acetone				Dissolved
*Cyclohexanone				Dissolved
Di-Isopropyl Ketone	2 days	0.04	0.31	Unchanged
*Methyl n-Butyl Ketone	2 days	13.40	16.20	Swollen, surface attacked
*Methyl Ethyl Ketone				Dissolved
*Methyl Isobutyl Ketone	2 days	40.40	7.39	Swollen, surface attacked
*Methyl n-Propyl Ketone	2 days	51.30	78.50	Swollen and warped; surface attacked
Phorone	2 days	0.04	0.24	Stained yellow

**Indicates that material is generally unsatisfactory for use in contact with TENITE Acetate under the conditions of this test.*

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Acetate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Salts				
Aluminum Acetate, Basic, 33% water slurry	2 months	3.97	2.07	Unchanged
Aluminum Chloride, 10%	2 months	3.25	1.85	Unchanged
Aluminum Chloride, saturated solution	2 months	0.34	0.00	Unchanged
Aluminum Sulfate, 30%	3 months	2.95	2.00	Unchanged
Ammonium Bifluoride, saturated solution	1 month	3.56		Slightly bleached
Ammonium Chloride, saturated solution	1 month	1.43	0.38	Unchanged
Ammonium Nitrate, solid	1 week	0.14	0.08	Unchanged
Ammonium Nitrate, 10%	1 week	2.91	1.56	Unchanged
Ammonium Sulfate, solid	1 year	0.0	0.55	Unchanged
Ammonium Sulfate, 10%	1 year	3.68	1.64	Unchanged
Calcium Chloride, solid	2 days	2.91	0.61	Unchanged
Calcium Chloride, 2.5%	1 year	2.93	2.10	Unchanged
Calcium Chloride, 40%	2 months	0.61	0.18	Unchanged
Calcium Hypochlorite, 6%	3 months	2.94	1.96	Slightly softened
*Calcium Phosphate, Monobasic, solid	1 year	−1.09	1.38	Brittle, surface attacked
Calcium Phosphate, Dibasic, solid	1 year	−3.27	−0.61	Unchanged
Calcium Phosphate, Tribasic, solid	1 year	−3.74	−0.87	Unchanged
Calcium Sulfate, solid	1 year	−0.20	0.42	Unchanged
Cupric Sulfate, 10%	2 months	3.50	1.76	Unchanged
Cupric Sulfate, saturated solution	2 months	3.07	1.68	Unchanged
Cuprous Chloride, saturated solution	1 week	2.28	2.75	Unchanged
Ferric Chloride, 5%	2 months	2.93	2.12	Unchanged
Ferric Chloride, 20%	2 months	2.50	1.91	Unchanged
Ferric Chloride, 40%	2 months	2.81	0.46	Unchanged
*Ferric Chloride, saturated solution	1 week			Surface tacky
Magnesium Chloride, solid	2 days	2.93	1.64	Unchanged
Magnesium Sulfate, solid	2 days	3.12	1.84	Unchanged
Mercuric Chloride, 5%	2 days	5.86	1.75	Unchanged
Potassium Aluminum Sulfate, 21%	4 months (100°F)	3.89	2.61	Surface attacked slightly
Potassium Chloride, solid	1 year	0.02	0.75	Unchanged
Salts (Cont.)				
Potassium Chloride, 10%	1 year	3.29	1.34	Unchanged
*Potassium Cyanide, 10%	2 months	−5.84	−4.84	Discolored and softened
*Potassium Cyanide, saturated solution	2 months	−1.15	−2.88	Discolored and softened
Potassium Iodide, saturated solution	3 days			Stained yellow
Potassium Permanganate, saturated solution	2 days	3.27	1.39	Stained black
Potassium Sulfate, solid	1 year	0.08	0.40	Unchanged
Potassium Sulfate, 10%	1 year	2.60	1.46	Unchanged
Silver Nitrate, 3%	2 days	1.97	0.61	Slightly softened
Sodium Bicarbonate, solid	2 days	2.96	1.60	Unchanged
Sodium Bisulfite, 20%	1 week	4.03	2.37	Unchanged
Sodium Borate, 2.5%	2 days	2.88	1.56	Unchanged
Sodium Carbonate, solid	4 days	−0.10	−0.08	Unchanged
Sodium Carbonate, 2.5%	1 year	−8.74	−2.25	Slightly softened
Sodium Chloride, 10%	1 year	2.52	1.53	Unchanged
Sodium Chloride, saturated solution	2 months	1.26	0.54	Unchanged
Sodium Chloride, saturated solution	2 months (140°F)	1.03	−0.52	Unchanged
*Sodium Cyanide, 10%	2 months	−4.20	−5.60	Discolored, softened
*Sodium Cyanide, saturated solution	2 months	−0.84	−2.59	Discolored, softened
Sodium Ferrocyanide, solid	1 week	0.37	0	Unchanged
Sodium Fluoride, 4%	1 month	3.60		Unchanged
*Sodium Hypochlorite, 5%	2 days	0.85	0.35	Softened, surface attacked
Sodium Nitrate, solid	2 months	−0.26	−0.23	Unchanged
Sodium Nitrate, 10%	1 year	2.58	1.45	Unchanged
Sodium Nitrate, saturated solution	2 months	1.48	0.85	Unchanged
Sodium Nitrite, solid	2 months	−0.42	−0.38	Unchanged
Sodium Nitrite, saturated solution	2 months	0.78	0.27	Unchanged
*Sodium Silicate, solid	2 months	0.57	0.19	Etched
*Sodium Silicate, saturated solution	2 months	−0.34	−2.60	Softened
Trimethylbenzyl Ammonium Chloride, 5%	17 days	0.59	3.20	Unchanged
Zinc Chloride, hydrous salt	1 week	0.88	0.00	Unchanged
*Zinc Chloride, saturated solution	1 week			Dissolved

**Indicates that material is generally unsatisfactory for use in contact with TENITE Acetate under the conditions of this test.*

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Acetate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Miscellaneous Chemicals, Compounds, and Gases				
Ammoniated Mercury	1 week (60°C)			Unchanged
*Aniline				Dissolved
Carbon Disulfide	1 month	0.59	1.86	Unchanged
Carbon Disulfide, saturated atmosphere	2 days	5.85	2.39	Unchanged
*Chlorine, dry	1 week	3.58	0.77	Crazed and brittle
*Chlorine, moist	1 week	2.96	0.12	Crazed and brittle
*Chlorine, saturated solution	1 week			Softened and considerably swollen
*Ethylene Oxide, gas	1 day	18.54	39.70	Softened and swollen
*Eugenol				Dissolved
*Formaldehyde, 35%	1 week	11.82	0.94	Softened and swollen
Hydrogen Sulfide, dry	1 month	1.05	0.75	Unchanged
Hydrogen Sulfide, moist	2 months	3.95	2.29	Unchanged
Hydrogen Sulfide, saturated solution	2 months	1.58	2.22	Unchanged
*Hydroquinone, 20 g/gal	1 week	5.58	3.11	Stained light yellow
*Iodine, saturated solution	2 days	2.48	0.82	Stained light brown
*Nitrobenzene	3 days			Softened, swollen, and badly warped
*Phenol, 5%	1 week			Decomposed
*Sulfur Dioxide, dry	2 months	17.30	11.60	Swollen and warped
*Sulfur Dioxide, moist	2 months	13.50	9.71	Swollen and warped
*Sulfur Dioxide, saturated solution	2 months	10.60	13.50	Swollen and considerably warped
*Titanium Tetrachloride	3 days			Very brittle
*Triethanolamine	1 week	11.72	24.90	Badly softened
*Triethanolamine, 10%	1 week	−5.16	0.69	Softened, surface attacked
COMMERCIAL AND NATURAL PRODUCTS				
Aeronautical and Automotive Items				
Gasolines:				
Amoco Regular	1 year	−2.80	−0.19	Stained light yellow
Amoco Premium	1 year	−2.92	−0.08	Unchanged
Aviation, 100 Octane (Standard Oil Company)	1 year	−4.41	−1.12	Slightly stained
Aeronautical and Automotive Items (Cont.)				
Gasolines:				
Aviation, 115-145 Octane (Socony Vacuum Oil Company)	1 year	−5.56	−1.62	Slightly stained
Esso Extra	1 year	−2.58	0.04	Stained yellow
Esso Regular	1 year	−2.33	−0.15	Stained yellow
Shell High-Test	1 year	−2.29	−0.04	Stained yellow
Shell Regular	1 year	−1.90	−0.07	Stained yellow
Texaco Fire Chief	1 year	−2.49	−0.15	Stained yellow
Texaco Sky Chief	1 year	−3.35	−0.04	Stained light yellow
Hydraulic Fluids:				
Skydrol	1 year	−1.07	−0.24	Unchanged
Skydrol 500	1 year	1.15	0.42	Surface dulled
Jet Propulsion Fuel 3 (Humble Oil Company)	1 year	−6.00	−1.64	Unchanged
Kerosene	1 week	−0.84	−1.93	Unchanged
Oils:				
Aeroshell No. 12	1 year	−5.95	−2.01	Unchanged
Purol HD, SAE 10	6 months	−0.31		Unchanged
Shell Diala Oil AX	2 months	−1.72	−0.82	No change
Socony Oil DTE Heavy Medium Special	3 days	−0.08	−0.12	Unchanged
Texaco #50, 1692 Low-Temperature Oil, MIL-L-644B	4 weeks (122°F)	−1.92	−0.30	
Nonautomotive Greases and Oils				
Essential Oils:				
*Bitter Almonds				Dissolved
Borneol, 50% in n-Butanol	2 days	0.10	0.33	Unchanged
Citronella	2 days	0.56	0.33	Unchanged
*Cloves				Dissolved
Eucalyptus	2 days	0.28	0.14	Unchanged
Lemon	2 days	0.26	0.09	Unchanged
Menthol, 50% in n-Butanol	2 days	0.04	0.19	Unchanged
Palmarosa	2 days	0.98	0.51	Unchanged
Pennyroyal	2 days	1.03	0.62	Unchanged
Spearmint	7 days			Unchanged

**Indicates that material is generally unsatisfactory for use in contact with TENITE Acetate under the conditions of this test.*

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Acetate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Nonautomotive Greases and Oils (Cont.)				
Essential Oils:				
Terpineol	2 days	0.06	0.09	Unchanged
Thyme (White)	2 days	0.37	0.05	Unchanged
Turpentine	1 year	−0.85	0.16	Unchanged
*Wintergreen	2 days	2.74	1.58	Surface attacked slightly
Mineral Oil	4 months	−2.18	−0.95	Unchanged
Sour Crude Oil	1 year	−3.20	−1.25	Slightly stained
Sperm Oil	1 week (194°F)	−4.03	0.00	Slightly warped
Transformer Oil, G.E., No. 10-C	1 week (180°F)	−2.94	0.56	Unchanged
Transformer Oil, Pyranol	1 week (194°F)	−3.58	0.00	Unchanged
Household Items				
Air-Wick Odor Neutralizer	2 months	−0.72	5.65	Unchanged
Bacon	3 weeks (in refrigerator)			Unchanged
Brilliantine Hair Dressing	3 days		0.00	Unchanged
*Burma Shave Cream	2 days			Slightly swollen
Butter	3 days			Unchanged
Carbolic Acid, 5%	1 week			Decomposed
Catsup	1 week			Slightly stained
*Clorox Solution	2 days			Badly softened
Coffee Grounds	3 days			Unchanged
Colgate Dental Cream	2 days			Unchanged
*Cologne Sticks	1 day			Badly warped
*Coty Bath Salts	1 day			Softened and swollen
*Coty Lipstick	40 days			Slightly brittle and slightly stained
Coty Lipstick Pomade	28 days			Unchanged
Dole Frozen Pineapple Concentrate	1 week	1.92	1.04	Unchanged
Dreft Detergent, 5%	2 months	0.93	1.31	Unchanged
Dwin Household Insect Killer	1 week	−0.02	0.00	Unchanged
Dwin Stainless Fly Killer	1 week	0.24	0.00	Unchanged
Glim Detergent	2 months	−0.99	1.80	Slightly warped, showed surface spots on drying
Glim Detergent, 10%	2 months	1.99	1.49	Unchanged
Household Items (Cont.)				
Hershey's Chocolate Syrup	1 week	1.67	0.74	Unchanged
Hind's Honey & Almond Cream	1 week	1.80	4.30	Slightly warped
Horseradish	3 days			Unchanged
*Hydrogen Peroxide, 3%	1 year	4.46	2.95	Bleached and softened
Hydrogen Peroxide, 5%	2 days	3.10	1.73	Slightly bleached
Iced Coffee	1 week	1.87	0.86	Stained
Iced Tea	1 week	1.98	1.04	Unchanged
*Joy Detergent	2 months	−3.27	10.05	Swollen and slightly warped
Joy Detergent, 10%	2 months	−0.32	1.82	Unchanged
Kool-Aid Soft Drink Mix	3 days			Surface attacked slightly
Lady Esther Lipstick	3 days			Stained
Lard	3 days			Unchanged
Lemon Juice	1 week	4.30	4.00	Unchanged
Lemonade	1 week	2.47	1.37	Unchanged
Lever Tooth Paste	4 days (100°F)	0.97	1.24	Unchanged
*Lysol	1 year			Badly softened
Marie Earle Talcum Powder	3 days	2.61	−0.73	Unchanged
Max Factor Powder Base Cream	3 days			Unchanged
Mayonnaise	3 days			Unchanged
Mennen Shave Cream	2 days			Unchanged
Mercurochrome	2 days	3.26	1.46	Stained light pink
Milk	3 days			Unchanged
Minute Maid Frozen Concentrates:				
Grapefruit	1 week	1.94	0.62	Unchanged
Orange	1 week	2.01	0.92	Unchanged
Tangerine	1 week	1.87	0.72	Unchanged
Lemonade	1 week	1.77	0.86	Unchanged
Mustard	2 days	2.78	1.44	Stained
Oleomargarine	3 days			Unchanged
Orange Juice Concentrate	3 days			Unchanged
Peanut Butter	3 days			Unchanged
Pebeco Tooth Powder	3 days (100°F)	2.65	2.00	Unchanged
Pine Bath Oil	1 week	1.38	1.17	Stained light green
*Port-a-Fount Liquid Dentifrice	2 days			Softened and slightly swollen

**Indicates that material is generally unsatisfactory for use in contact with TENITE Acetate under the conditions of this test.*

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Acetate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Household Items (Cont.)				
Powder Deodorants:				
Amolin	1 week			Unchanged
Spiro	1 week			Unchanged
Quest	1 week			Unchanged
***Rad** Household Cleaner	1 day (160°F)		4.90	Swollen and showed exudation
Richard Hudnut Creme Waving Lotion	1 day (100°F)	3.57	2.15	Unchanged
***Ronsonol** Lighter Fluid	1 year	−5.85	−1.32	Softened and etched
***Servac** Detergent	1 year			Decomposed
Shoe Polish:				
Kusan	3 days	0.15	0.00	Stained
Shinola				Stained
Soap, 10%	1 day (190°F)		4.13	
***Stanley** Floor Cleaner	1 week	1.0	0.07	Softened
Stokely's Orange Juice	1 week	2.50	1.36	Unchanged
Temp Cleaner	1 day			Unchanged
Tide Detergent, 5%	2 months	0.08	1.24	Slightly warped
Tomato Juice (**Campbell's**)	1 week	2.06	1.52	Unchanged
Toni Wave Lotion	3 days	4.72	0.86	Unchanged
Toni Wave Lotion Neutralizer	3 days	3.24	1.28	Unchanged
***Vicks** Decongestant	2 days (122°F)	1.08	2.16	Badly stained
***Vitalis** Hair Tonic	3 days		37.30	Considerably swollen
Watkins Fly Spray	2 months	−1.34	0.04	Unchanged
Welch's Frozen Grape Juice Concentrate	1 week	1.74	1.02	Unchanged
Welch's Grape Juice	1 week	2.25	1.03	Unchanged
Wildroot Cream Oil	3 days		1.30	Unchanged
Miscellaneous				
Blood	1 week			Unchanged
***Budweiser** Lager Beer	1 week	5.28	3.93	Swollen
Canada Balsam	3 weeks	−0.01	0.00	
***Carboseal** Gas Antileak Compound, liquid	2 months (100°F)	26.60	22.50	Swollen, softened, and stained
Carboseal Gas Antileak Compound, vapor	2 months (100°F)	2.76	0.81	Slightly stained

Indicates that material is generally unsatisfactory for use in contact with TENITE Acetate under the conditions of this test.

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Miscellaneous (Cont.)				
Caulking Compound (average of five brands)	1 week (140°F)	−2.68	−0.05	Unchanged
Cherry Smash Syrup Concentrate	1 year	2.58	1.36	Unchanged
Chlordane, 20%	3 days	1.83	3.20	Unchanged
Coca-Cola Syrup Concentrate	1 year	0.32	1.32	Stained slightly
Creosote	8 months	−2.69	0.73	Unchanged
*2,4-D (Amine Type, 14% free acid)	2 months	1.59	2.96	Swollen, softened, and warped
2,4-D, 4 tablespoons/gal	2 months	2.82	1.94	Very slightly softened
DDT, solid	1 week	0.17	0.00	Unchanged
DDT, 6% in **Flit** Insect Spray	1 week	0.38	0.39	Unchanged
***End-O-Weed** Weed Killer (Ester Type, 12.7% free acid)	2 months	2.80	−0.45	Very slightly softened
End-O-Weed Weed Killer, 4 tablespoons/gal	2 months	1.48	1.41	Very slightly softened
Flit Insect Spray with 6% DDT added	1 week	0.38	0.39	Unchanged
Inks:				
Cado	4 days	0.69	0.00	Slightly stained
Carter's No. 10856 Ball Point	2 months	2.06	5.12	Stained blue
Cushman and Denison (for felt tip pens)	2 weeks	2.04	0.62	Unchanged
Diagraph-Bradleys Stencil	2 months	−4.49	3.45	Stained black
E-Z Brite Edge	1 week	3.52		Stained amber
***Parker Superchrome**	2 days (100°F)			Swollen, stained
Sanford's Black Marking	3 days			Very slightly stained
Sanford's Dri-Line Black Marking	3 days			Stained red
Sheaffer's Skrip	1 month	1.12	5.75	Stained
Latex Emulsion	1 year	−6.00	−2.23	Unchanged
Mineral Spirits	10 days	−6.5	−1.4	Unchanged
Mortemoth Insecticide, liquid	2 months	1.69	0.68	Unchanged
Naphtha, Industrial	1 month	−3.24	−0.82	Unchanged
Paints:				
Du Pont Dulux Outside Yellow Enamel (Oil base)	1 week	−1.52	−0.26	Unchanged
Kemtone	1 day			Unchanged

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Acetate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Miscellaneous (Cont.)				
Paints:				
Luminall One-Coat Interior, L402 Peach (water emulsion)	1 week	3.31	1.61	Unchanged
Pittsburg Semi-Gloss White (Oil base)	1 week	−1.20	−0.42	Unchanged
Photographic Products: (All **KODAK** Brand)				
Acid Fixer	1 week	4.46	2.56	Unchanged
*D-72 Developer	1 week	3.43	2.53	Slightly softened
DK-50 Developer	1 week	4.58	2.89	Stained light amber
Polycarbonate Plastic (**Lexan**)	3 days (100°F, 80% R.H.)			Unchanged (Polycarbonate softened, cracked when flexed)
Quinine	2 days (120°F)			Unchanged
Refrigerants:				
Freon 11	2 hours			Showed exudation
Freon 12, gas	1 month	0.32	0.16	Unchanged
Freon 12, liquid	1 month	−3.37	−1.11	Unchanged
Freon 22, gas	1 month	2.68	0.74	Unchanged
***Freon** 22, liquid				Dissolved
Freon 114, gas	1 month	0.38	0.12	Unchanged
Freon 114, liquid	1 month	0.55	0.56	Unchanged
Solvex Maintenance Scale Retarder, 2 lb/10 gal	1 month	−1.30	−1.01	Unchanged
Stoddard Solvent	3 days	−0.05	0.00	Unchanged
Super Market Fly Spray	1 week	0.12	0.00	Unchanged
***Taxite** Paint and Varnish Remover	1 day			Swollen, partially dissolved
*Tincture of Green Soap, U.S.P.	2 months	−3.59	7.98	Swollen, slightly softened
Toxaphine, 61% (12% solution)	3 days (100°F)	1.94	2.50	Unchanged
Ultra Solvex Descaling Agent, 3 lb/10 gal	1 month	3.00	1.45	Unchanged
Varsol No. 2 Solvent	1 week	−1.60	−0.28	Unchanged
Water	1 year	3.09	1.96	Unchanged
***Weed-B-Gon** Weed Killer (Ester Type, 13.8% free acid)	1 month	1.90	1.74	Unchanged
Miscellaneous (Cont.)				
Weed-B-Gon Weed Killer, 2½ tablespoons/gal	1 month	3.32	1.60	Unchanged
***Weedone** Weed Killer (Ester Type, 9% free acid)	2 months	2.88	1.66	Very slightly swollen
Weedone Weed Killer, 5 tablespoons/gal	2 months	2.56	1.62	Very slightly swollen

****Indicates that material is generally unsatisfactory for use in contact with TENITE Acetate under the conditions of this test.***

Most tests were conducted by placing dry, injection-molded specimens of TENITE Acetate in contact with the other material for the period of time shown. Most figures given are the result of a single test, and the measured gains in weight and thickness are reported exactly, without rounding. Unless stated otherwise, tests were conducted at 73°F (23°C) and solutions were aqueous.

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
CHEMICALS				
Acids				
Acetic, 5%	1 year	3.59	2.07	Slightly softened
Acetic, 10%	2 months	5.22	2.38	Slightly softened
*Acetic, 30%	2 months	13.60	8.58	Softened and swollen
Boric, 5%	2 days	1.25	0.00	Unchanged
Chromic, 6%	8 days (100°F)	2.00	0.13	Slightly stained
Citric, 10%	4 months (140°F)	1.64	0.78	Slightly softened
Citric, 10%	1 year	1.38	0.62	Unchanged
*Citric, 60%	4 months (140°F)			Surface attacked
Fluosilicic, 10%	2 months	4.45	1.20	Unchanged
Fluosilicic, 28%	2 months	4.69	3.57	Unchanged
Formic, 3%	20 days			Unchanged
Hydrochloric, 10%	1 year	0.86	0.53	Surface slightly attacked
*Hydrofluoric, 10%	1 month	10.30	5.47	Slightly swollen and softened
*Hydrofluoric, 48%				Dissolved
Lactic, 50%	2 days	1.60	0.50	Unchanged
*Nitric, 10%	8 months			Decomposed
Oleic	1 year	2.31	1.53	Unchanged
Phosphoric, 30%	2 months	1.26	0.80	Unchanged
Phosphoric, 50%	2 months	1.58	0.75	Unchanged
*Phosphoric, 75%	2 months			Partially decomposed
Pyrogallic, 4%	1 week	2.56	1.08	Stained yellow
Stearic	1 week			Unchanged
Sulfuric, 3%	1 year	1.60	0.97	Slightly discolored
Sulfuric, 10%	1 year	1.50	0.74	Slightly discolored
*Sulfuric, 20%	1 year	0.91	0.31	Slightly softened, surface attacked
*Sulfuric, 30%	1 year	−0.42	−0.29	Surface attacked
*Sulfuric, 94%				Disintegrated
Tannic, 10%	4 months (100°F)	2.75	1.20	Unchanged
Trichloroacetic, 1%	1 month	3.28	0.50	Unchanged
*Trichloroacetic, 5%	1 month	9.25	3.07	Softened
Alcohols, Monohydric				
n-Amyl	2 days	3.06	3.00	Unchanged
*tert-Amyl	2 days	14.00	11.30	Softened, tacky

Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Alcohols, Monohydric (Cont.)				
*n-Butyl	2 days	6.45	7.20	Swollen
*sec-Butyl	2 days	7.20	10.70	Swollen
*tert-Butyl	2 days	3.62	3.30	Slightly softened
*Diacetone				Dissolved
*Ethyl (denatured)	2 days	23.00	24.70	Softened
*Ethyl, 50%	1 week	13.40	11.60	Softened
*2-Ethylhexyl	1 week			Swollen
*Isoamyl	2 days	2.02	2.12	Very slightly softened
*Isopropyl	2 days	23.40	25.10	Softened, tacky
*Methyl				Dissolved
Methyl, 5%	1 year	2.02	1.24	Slightly softened
*n-Propyl	2 days	15.00	4.40	Slightly softened
*Tetrahydrofurfuryl				Dissolved
Alcohols, Di- and Tri-hydric				
*Diethylene Glycol	2 months	8.24	6.10	Softened
2-Ethyl Hexanediol-1,3	2 days (100°F)			Unchanged
Ethylene Glycol	1 year	4.24	2.10	Unchanged
Glycerin	1 year	0.03	0.41	Unchanged
Propylene Glycol	2 days	0.44	0.00	Unchanged
*Triethylene Glycol	2 months	8.61	6.70	Softened
Bases				
*Ammonium Hydroxide, 10%	2 months	21.87	12.93	Softened
Calcium Hydroxide, saturated solution	1 week	1.72	0.65	Unchanged
Sodium Hydroxide, 1%	1 year	0.95	0.61	Unchanged
*Sodium Hydroxide, 10%	8 months	3.19	2.20	Brittle
Trimethylbenzyl Ammonium Hydroxide, 5%	17 days	1.13	0.00	Unchanged
Esters				
*n-Butyl Acetate				Dissolved
*sec-Butyl Acetate				Dissolved
Di-2-Ethylhexyl Adipate	1 year	0.91	0.32	Unchanged
Dioctyl Phthalate	1 month (122°F)	Small gain		
*Ethyl Acetate				Dissolved

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Esters (Cont.)				
*Ethyl Lactate				Dissolved
*Ethyl Propionate				Dissolved
*Ethylene Glycol Monoethyl Ether Acetate (**EKTASOLVE® EE** Acetate; **Cellosolve** Acetate)				Dissolved
*Ethylene Glycol Monomethyl Ether Acetate (**EKTASOLVE EM** Acetate; Methyl **Cellosolve** Acetate)				Dissolved
*Isoamyl Acetate				Dissolved
*Isobutyl Acetate				Dissolved
*Isopropyl Acetate				Dissolved
*Methyl Acetate				Dissolved
*n-Propyl Acetate				Dissolved
Ethers				
*Dichloro Diethyl Ether				Dissolved
*Diethyl Ether	2 days	46.00	50.00	Considerably swollen
Di-Isopropyl Ether	2 days	0.78	1.06	Unchanged
Ether-Alcohols				
*Ethylene Glycol Monoethyl Ether (**EKTASOLVE EE; Cellosolve**)				Dissolved
*Ethylene Glycol Monomethyl Ether (**EKTASOLVE EM**; Methyl **Cellosolve**)				Dissolved
Hydrocarbons				
*Benzene				Dissolved
Gas, Natural, aromatic-free	1 year			Showed slight decrease in tensile strength and increase in impact strength
Gas, Natural, 5% aromatic content	23 days			Showed slight decrease in tensile strength and increase in impact strength
Heptane	1 year	1.60	2.48	Unchanged
Hexane	1 week			Unchanged

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Hydrocarbons (Cont.)				
Propane, gas	2 months	0.34	0.64	Unchanged
Propane, liquid	2 months	1.42	4.55	Unchanged
*Toluene	2 days	39.30	54.90	Softened
*Xylene	1 week	41.52	33.17	Softened
Hydrocarbons, Halogenated				
*Carbon Tetrachloride	2 days	14.80	6.80	Surface slightly softened
*Chlorobenzene				Dissolved
*Chlorobromomethane				Dissolved
*Chloroform				Dissolved
*o-Dichlorobenzene	3 days			Softened and swollen
*p-Dichlorobenzene	3 days	11.14	11.70	Swollen
*Ethylene Chloride				Dissolved
*Methylene Chloride				Dissolved
*Propylene Chloride				Dissolved
*s-Tetrabromoethane	3 days			Softened, swollen, and tacky
*Tetrachloroethane				Dissolved
*Tetrachloroethylene	12 days			Badly swollen
*Trichloroethylene	1 day			Badly swollen
Ketones				
*Acetone				Dissolved
*Cyclohexanone				Dissolved
*Di-Isopropyl Ketone				Dissolved
*Methyl Ethyl Ketone				Dissolved
*Methyl n-Butyl Ketone				Dissolved
*Methyl Isobutyl Ketone				Dissolved
*Phorone				Dissolved
Salts				
Aluminum Acetate, Basic, 33% water slurry	2 months	1.83	0.56	Unchanged
Aluminum Chloride, 10%	2 months	1.48	0.71	Unchanged
Aluminum Chloride, saturated solution	2 months	0.10	0.00	Unchanged
Aluminum Sulfate, solid	3 months	1.68	1.07	Unchanged
Ammonium Bifluoride, saturated solution	1 month	2.34		Slightly bleached

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Salts (Cont.)				
Ammonium Chloride, saturated solution	1 month	2.11	0.78	Unchanged
Ammonium Nitrate, solid	1 week	0.16	0.23	Unchanged
Ammonium Nitrate, 10%	1 week	1.65	0.75	Unchanged
Ammonium Sulfate, solid	1 year	0.11	0.58	Unchanged
Ammonium Sulfate, 10%	1 year	1.30	0.52	Unchanged
Calcium Chloride, 2.5%	1 year	1.49	0.88	Unchanged
Calcium Chloride, 40%	2 months	0.44	0.00	Unchanged
Calcium Hypochlorite, 6%	1 year	6.00	−3.75	Softened and cracked
Calcium Hypochlorite, 30%	13 days	0.77	0.00	Unchanged
Calcium Phosphate, Monobasic, solid	1 year	1.73	0.54	Unchanged
Calcium Phosphate, Dibasic, solid	1 year	−0.58	0.58	Unchanged
Calcium Phosphate, Tribasic, solid	1 year	−0.63	0.60	Unchanged
Calcium Sulfate (Gypsum), solid	1 year	−0.10	0.55	Unchanged
Copper Sulfate (Cupric), 10%	2 months	1.67	0.64	Unchanged
Copper Sulfate, saturated solution	2 months	1.68	0.93	Unchanged
Cuprous Chloride, solid	1 week	1.50		Unchanged
Ferric Ammonium Sulfate, solid	1 week (100°F, 80% R. H.)	0.25		Unchanged
Ferric Chloride, 5%	2 months	2.00	0.75	Unchanged
Ferric Chloride, 20%	2 months	1.73	0.96	Unchanged
Ferric Chloride, 40%	2 months	1.34	0.43	Unchanged
Ferric Chloride, saturated solution	1 month	0.88	0.30	Unchanged
Lithium Bromide, solid	1 week	−0.68	−0.04	Unchanged
Lithium Bromide, 50%	1 week	−0.04	0.00	Unchanged
Magnesium Carbonate, 2.5%	2 days	1.55	1.00	Unchanged
Potassium Aluminum Sulfate (alum), 21%	4 months (100°F)	1.94	0.84	Unchanged
Potassium Bromide, 3%	3 days (100°F)	1.30		Unchanged
Potassium Chloride, solid	1 year	0.09	0.47	Unchanged
Potassium Chloride, 10%	1 year	1.66	0.44	Unchanged
Potassium Chrome Alum, 10%	3 days (100°F)	1.33		Unchanged
Potassium Cyanide, 10%	2 months	1.40	0.32	Slightly discolored (brown)
Salts (Cont.)				
Potassium Cyanide, saturated solution	2 months	0.46	0.04	Slightly discolored (brown)
Potassium Ferricyanide, 10%	4 days			Unchanged
Potassium Sulfate, solid	1 year	0.12	0.57	Unchanged
Potassium Sulfate, 10%	1 year	1.36	0.37	Unchanged
Silver Nitrate, 2.5%	2 days	1.46	0.00	Unchanged
Sodium Acetate, 3%	3 days (100°F)	1.30		Unchanged
Sodium Aluminum Sulfate, solid	1 week	1.64	0.44	Unchanged
Sodium Bicarbonate, 2.5%	2 days	1.68	0.53	Unchanged
Sodium Bisulfate, solid	1 week (100°F, 80% R. H.)	0.10		Unchanged
Sodium Bisulfate, 1%	3 days (100°F)	1.25		Unchanged
Sodium Bisulfite, 20%	1 week	2.14	0.80	Unchanged
Sodium Borate, 2.5%	2 days	1.53	0.52	Unchanged
Sodium Carbonate, solid	1 week (100°F, 80% R. H.)	3.90		Unchanged
Sodium Carbonate, 2.5%	1 year	1.28	0.93	Unchanged
Sodium Carbonate, 6%	3 days (100°F)	1.18		Unchanged
Sodium Carbonate, 10%	1 year			Unchanged
Sodium Chloride, 2.5%	1 year			Unchanged
Sodium Chloride, 10%	1 year	1.33	0.54	Unchanged
Sodium Chloride, saturated solution	2 months	0.79	0.31	Unchanged
Sodium Chloride, saturated solution	2 months (140°F)	0.89	0.89	Unchanged
Sodium Chromate, saturated solution	1 week	0.57	0.20	Unchanged
Sodium Cyanide, 10%	2 months	1.02	0.28	Unchanged
Sodium Cyanide, saturated solution	2 months	−0.18	−0.44	Unchanged
Sodium Ferrocyanide, solid	1 week	0.84		Unchanged
Sodium Fluoride, 4%	1 month	2.45		Unchanged
Sodium Hypochlorite, 30%	13 days	1.11	−2.09	Unchanged
Sodium Nitrate, solid	2 months	0.08	0.12	Unchanged
Sodium Nitrate, 10%	1 year	1.23	0.42	Unchanged
Sodium Nitrate, saturated solution	2 months	0.92	0.39	Unchanged
Sodium Silicate, solid	2 months	0.30	0.20	Unchanged

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase Weight	Percent Increase Thickness	Observed Condition of Plastic
Salts (Cont.)				
Sodium Silicate, saturated solution	2 months	1.18	0.13	Unchanged
Sodium Sulfite, 10%	1 week	2.08	0.88	Unchanged
Sodium Thiosulfate, 20%	13 days	1.10	0.00	Unchanged
Sodium Thiosulfate, 24%	3 days (100°F)	1.22		Unchanged
Tetra (2-Ethylbutyl) Silicate	1 month (122°F)	−0.74	−0.1	Unchanged
Trimethyl Benzyl Ammonium Chloride, 5%	17 days	1.13	0.06	Unchanged
Zinc Chloride (hydrous salt)	1 week	0.53	0.00	Unchanged
Zinc Chloride, saturated solution	1 week	1.37	0.78	Slightly etched
Zinc Oxide, solid	1 week			Unchanged
Miscellaneous Chemicals and Gases				
Ammoniated Mercury	1 week (60°C)			Unchanged
*Aniline				Dissolved
*Benzaldehyde				Dissolved
*Butadiene-1,3, liquid	6 months	19.25	26.40	Swollen and softened
Butadiene-1,3, gas	1 month	2.72	2.34	Unchanged
*Carbon Disulfide	1 week	25.82	1.56	Softened and swollen
*Carbon Disulfide, saturated atmosphere	2 days	17.40	11.75	Warped
*Chlorine, dry	1 week	8.80	2.22	Crazed and brittle
*Chlorine, moist	1 week	7.77	0.14	Crazed and brittle
*Chlorine, saturated solution	1 week			Considerably softened and swollen
*1,4-Dioxane				Dissolved
Ethylene Oxide, gas	10 minutes (105°F)			Unchanged
*Ethylene Oxide, gas	1 day	20.85	25.60	Swollen and softened
Formaldehyde, 4%	10 min per day for 5 days	0.24		Unchanged
*Formaldehyde, 35%	2 months	12.98	6.74	Swollen and softened
*Furfural				Dissolved
Hydrogen Peroxide, 3%	1 year	1.72	1.07	Unchanged
Hydrogen Peroxide, 5%	2 days	1.40	1.30	Unchanged
Hydrogen Sulfide, dry	2 months	2.26	0.81	Unchanged
Hydrogen Sulfide, moist	2 months	3.04	1.65	Unchanged
Miscellaneous Chemicals and Gases (Cont.)				
Hydrogen Sulfide, saturated solution	2 months	5.87	2.34	Unchanged
Hydroquinone, 20 g per gallon	1 week	2.39	0.99	Slightly stained yellow
*Methyl Methacrylate Monomer				Dissolved
*Nitrobenzene				Dissolved
Ozone, 0.05-0.15 ppm	45 days (outdoors)			Unchanged
Ozone, 0.7 ppm	45 days (120°F)			Yellowed
*Phenol	1 week			Decomposed
*Styrene Monomer				Dissolved
Sulfur, solid	1 week			Unchanged
*Sulfur Dioxide, dry	2 months	19.40	8.60	Swollen, slightly warped
*Sulfur Dioxide, moist	2 months	31.90	10.20	Considerably swollen and warped
*Sulfur Dioxide, saturated solution	2 months	23.20	18.10	Swollen and warped
*Sulfur Dioxide in Hydrocarbons				Dissolved
*Sulfur Dioxide and Hydrocarbon Vapor	2 months	19.20	11.50	Swollen
*Titanium Tetrachloride	3 days			Very brittle
Trinitrotoluene (TNT), water slurry	4 weeks			Stained
COMMERCIAL AND NATURAL PRODUCTS				
Aeronautical and Automotive Items				
Dane Head Radiator Sealer	3 weeks (122°F)			Unchanged
Gasolines:				
*Amoco Regular	1 year	7.7	5.5	Swollen and stained yellow
*Amoco Premium	1 year	18.4	9.5	Swollen
Aviation 100 Octane (Standard Oil Company)	1 year	3.03	3.20	Slightly discolored
*Aviation 115-145 Octane (Socony Vacuum Oil Company)	1 year	5.21	6.06	Slightly stained
*Exxon Extra	1 year	13.9	9.8	Swollen and stained pink
*Exxon Regular	1 year	5.19	5.77	Swollen and stained pink
*Shell High-Test	1 year	11.9	7.5	Swollen and stained pink
*Shell Regular	1 year	9.9	8.1	Swollen and stained yellow

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Aeronautical and Automotive Items (Cont.)				
***Texaco Fire Chief**	1 year	9.7	7.0	Swollen and stained yellow
***Texaco Sky Chief**	1 year	15.0	12.1	Swollen and stained pink
Hydraulic Fluids:				
***Delco Super 9** Brake Fluid	1 week			Swollen and softened
***Du Pont No. 7** Heavy-Duty Brake Fluid (VV-B-860)	Screwdriver handle dipped in fluid and allowed to stand 3 days passed torsional requirement of Federal Specification GGG-S-121d.			Dissolved
***Indian Head** Brake Fluid	1 week			Swollen and stained
***Skydrol** Hydraulic Fluid				Dissolved
***Skydrol 500** Hydraulic Fluid				Dissolved
***Wagner 21-B** Brake Fluid	1 week			Swollen and softened
Jet Propulsion Fuel 1A (Shell Oil Company)	8 months	3.42	3.01	Unchanged
Jet Propulsion Fuel 3 (Esso Standard Oil Company)	8 months	3.87	3.22	Unchanged
Jet Propulsion Fuel 3 (Humble Oil Company)	1 year	1.41	1.32	Unchanged
Jet Propulsion Fuel 4 (Esso Standard Oil Company)	8 months	3.39	3.22	Unchanged
Jet Propulsion Fuel 5 (Shell Oil Company)	8 months	0.29	0.32	Unchanged
Kerosene	1 week	0.41	1.32	Unchanged
Oils:				
Aeroshell No. 2	2 months	0.27	0.00	Unchanged
Aeroshell No. 12	1 year	0.60	0.34	Unchanged
Aeroshell Turbine Oil No. 300	3 days (120°F)	0	0	
Bearing Guard Oil	4 weeks	0.04		Unchanged
Duo-Drive Oil	4 weeks (122°F)			Unchanged
Houghton Safe 1120 Lubricating Oil	1 week	<1	<1	Unchanged
MIL-L-7808 Oil	Screwdriver handle dipped in oil and allowed to stand 3 days passed torsional requirement of Federal Specification GGG-S-121d.			

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Aeronautical and Automotive Items (Cont.)				
Purol HD, SAE 10	6 months	–0.10		Unchanged
Shell Diala Oil AX	2 months	–0.08	0.00	Unchanged
STP	2 weeks	–0.16	0.09	
Texaco No. 50, 1692 Low-Temperature Oil, MIL-L-644B	4 weeks (122°F)	0.00	0.17	
Winsorlube	30 minutes (150°F)			Unchanged
Zerolene Oil	5 weeks (140°F)	–1.09	–0.09	Unchanged
Nonautomotive Greases and Oils				
Essential Oils:				
*Bitter Almonds				Dissolved
*Citronella	2 days	6.10	4.20	Slightly softened
*Eucalyptus	2 days	0.45	1.01	Slightly softened
Lavender	2 days	0.89	0.51	Unchanged
Lemon	2 days	0.41	0.00	Unchanged
*Palmarosa	2 days	5.40	4.50	Slightly softened
*Pennyroyal				Dissolved
*Spearmint				Dissolved
Sweet Orange	2 days	0.26	0.88	Unchanged
Terpineol	2 days	0.56	0.00	Unchanged
*Thyme				Dissolved
*Turpentine	1 year	99.20	62.62	Softened, swollen, surface attacked
*Vanilla (Imitation)	2 days	11.80	9.70	Unchanged
*Wintergreen				Dissolved
Fuel Oil #1	1 week			Unchanged
Fuel Oil #2	1 week			Unchanged
Heavy Machine Oil	1 day			Unchanged
Light Machine Oil	1 day			Unchanged
Linseed Oil	1 month			Unchanged
Mineral Oil	4 months	–0.40	–0.16	Unchanged
Neatsfoot Oil	6 weeks			Unchanged
NO-OX-ID Grease	3 days (140°F)			Slightly stained
Pine Bath Oil	1 week	3.87	3.10	Unchanged
Silicone Oil, **Dow-Corning** #200	3 months	0.77	0.16	Unchanged

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*

(continued)

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Nonautomotive Greases and Oils (Cont.)				
Silicone Grease No. 44 (Dow)	10 days (160°F)			Stained yellow, properties unaffected
Sour Crude Oil	6 months	6.40	2.24	Unchanged
Soya Oil	1 week			Unchanged
Sperm Oil	1 week	–0.78	0.00	Unchanged
Sperm Oil	1 week (194°F)	–0.48	0.00	Unchanged
Transformer Oil, G. E. No. 10-C	1 week (180°F)	–0.90	0.22	Unchanged
Transformer Oil, Pyranol	1 week (77°F)	–0.92	0.00	Unchanged
Transformer Oil, Pyranol	1 week (194°F)	–0.74	0.00	Unchanged
Wesson Oil	1 week	0.19	3.56	Unchanged
3-in-1 Oil	2 days	0.12	0.00	Unchanged
Household Items				
*Air-Wick Odor Neutralizer	2 months	12.55	12.40	Swollen and slightly softened
Armour (694) Flotilla Soap Flakes	4 days			Unchanged
Armour Mioma Soap	4 days			Unchanged
Armour No. 99 Soap	4 days			Unchanged
Armour Pumex Soap	4 days			Unchanged
Atabrine	3 days (100°F)	0.10		Unchanged
Avon Cream Cake	1 day (100°F)	0.12	0.78	Stained
Bon Ami, saturated solution	2 days	1.42	0.49	Unchanged
Borax, 2.5%	2 days	1.53	0.52	Unchanged
*Breath O'Pine Disinfectant	1 week			Badly swollen
Brilliantine Hair Dressing	3 days		0.00	Unchanged
Bubble Bath Oil	1 week	1.67	0.54	Unchanged
Butter	3 days			Unchanged
Campbell's Tomato Juice	1 week	1.77	1.36	Unchanged
Carbolic Acid, 5%	1 week			Decomposed
Catsup	1 week			Slightly discolored
Clorox Solution	6 weeks			Unchanged
Coffee Grounds	3 days			Unchanged
*Cologne Sticks				Dissolved
Coty Lipstick	42 days			Stained
Dart Furniture Polish (Kress)	4 days			Very slightly stained
Dole Frozen Pineapple Juice Concentrate	1 week	1.45	0.54	Unchanged
Household Items (Cont.)				
Dreft Detergent, 5%	2 months	1.31	0.50	Unchanged
Dwin Household Insect Killer	1 week	0.18	0.0	Unchanged
Dwin Stainless Fly Spray	1 week	0.51	0.38	Unchanged
Glim Detergent	2 months	2.54	1.31	Slightly warped
Glim Detergent, 10%	2 months	1.47	0.60	Unchanged
Handy Andy Detergent	1 year	1.97	1.50	Slightly yellowed
Hershey's Chocolate Syrup	1 week	1.30	0.48	Unchanged
Hind's Honey and Almond Cream	1 week	1.20	1.50	Unchanged
Horseradish	3 days			Unchanged
Iced Coffee	1 week	1.46	0.80	Stained
Iced Tea	1 week	1.50	1.05	Unchanged
Insect Repellent "6-12"	2 days (100°F)			Unchanged
Joy Detergent	2 months	3.48	4.07	Slightly warped
Joy Detergent, 10%	2 months	1.67	0.82	Unchanged
Lady Esther Lipstick	3 days			Slightly stained
Lard	3 days			Unchanged
Lava Soap, saturated solution	2 days	1.36	0.00	Unchanged
Lemonade	1 week	1.63	1.01	Unchanged
Lemon Juice	2 days	2.40	0.21	Unchanged
Lighter Fluids:				
AMR	2 months	3.03	2.69	Unchanged
Energene	2 months	1.44	3.18	Unchanged
Exxon	2 months	1.83	1.28	Unchanged
Kwik-Lite	2 days	0.44	0.0	Unchanged
Ronsonol	1 year	0.25	0.95	Unchanged
Zippo	2 months	2.17	2.05	Unchanged
Lighthouse Cleanser	2 days	1.38	0.00	Unchanged
Lighthouse Soap, saturated solution	2 days	1.28	0.00	Unchanged
*Lysol Disinfectant, 5 tablespoonsful per gallon of water	2 months	6.97	4.37	Slightly softened
*Malathion Insecticide, 50% spray diluted to 0.5%	1 week	8.73	4.53	Softened, swollen, surface pitted, cloudy when wet
Marie Earle Talcum Powder	3 days	2.93	2.36	Unchanged
Mayonnaise	3 days			Unchanged
Milk	3 days			Unchanged

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Household Items (Cont.)				
Minute Maid Frozen Concentrates:				
Orange Juice	1 week	1.46	0.64	Unchanged
Grapefruit Juice	1 week	1.34	0.62	Unchanged
Lemonade	1 week	1.36	0.56	Unchanged
Tangerine Juice	1 week	1.41	0.46	Unchanged
Mr. Clean Detergent	1 year	3.42	2.74	Slightly yellowed
Mustard	11 days	2.30	0.50	Stained
O'Cedar Furniture Polish	2 days	0.12	0.45	Unchanged
Old Dutch Cleanser, saturated solution	2 days	1.30	0.00	Unchanged
Oleomargarine	3 days			Unchanged
Peanut Butter	3 days			Unchanged
Pebeco Tooth Powder	3 days (100°F)	4.00	6.00	Unchanged
Penicillin (powder)	1 week (100°F, 80% R. H.)			Unchanged
*Perfume	2 days	34.80	29.10	Swollen
Pine Bath Oil	1 week	3.87	3.10	Unchanged
***Port-a-Fount** Liquid Dentifrice	2 days		16.70	Swollen, slightly crazed
Powder Deodorants:				
Amalin	1 week			Unchanged
Spiro	1 week			Unchanged
Quest	1 week			Unchanged
Pride Wax	1 week	3.01	2.25	Slightly softened
Quinine	4 days (120°F)			Unchanged
Rad Household Cleaner	1 day (160°F)		0.70	Unchanged
Radiant Polish (Woolworth)	4 days			Slightly stained
Richard Hudnut Cream Waving Lotion	1 day (100°F)	1.65	1.60	Unchanged
Sano-Genio Cleanser, saturated solution	2 days	0.22	0.22	Unchanged
Servac Detergent	1 year	1.04	−0.24	Unchanged
Stanley Floor Cleaner	1 week	1.8	0.06	Unchanged
Stokely's Orange Juice	1 week	1.66	0.69	Unchanged
Temp Cleaner	1 day			Unchanged
Tide Detergent, 5%	2 months	1.58	0.20	Unchanged

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Household Items (Cont.)				
*Tincture of Green Soap, USP (30% alcohol)	2 months	9.82	6.56	Slightly softened
Toni Wave Lotion	3 days	1.73	0.62	Slightly stained yellow
Toni Wave Lotion Neutralizer (Potassium Bromate Solution)	3 days	2.23	0.78	Unchanged
***Vicks** Decongestant	2 days (122°F)			Swollen and stained
Vicks VapoRub Salve	2 days	0.13	0.00	Unchanged
Vicks Va-Tro-Nol Solution	2 days	0.14	0.00	Unchanged
***Vitalis** Hair Tonic	3 days		33.90	Swollen and softened
Watkin's Fly Spray	2 months	2.17	1.08	Unchanged
Welch's Frozen Grape Juice Concentrate	1 week	1.30	0.53	Unchanged
Welch's Grape Juice	1 week	1.52	0.64	Unchanged
Wesson Oil	1 week	0.19	3.56	Unchanged
Wildroot Cream Oil	3 days			Unchanged
Wisk Detergent	1 year	1.10	0.98	Discolored
Polymers and Plastics				
Polycarbonate	3 days (100°F, 80% R. H.)			Unchanged
Polyurethane Foam	3 days (100°F, 80% R. H.)			Unchanged
Vinyl Plastisol (cured)	2 days (140°F)			Softened and distorted
Vinyl Plastic, semi-rigid	3 days (100°F, 80% R. H.)			Unchanged
Miscellaneous				
Amway L.O.C. Detergent Conc.	30 days (122°F)			Unchanged
***Bitumastic** No. 50	3 days	32.6	24.9	Softened, swollen
Blood	1 week			Unchanged
Budweiser Lager Beer	1 week	2.71	0.77	Unchanged
Canada Balsam	3 weeks	0.85	0.34	
***Carboseal** Gas Anti-leak Compound, liquid	2 months (100°F)	26.90	23.20	Softened, swollen, and stained
***Carboseal** Gas Anti-leak Compound, vapor	2 months (100°F)	9.56	8.80	Slightly stained
Caulking Compound (Average of five brands)	1 week	0.97	0.80	Unchanged

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Miscellaneous (Cont.)				
Chlordane, 20%	3 days	3.33	2.42	Unchanged
*Creosote	1 year	11.65	5.45	Softened
*2,4-D (Amine Type), Undiluted (14% free acid)	4 months	5.02	3.60	Slightly swollen and softened
2,4-D, four tablespoons per gallon of water	4 months	1.53	7.61	Very slightly swollen
***Endoweed** Weed Killer (Ester Type), Undiluted (12.7% as free acid)	4 months	19.50	8.19	Softened, swollen, and discolored
***Endoweed** Weed Killer, 4 tablespoons per gallon of water	4 months	3.47	1.31	Slightly softened and swollen
*Epoxy Hardener				Dissolved
Epoxy Resin	1 month (122°F)	−0.07		
Fertilizer (20% Disodium Phosphate)	3 days (100°F)			Stained yellow
Fertilizer, Liquid	3 days	1.44	1.56	Unchanged
Fountain Syrups:				
Cherry	1 year	2.96	1.84	Unchanged
Cherry Smash Concentrate	1 year	2.08	1.04	Unchanged
Coca-Cola Concentrate	1 year	1.69	1.15	Stained slightly yellow
Grape	1 year	1.61	0.00	Unchanged
Lemon	1 year	3.34	1.14	Unchanged
Maple	1 year	1.31	0.14	Unchanged
Orange	1 year	3.40	1.40	Unchanged
Pepsi-Cola	1 year	3.87	3.10	Unchanged
Pineapple	1 year	1.18	0.21	Unchanged
Root Beer	1 year	5.02	1.15	Discolored and blistered
Strawberry	1 year	2.04	0.66	Unchanged
Vanilla	1 year	1.70	0.28	Unchanged
Gas Odorizers:				
***Pentalarm 86** (Concentrate)	1 week			Badly swollen
***Spotleak 1008** (Concentrate)	1 week			Badly swollen
***Spotleak 1009** (Concentrate)	1 week			Badly swollen
Inks:				
Cado	4 days	5.09	5.37	Stained
***Carter's** No. 10,856 Ball Point Ink	10 days (140°F)	10.38	6.10	Stained
***Carter's** No. 10,856 Ball Point Ink	2 months	12.85	7.00	Stained

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Miscellaneous (Cont.)				
Inks:				
***Carter's** No. 4,715 Ink	1 week	38.40	32.00	Softened
***Cushman & Denison** (For Felt-Tip Pens)	10 days	21.8	15.9	Softened, swollen
Dyna-Flo Pen Ink	3 days (100°F)			Unchanged
***Diagraph-Bradley** Stencil Ink	1 week	60.65	30.50	Softened, stained
Parker Superchrome Ink	2 days (100°F)			Slightly stained
Quick Drying (Formulab, Inc., Blue No. 353)	18 days	2.0	0.5	
Sanford's Dri-Line Black Marking Ink	3 days			Stained
Sheaffer's Skrip Ink	1 month	4.09	2.40	Unchanged
Latex Emulsion	1 year	1.11	0.31	Unchanged
Malaphos 25D Insecticide	48 hours (100°F, 80% R. H.)			Surface etched
Mineral Spirits	10 days	2.0	2.1	Unchanged
***Mortemoth** Insecticide, liquid	1 week	26.45	16.68	Softened and swollen
Naphtha, Industrial	1 month	3.56	2.73	Unchanged
Orthocryl Yarn Size	3 days (100°F)	1.75	0.73	Unchanged
Paint Remover (**CPC 400**)	Used as suggested by manufacturer			Distorted, surface attacked
Paints:				
Du Pont Dulux (outside yellow enamel, oil base)	1 week	2.88	2.45	Unchanged
Kemtone	1 day			Unchanged
Luminall, one coat interior paint L-402 (water emulsion)	1 week	3.11	1.89	Unchanged
Pittsburgh Semi-Gloss White, oil base	1 week	0.75	0.62	Unchanged
Penetrox A Lubricant	4 weeks (122°F)	−0.9	−0.1	Unchanged
Photographic Products: (All **Kodak®** Brand)				
Acid Fixer	1 week	2.16	0.85	Unchanged
Developer D-72	1 week	2.20	0.91	Unchanged
Developer DK-50	1 week	2.33	0.80	Unchanged

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

Effect of Various Chemicals and Reagents on TENITE® Butyrate

Material Tested	Time Exposed	Percent Increase		Observed Condition of Plastic
		Weight	Thickness	
Miscellaneous (Cont.)				
Photographic Products:				
Ektachrome® Processing Kit No. E2:				
First Developer	1 week	3.05	0.55	Stained yellow
Hardener	1 week	1.56	0.28	Unchanged
Color Developer	1 week	1.56	0.82	Stained dark amber
Clearing and Fixing Solution	1 week	1.56	0.28	Unchanged
Bleach	1 week	1.45	0.28	Stained light amber
Stabilizer	1 week	2.30	0.28	Unchanged
Refrigerants:				
Freon 12, gas	1 month	0.88	0.20	Unchanged
*Freon 12, liquid	1 month	18.75	9.50	Slightly swollen
Freon 22, gas	1 month	4.28	1.20	Unchanged
*Freon 22, liquid				Dissolved
Freon 113	3 days	S2 Flow		
		49.3	24.5	
		H3 Flow		
		0.5	0.2	
Freon 114, gas	1 month	0.84	0.00	Unchanged
Freon 114, liquid	1 month	7.76	2.37	Unchanged
Showersan Disinfectant	12 days	1.88	1.20	Unchanged
Solvex Maintenance Scale Retarder, 1/5 lb per gallon of water	1 month	1.58	0.62	Unchanged
Steel Pickling Bath (3% Sulfuric Acid and 8% Ferrous Sulfate)	1 year	1.60	0.58	Unchanged
	1 year (140°F)	1.52	1.08	Slightly softened
Steel Pickling Bath (8% Sulfuric Acid and 14% Ferrous Sulfate)	1 year	1.46	0.38	Unchanged
	8 months (160°F)	−5.85	−4.51	Softened
Stoddard Solvent, liquid	3 days	0.48	0.00	Unchanged
Stoddard Solvent, vapor	2 months (100°F)	9.56	8.80	Slightly stained
Super Market Fly Spray	1 week	0.47	0.43	Slightly stained
*Taxite Paint and Varnish Remover				Dissolved
Toxaphene Insecticide, 12% solution	3 days	3.13	1.57	Unchanged
Miscellaneous (Cont.)				
Ultra Solvex Descaling Agent, 1/3 lb per gallon of water	1 month	1.70	0.54	Unchanged
Urine	1 week	1.50	0.40	Unchanged
Varsol No. 2 Solvent	1 week	1.14	0.94	Unchanged
Water, distilled	1 year	1.66	0.74	Unchanged
*Weedone Weed Killer, (Ester Type), Undiluted (9% free acid)	2 months	27.32	14.00	Softened, swollen, discolored, and warped
Weedone Weed Killer, 5 tablespoons per gallon of water	2 months	1.98	0.55	Slightly swollen
*Weed-B-Gon Weed Killer, (Ester Type), Undiluted (13.8% as free acid)	1 month	13.43	6.58	Softened, swollen, discolored, and warped
Weed-B-Gon Weed Killer, 2½ tablespoons per gallon of water	1 month	2.67	1.06	Softened, swollen, discolored, and warped
Wine (12% Ethyl Alcohol)	2 months	7.88	5.17	Unchanged

**Indicates that material is generally unsatisfactory for use in contact with TENITE Butyrate under the conditions of this test.*

Most tests were conducted by placing dry, injection-molded specimens of TENITE Butyrate in contact with the other material for the period of time shown. Most figures given are the result of a single test, and the measured gains in weight and thickness are reported exactly, without rounding. Unless stated otherwise, tests were conducted at 73°F (23°C) and solutions were aqueous, i.e., "Acid, Acetic, 5%" indicates a 5% solution of acetic acid in water tested at 73°F. Unless other characteristics are specifically mentioned, the information given under "Observed Condition of Plastic" refers only to the appearance and feel of the plastic specimen.

(continued)

TABLE 1.6: CELLULOSE ACETATES, BUTYRATES, PROPIONATES—EASTMAN CHEMICAL (continued)

The Effects of Various Chemicals and Reagents on TENITE® Propionate

Reagent	Time Exposed	Percent Change		Observed Condition of Plastic
		Weight	Thickness	
CHEMICALS				
Acetic acid, 5%	1 year			Slightly softened
*Acetone				Dissolved
Ammonium hydroxide, 10%	1 year			Slightly swollen
*Butyl acetate				Dissolved
Calcium chloride, 2.5%	1 year			Unchanged
*Carbon disulfide	1 year			Softened, swollen
*Carbon tetrachloride	1 year			Softened, swollen
*Chloroform	1 year			Softened, swollen
Citric acid, 10%	1 year			Unchanged
Citric acid (tablets)	1 month (122°F)			Unchanged
*Ethyl acetate				Dissolved
*Ethyl alcohol, 50%	1 year			Softened, swollen
*Ethyl alcohol, 95%	1 year			Softened, swollen
Ethylene glycol	1 year			Unchanged
*Ethylene glycol monoethyl ether (EKTASOLVE® EE)				Dissolved
*Ethylene glycol monomethyl ether acetate (EKTASOLVE EM Acetate)				Dissolved
*Formaldehyde, 35%	1 year			Softened, swollen
*Gasoline, Regular	1 year			Dark yellow
Glycerin	1 year			Unchanged
Heptane	1 year			Unchanged
*Hydrochloric acid, 10%	1 year			Disintegrated
Hydrogen peroxide, 3%	1 year			Unchanged
Methanol, 5%	1 year			Unchanged
*Methanol, 100%	1 year			Dissolved
*Methyl ethyl ketone				Dissolved
*Methyl isoamyl ketone				Dissolved
*Nitric acid	1 year			Disintegrated
Oleic acid	1 year			Unchanged
Ozone, 5-15 pphm	45 days (outdoors)			Unchanged
Ozone, 70 pphm	45 days (120°F)			Unchanged
*Phenol, 5%	1 year			Disintegrated
Propane (gas)	1 year			Unchanged
Propane (liquid)	1 year			Unchanged
Soap solution, USP	1 year			Unchanged
Sodium carbonate, 2.5%	1 year			Unchanged
Sodium chloride, 10%	1 year			Unchanged
Sodium ferrocyanide (dry crystals)	1 week	0.80	0.96	Unchanged
Sodium hydroxide, 1%	1 year			Unchanged
*Sodium hydroxide, 10%	1 year			Disintegrated
Sulfuric acid, 3%	1 year			Unchanged
*Sulfuric acid, 30%	1 year			Slightly warped
*Toluene	1 year			Softened, swollen
Turpentine	1 year			Unchanged
Water	1 year			Unchanged
*Xylene	1 year			Softened, swollen

Reagent	Time Exposed	Percent Change		Observed Condition of Plastic
		Weight	Thickness	
MISCELLANEOUS MATERIALS				
Burndy's Penetrox A (conductive lubricant)	4 weeks (122°F)	−0.9	−0.1	Unchanged
Dane Head radiator sealer	3 weeks			Unchanged
Gasoline:				
*Amoco Premium	1 year	6.28	12.16	Swollen, wavy surface
Amoco Regular	1 year	2.25	5.38	Brownish yellow
*Esso Premium	1 year	4.81	5.33	Pink, swollen, and warped
Esso Regular	1 year	2.44	5.08	Dark yellow
*Shell High-Test	1 year	4.81	7.03	Pink and warped
*Shell Regular	1 year	3.58	5.48	Yellow, slightly warped
*Texaco Regular	1 year	3.22	6.91	Yellow
*Texaco "Sky Chief"	1 year	6.96	23.25	Swollen and pink
Ink:				
Quick drying Blue No. 353; Formulab, Inc.	18 days	2.2	−5.6	
*Malathion, 50% spray diluted with water to 0.5% Malathion	1 week	9.36	8.15	Softened, swollen, surface pitted and cloudy when wet
Oil:				
Bardahl oil	1 week (122°F)	−0.92		
Bardahl oil	4 weeks (122°F)	−1.96		
Crude oil	1 year			Unchanged
Purol HD SAE 10 motor oil	2 months	−0.10		Unchanged
	6 months	−0.30		
Texaco Co. #50 oil 1692 low temperature oil, MIL-L-644B	1 week (122°F)	−2.04	0.03	
Texaco Co. #50 oil 1692 low temperature oil, MIL-L-644B	4 weeks (122°F)	−3.38	−0.64	
Sachet powder	1 month (122°F)			Unchanged
*Vicks decongestant	2 days (122°F)			Badly stained, softened

*Indicates that material is generally unsatisfactory for use in contact with TENITE Propionate

Most tests were conducted by placing dry, injection-molded specimens of TENITE Propionate in intimate contact with the other material listed for the period of time shown. Tests for which no temperature is shown were conducted at 73°F (23°C).

TABLE 1.7: CHLORINATED POLYVINYL CHLORIDE PIPE AND FITTINGS—B.F. GOODRICH

The attached list is a compilation of chemical resistance data from three companies involved in the CPVC pipe, fittings and accessories market. Since each company has used a different scheme to report their findings, the following key will be needed to interpret the data.

Company A - E - Excellent to operating limit of material

G - Excellent to 80°F; Good to maximum operating limit of material

S - Good to 80°F.

L - Limited; may be used under certain conditions

U - Unsatisfactory; not recommended

Maximum operating limit is 180°F for pressure applications;

225°F for non-pressure applications

Company B - 1 - Good for 200°F (93°C)

2 - Good for 185°F (85°C)

3 - Good for 140°F (60°C)

4 - Good for 70°F (21°C)

Q - *Questionable*

NR - Not Recommended

Company C - R - Recommended

NR - Not Recommended

R* - Recommended to 210°F

CPVC PIPE/FITTINGS CHEMICAL RESISTANCE

Chemical	Company A	Company B	Company C 73°F	Company C 185°F
Acetaldehyde	U	NR	-	-
Acetate Solvents, Crude	U	-	-	-
Acetate Solvents, Pure	U	-	-	-
Acetic Acid, 10%	-	-	R	-
Acetic Acid, 20%	S	4	R	NR
Acetic Acid, 50%	-	-	-	NR
Acetic Acid, 80%	L	-	R	NR
Acetic Acid, Glacial	L	NR	NR	NR
Acetic Anhydride	U	NR	-	-
Acetone	U	NR	NR	NR
Acrylonitrile	-	-	NR	NR
Adipic Acid	E	-	R	R
Allyl Alcohol	S	-	-	-
Allyl Chloride	U	-	-	-
Alum	E	-	R	R
Aluminum Chloride	E	1	R	R
Aluminum Fluoride	E	1	-	-
Aluminum Hydroxide	E	-	R	R
Aluminum Oxychloride	E	-	-	-
Aluminum Nitrate	E	-	R	R
Aluminum Sulfate	E	1	R	R
Ammonia, Aqueous	-	3	R	NR
Ammonia, Dry Gas	E	-	R	R
Ammonia, Liquid	E	-	-	-
Ammonium Bifluoride	E	-	R	R
Ammonium Carbonate	E	1	-	-
Ammonium Chloride	E	1	R	R
Ammonium Fluoride, 25%	E	-	-	-
Ammonium Hydroxide	E	1	R	R
Ammonium Metaphosphate	E	-	-	-
Ammonium Nitrate	E	1	R	R
Ammonium Persulfate	E	-	R	NR
Ammonium Phosphate	E	1	-	-
Ammonium Sulfate	E	1	R	R
Ammonium Sulfide	E	-	-	-
Ammonium Thiocyanate	E	-	-	-
Amyl Acetate	U	NR	-	-
Amyl Alcohol	S	3	R	NR
Amyl Chloride	U	-	-	-
Aniline	U	NR	NR	NR
Aniline Chlorohydrate	U	-	-	-
Aniline Hydrochloride	U	-	-	-
Anthraquinone	E	-	-	-
Anthraquinone Sulfonic Acid	E	-	-	-
Antimony Trichloride	E	-	-	-
Aqua Regia	L	Q	R	NR
Arsenic Acid	E	1	R	R
Arylsulfonic Acid	L	-	-	-
Asphalt	E	-	-	-
Barium Carbonate	E	-	-	-
Barium Chloride	E	1	-	-

(continued)

TABLE 1.7: CHLORINATED POLYVINYL CHLORIDE PIPE AND FITTINGS—B.F. GOODRICH (continued)

Chemical	Company A	Company B	Company C 73°F	Company C 185°F
Barium Hydroxide	E	1	-	-
Barium Sulfate	E	1	R	R
Barium Sulfide	E	-	-	-
Beer	E	-	-	-
Beet Sugars Liquors	E	-	-	-
Benzaldehyde	U	NR	-	-
Benzene	U	NR	NR	NR
Benzene Sulfonic Acid, 10%	E	-	-	-
Benzene Sulfonic Acid	-	NR	-	-
Benzoic Acid	E	1	-	-
Bismuth Carbonate	E	-	-	-
Black Liquor	E	-	R	R
Bleach, 12.5% Active CL_2	E	-	R	R
Borax	E	1	-	-
Boric Acid	E	1	R	R
Boron Trifluoride	E	-	-	-
Breeder pellets, fish	E	-	-	-
Brine	E	-	-	-
Bromic Acid	E	-	R	R
Bromine, Liquid	U	-	-	-
Bromine Water	L	4	-	-
Butadiene	S	-	R	-
Butane	L	-	-	-
Butanol, Primary	S	-	R	NR
Butanol, Secondary	S	-	R	NR
Butyl Acetate	U	Q	R	NR
Butyl Alcohol	S	3	R	NR
Butyl Amine	-	Q	-	-
Butyl Phenol	S	-	-	-
Butyl Phthalate	-	NR	-	-
Butylene	S	-	-	-
Butynedial (Erythrital)	S	-	-	-
Butyric Acid	L	NR	-	-
Cadmium Cyanide	-	1	R	R
Calcium Bisulfite	E	1	-	-
Calcium Carbonate	E	-	R	R
Calcium Chlorate	E	-	-	-
Calcium Chloride	E	1	R	R
Calcium Hydroxide	E	-	R	R
Calcium Hypochlorite	E	1	R	R
Calcium Nitrate	E	1	-	-
Calcium Phosphate	-	1	-	-
Calcium Sulfate	E	1	-	-
Cane Sugars Liquors	E	-	-	-
Carbon Bisulfide	U	NR	-	-
Carbon Dioxide	E	-	R	R
Carbon Monoxide	E	-	R	R
Carbon Tetrachloride	E	4	R	-
Carbonic Acid	E	1	R	R
Casein	E	-	-	-
Castor Oil	E	-	R	R
Caustic Potash	E	-	R	R
Caustic Soda	E	-	-	-
Cellosolve	E	Q	-	-
Chloracetic Acid	S	4	-	-
Chloral Hydrate	E	-	-	-
Chloric Acid, 20%	E	-	-	-
Chlorine Gas, Dry	S	-	-	-
Chlorine Gas, Wet	U	-	-	-
Chlorine, Liquid	-	-	NR	NR
Chlorine Water	E	2	R	NR
Chlorobenzene	U	NR	-	-
Chloroform	U	NR	NR	NR
Chlorosulfonic Acid	L	4	-	-
Chrome Alum	E	-	-	-
Chromic Acid, 10%	E	3	R	R*
Chromic Acid, 30%	-	-	R	R*
Chromic Acid, 50%	E	4	R	R*
Citric Acid	E	2	R	R
Coconut Oil	E	-	-	-
Copper Chloride	E	1	R	R
Copper Cyanide	E	1	R	R
Copper Fluoride	E	-	-	-
Copper Nitrate	E	1	-	-
Copper Sulfate	E	1	R	R
Core Oils	E	-	-	-
Cottonseed Oil	E	-	R	R
Cresol	S	Q	-	-
Cresylic Acid, 50%	G	-	-	-
Croton Aldehyde	U	-	-	-
Crude Oil	E	1	R	R
Cyclohexane	-	NR	-	-
Cyclohexanol	U	-	-	-
Cyclohexanone	U	-	NR	NR
Decalin	-	Q	-	-
Demineralized Water	G	-	R	R*
Detergents	-	1	R	R
Dextrin	E	-	-	-
Dextrose	E	-	-	-
Diazo Salts	E	-	-	-
Diesel Fuel	-	1	-	-
Diglycolic Acid	E	-	-	-
Dimethylamine	U	-	-	-
Dimethyl Formamide	-	0	NR	NR
Dioctylphthalate	U	-	NR	NR
Disodium Phosphate	E	-	R	R
Dowtherm	-	1	-	-
Ethers	U	4	-	-
Ethanolamine	-	3	-	-
Ethyl Acetate	U	Q	-	-
Ethyl Acrylate	U	-	-	-
Ethyl Alcohol	E	3	R	R
Ethyl Chloride	U	-	-	-
Ethyl Ether	U	-	-	-
Ethylene Bromide	U	-	-	-
Ethylene Chlorohydrin	U	-	-	-

(continued)

TABLE 1.7: CHLORINATED POLYVINYL CHLORIDE PIPE AND FITTINGS—B.F. GOODRICH (continued)

Chemical	Company A	Company B	Company C 73°F	Company C 185°F
Ethylene Dichloride	U	NR	-	-
Ethylene Glycol	E	1	R	R
Ethylene Oxide	U	-	-	-
Fatty Acids	E	-	-	-
Ferric Chloride	E	1	R	R
Ferric Hydroxide	-	1	-	-
Ferric Nitrate	E	1	-	-
Ferric Sulfate	E	1	-	-
Ferrous Chloride	E	1	R	R
Ferrous Sulfate	E	1	R	R
Fish Solubles	E	-	-	-
Fluorine Gas	L	-	-	-
Fluoroboric Acid	E	3	R	NR
Fluorosilicic Acid	E	3	R	NR
Formaldehyde, 35%	-	-	R	NR
Formaldehyde, 37%	S	3	R	NR
Formaldehyde, 50%	-	-	R	NR
Formic Acid	s	4	R	NR
Freon - 11	-	-	R	-
Freon - 12	S	3	R	-
Fructose	E	-	-	-
Fruit Juices, Pulp	E	-	-	-
Fuel Oils	-	4	-	-
Fuel Oil with H_2SO_4	E	-	-	-
Furfural	U	NR	-	-
Gallic Acid	E	-	R	NR
Gas - Coke Oven	G	-	-	-
Gas - Manufactured	E	-	-	-
Gas - Natural	S	-	-	-
Gasoline - Refined	S	4	-	-
Gasoline - Sour	E	-	-	-
Gelatin	E	-	-	-
Glucose	E	-	R	R
Glycerine (Glycerol)	E	2	R	R
Glycol	E	-	R	R
Glycolic Acid	E	-	-	-
Green Liquor	E	-	-	-
Heptane	S	2	-	-
Hexane	S	2	R	-
Hexanol, Tertiary	S	-	-	-
Hydrobromic Acid, 20%	E	2	R	NR
Hydrochloric Acid, 0-25%	G	2	R	R*
Hydrochloric Acid, 25-37%	G	2	R	R*
Hydrocyanic Acid	E	-	-	-
Hydrofluoric Acid, 10%	S	4	R	NR
Hydrofluoric Acid, 30%	S	4	-	NR
Hydrofluoric Acid, 50%	-	4	NR	NR
Hydrofluoric Acid, 60%	L	-	-	-
Hydrofluorosilicic Acid	L	-	-	-
Hydrogen	S	-	R	-
Hydrogen Cyanide	E	-	-	-
Hydrogen Fluoride, Anhydrous	-	-	NR	NR
Hydrogen Peroxide, 30%	6	3	-	-
Hydrogen Peroxide, 50%	S	3	R	R
Hydrogen Peroxide, 90%	U	-	-	-
Hydrogen Phosphide	S	-	-	-
Hydrogen Sulfide, Aq. Sol	S	-	-	-
Hydrogen Sulfide, Dry	E	-	R	R
Hydroquinone	E	-	-	-
Hydroxylamine Sulfate	E	-	-	-
Hypochlorous Acid	S	-	-	-
Iodine (in Alcohol)	U	-	-	-
Isopropyl Alcohol	G	-	-	-
Jet Fuel, JP-4	-	-	R	-
Jet Fuel, JP-5	-	-	R	-
Kerosene	G	2	R	R
Ketones	-	NR	-	-
Kraft Liquor	G	-	R	R
Lacquer Thinners	L	-	-	-
Lactic Acid, 25%	G	Q	-	-
Lard Oil	G	-	R	R
Lauric Acid	G	-	-	-
Lauryl Chloride	S	-	-	-
Lauryl Sulfate	E	-	-	-
Lead Acetate	E	1	R	R
Lime Sulfur	E	-	-	-
Lineolic Acid	G	-	-	-
Linseed Oil	S	-	R	R
Liquors, Liquers	E	-	-	-
Lubricating Oils	G	1	-	-
Magnesium Carbonate	E	-	-	-
Magnesium Chloride	E	1	R	R
Magnesium Hydroxide	E	1	-	-
Magnesium Nitrate	E	1	-	-
Magnesium Sulfate	E	1	R	R
Maleic Acid	E	-	-	-
Malic Acid	-	-	R	R
Mercuric Chloride	E	-	-	-
Mercuric Cyanide	E	-	-	-
Mercurous Nitrate	E	-	-	-
Mercury	E	-	R	R
Methyl Alcohol	S	3	-	-
Methyl Chloride	U	NR	-	-
Methyl Ethyl Ketone	U	NR	NR	NR
Methyl Isobutyl Ketone	-	-	NR	NR
Methyl Sulfate	S	-	-	-
Methyl Sulfuric Acid	S	-	-	-
Methylene Chloride	U	NR	-	-
Milk	S	-	R	-
Mineral Oils	E	-	R	R
Molasses	E	-	-	-
Motor Oil	-	-	R	R
Naphtha	S	3	R	-
Naphthalene	U	-	-	-
Nickel Acetate	E	-	-	-
Nickel Chloride	E	2	R	R

(continued)

TABLE 1.7: CHLORINATED POLYVINYL CHLORIDE PIPE AND FITTINGS—B.F. GOODRICH (continued)

Chemical	Company A	Company B	Company C 73°F	Company C 185°F
Nickel Nitrate	E	-	-	-
Nickel Sulfate	E	2	R	R
Nicotine	E	-	-	-
Nicotinic Acid	E	-	-	-
Nitric Acid, 10%	G	2	R	R
Nitric Acid, 20%	-	2	-	-
Nitric Acid, 30%	G	-	R	R*
Nitric Acid, 40%	-	-	R	R*
Nitric Acid, 50%	-	2	R	NR
Nitric Acid, 60%	G	-	-	-
Nitric Acid, 68%	G	-	R	NR
Nitric Acid, Anhydrous	U	NR	-	-
Nitrobenzene	U	NR	-	-
Nitropropane	-	-	-	-
Nitrous Oxide	S	-	-	-
Ocenol	E	-	-	-
Oils and Fats	E	1	R	R
Oleic Acid	E	1	R	R
Oleum	U	-	-	-
Oxalic Acid	E	1	R	R
Oxalic Acid, 50%	-	-	R	R
Oxygen	E	-	R	R
Ozone	E	-	-	-
Palmitic Acid, 10%	S	-	R	-
Palmitic Acid, 70%	S	-	R	-
Paracetic Acid, 40%	U	-	-	-
Perchloric Acid, 10%	E	-	R	R
Perchloric Acid, 70%	U	-	R	R
Perchloroethylene	-	1	-	-
Phenol	S	3	R	-
Phenylhydrazine	U	-	-	-
Phenylhydrazine Hydrochloride	E	-	-	-
Phosgene Gas	G	-	-	-
Phosgene Liquid	U	-	-	-
Phosphoric Acid, 0-50%	6	2	R	R*
Phosphoric Acid, 50-75%	6	2	-	-
Phosphoric Acid, 85%	-	-	R	NR
Phosphorous, Yellow	S	-	-	-
Phosphorous, Red	S	-	-	-
Phosphorous, Pentoxide	L	-	-	-
Phosphorous, Trichloride	U	-	-	-
Photographic Solutions	E	-	R	R
Picric Acid	U	-	-	-
Plating Solution, Brass	E	-	R	R
Plating Solution, Cadium	E	-	R	R
Plating Solution, Chromium	E	-	R	R*
Plating Solution, Copper	E	-	R	R*
Plating Solution, Gold	E	-	R	R
Plating Solution, Lead	E	-	R	R*
Plating Solution, Nickel	E	-	R	R*
Plating Solution, Rhodium	-	-	R	R*
Plating Solution, Silver	E	-	R	R

Chemical	Company A	Company B	Company C 73°F	Company C 185°F
Plating Solution, Tin	E	-	R	R*
Plating Solution, Zinc	E	-	R	R
Potassium Acid Sulfate	E	-	-	-
Potassium Antimonate	E	-	-	-
Potassium Bicarbonate	E	-	R	NR
Potassium Bichromate	E	-	-	-
Potassium Bisulfite	E	-	-	-
Potassium Borate	E	-	-	-
Potassium Bromate	E	-	-	-
Potassium Bromide	E	1	-	-
Potassium Carbonate	E	1	-	-
Potassium Chlorate	E	1	-	-
Potassium Chloride	E	1	R	R
Potassium Chromate	E	-	-	-
Potassium Cuprocyanide	E	-	-	-
Potassium Cyanide	E	1	R	R
Potassium Dichromate	E	1	R	R
Potassium Ferricyanide	E	-	-	-
Potassium Fluoride	E	-	-	-
Potassium Hydroxide, 0-20%	E	1	R	R
Potassium Hydroxide, 35%	E	1	R	R
Potassium Hypochlorite	L	-	-	-
Potassium Nitrate	E	1	-	-
Potassium Perborate	E	-	-	-
Potassium Perchlorite	E	-	-	-
Potassium Permanganate	E	1	-	-
Potassium Persulfate	E	-	-	-
Potassium Sulfate	E	1	-	-
Potassium Sulfide	E	-	-	-
Propane	S	-	R	-
Propargyl Alcohol	E	-	-	-
Propyl Alcohol	S	2	-	-
Propylene Dichloride	U	-	-	-
Rayon Coagulating Bath	G	-	-	-
Selenic Acid	E	-	-	-
Salicic Acid	E	-	-	-
Silver Cyanide	E	-	R	R
Silver Nitrate	E	1	R	R
Soaps	E	1	R	R
Sodium Acetate	E	1	R	R
Sodium Acid Sulfate	E	-	-	-
Sodium Antimonate	E	-	-	-
Sodium Arsenite	R	-	-	-
Sodium Benzoate	E	-	-	-
Sodium Bicarbonate	E	1	R	R
Sodium Bisulfite	-	-	R	R
Sodium Chlorate	E	1	-	-
Sodium Chloride	E	1	R	R*
Sodium Chlorite	-	-	R	-
Sodium Cyanide	E	1	R	R
Sodium Dichromate	E	-	R	R
Sodium Ferricyanide	E	-	-	-
Sodium Ferrocyanide	E	-	R	R

(continued)

TABLE 1.7: CHLORINATED POLYVINYL CHLORIDE PIPE AND FITTINGS—B.F. GOODRICH (continued)

Chemical	Company A	Company B	Company C 73°F	Company C 185°F
Sodium Fluoride	E	-	-	-
Sodium Hydroxide, 15%	E	1	R	R
Sodium Hydroxide, 30%	E	1	R	R*
Sodium Hydroxide, 50%	E	1	R	R*
Sodium Hydroxide, 70%	E	1	-	-
Sodium Hypochlorite	E	1	R	R
Sodium Nitrate	E	1	R	R
Sodium Nitrite	E	-	-	-
Sodium Phosphate Acid	E	-	-	-
Sodium Silicate	E	1	-	-
Sodium Sulfate	E	1	R	R
Sodium Sulfide	E	1	R	R
Sodium Sulfite	-	-	R	R
Stannic Chloride	E	1	R	R
Stannous Chloride	E	-	R	R
Stearic Acid	E	-	R	R
Stoddards Solvent	U	-	-	-
Sulfur	E	-	-	-
Sulfur Dioxide, Dry	S	-	NR	-
Sulfur Dioxide, Wet	S	-	NR	-
Sulfuric Acid, 0-10%	G	3	R	R*
Sulfuric Acid, 10-50%	G	3	R	R*
Sulfuric Acid, 50-75%	G	3	R	R*
Sulfuric Acid, 80%	-	-	R	R*
Sulfuric Acid, 75-90%	S	-	-	-
Sulfuric Acid, 90%	-	-	R	NR
Sulfuric Acid, 93%	-	-	R	NR
Sulfuric Acid, 94%	-	-	R	NR
Sulfuric Acid, 95%	S	4	R	NR
Sulfuric Acid, 96%	-	-	R	NR
Sulfuric Acid, 98%	-	-	R	NR
Sulfuric Acid, 100%	-	-	NR	NR
Sulfurous Acid	E	2	-	-
Sulfur Dioxide, Liquid	S	-	-	-
Sulfur Trioxide	E	-	-	-
Tannic Acid	E	1	R	R
Tanning Liquors	E	-	R	R
Tartaric Acid	E	1	-	-
Tetraethyl Lead	S	-	-	-
Tetrahydrofurane	U	NR	-	-
Tetrahydrofuran	-	-	NR	NR
Thionyl Chloride	U	-	-	-
Titanium Tetrachloride	S	-	-	-
Toluol, Toluene	U	NR	NR	NR
Tributyl Phosphate	U	-	-	-
Trichloroethylene	U	NR	NR	NR
Tricresylphosphate	U	-	-	-
Triethanolamine	L	-	-	-
Triethylamine	S	-	-	-
Trimethylpropane	G	-	-	-
Trisodium Phosphate	E	-	R	R
Turpentine	S	4	R	-
Urea and Urine	E	1	R	R
Vinegar	E	1	R	NR
Vinyl Acetate	U	-	-	-
Water	-	-	R	R*
Water, Acid Mine	G	2	R	R
Water, Demineralized	G	2	R	R*
Water, Distilled Fresh	G	2	R	R*
Water, Potable	-	-	R	R*
Water, Salt	G	2	R	R*
Water, Sea	-	-	R	R*
Water, Sewage	G	2	R	R
Whiskey	E	-	R	R
White Liquor	E	-	R	R
Wines	-	-	R	R
Xylene or Xylol	U	NR	NR	NR
Zinc Chloride	E	1	R	R
Zinc Chromate	E	-	-	-
Zinc Cyanide	E	-	-	-
Zinc Nitrate	E	-	-	-
Zinc Sulfate	E	1	R	R

TABLE 1.8: EPOXY COMPOUNDS—DEVCON

Chemical Resistance of Devcon Epoxy Compounds

Sample Size: ½" x ½" x 1" Cure: 7 days at room temperature. Immersion: 30 days.

Product Name	Kerosene	Hydrochloric Acid-10%	Chlorinated Solvent	Sulphuric Acid-10%	Methanol	Toulene	Ammonia	10% Sodium Hydroxide
Plastic Steel Putty	VG	VG	VG	VG	F	F	VG	VG
Plastic Steel Liquid	VG	VG	VG	VG	U	VG	VG	VG
Plastic Steel 5-Min. Putty	VG	VG	U	VG	U	VG	VG	VG
Aluminum Putty	VG	VG	VG	VG	F	VG	VG	U
Aluminum Liquid	VG	VG	VG	VG	F	VG	VG	F
Aluminum Very Liquid	VG	VG	F	VG	F	F	VG	VG
Bronze Putty	VG	VG	VG	U	F	VG	VG	VG
Stainless Steel Putty	VG	F	VG	VG	U	VG	VG	VG
Carbide Putty	VG	VG	VG	F	VG	VG	VG	VG
Wear Resistant Putty	VG	F	VG	U	F	VG	VG	VG
Wear Resistant Liquid	VG	F	VG	F	F	VG	VG	VG
Ceramic Wear Compound	VG	F	F	F	U	F	VG	VG
Tile Adhesive	VG	F	F	F	U	F	VG	VG
Pump Repair Compound	VG	VG	VG	VG	F	VG	VG	VG
High Temp Wear Resistant Putty	VG	VG	VG	VG	VG	VG	VG	VG
High Temp Ceramic Putty	VG	VG	VG	VG	VG	VG	VG	VG
High Temp Mold Maker	VG	VG	VG	VG	VG	VG	VG	VG
Tankite II	VG	VG	F	VG	F	U	VG	VG
Backing Compound Liquid	VG	VG	U	U	U	U	VG	VG
Backing Compound Putty	VG	VG	F	U	U	U	VG	VG
High Impact Backing	VG	F	VG	F	U	F	VG	VG
Wet Surface Repair Putty	VG	F	U	U	U	U	VG	VG
Floor Grip	VG	VG	VG	VG	F	U	VG	VG
Floor Patch	F	F	U	F	VG	U	F	F
Epoxy Sealer 100	VG	VG	VG	VG	F	U	VG	VG

All products are VG in Water, saturated salt solution, leaded gasoline, mineral spirits, ASTM #3 oil and propylene glycol.

CAUTION: Epoxies are generally not recommended for long term exposures to concentrated acids and organic solvents.

Key: VG-Very Good; F-Fair, U-Unsatisfactory

TABLE 1.9: EPOXY PIPE AND FITTINGS–AMERON

BONDSTRAND Series 1200 and Series 1600 are unlined epoxy products produced by the filament-winding process. Series 1200 piping offers the user a locked O-ring joint for quick, reliable joining of either suspended or buried pipe systems, even under adverse weather conditions. For those users who prefer the rugged strength and performance of the QUICK-LOCK® adhesive bonded joint, Ameron offers Series 1600 piping with its heavier pipe walls, longer spans and greater ring stiffness.

Chemical Solution	Concentration[1]	Temperature Limit °F	Temperature Limit °C	Gasket Suitability[3]
Acetic Acid	0-10%	150	66	✓
	10-100%	NR	NR	
Acetone		75	24	✓
Acrylic Acid		NR	NR	
Air		210	99	✓
Aluminum Potassium Sulfate		210	99	✓
Aluminum Chloride	0-1%	210	99	✓
Aluminum Nitrate		200	93	✓
Aluminum Sulfate		210	99	✓
Ammonia Gas Dry		150	66	✓
Ammonium Chloride		120	49	✓
Ammonium Hydroxide	0-28%	100	38	✓
Ammonium Phosphate		150	66	✓
Ammonium Sulfate		210	99	✓
Ammonium Nitrate	0-25%	210	99	✓
Aniline		75	24	✓
Barium Chloride		200	93	✓
Benzene		120	49	NR
Black Liquor (paper mfg.)		150	66	✓
Boric Acid	0-20%	200	93	✓
Bromine Water	0-4%	150	66	NR
Calcium Chloride		210	99	✓
Calcium Hypochlorite[2]		150	66	✓
Calcium Nitrate		200	93	✓
Calcium Sulfate		200	93	—
Carbon Disulfide		75	24	NR
Carbon Tetrachloride		150	66	NR
Chloroacetic Acetic	0-10%	75	24	✓
Chloroacetic Acid—Glacial		NR	NR	
Chlorobenzene		75	24	NR

Chemical Solution	Concentration[1]	Temperature Limit °F	Temperature Limit °C	Gasket Suitability[3]
Chloroform		NR	NR	
Chlorine Gas, wet		NR	NR	
Chlorinated Brine		NR	NR	
Chlorinated Water[2]	0-50 ppm	150	66	—
Chlorinated Water	>50 ppm	NR	NR	
Chromic Acid	0-10%	NR	NR	
Citric Acid		210	99	✓
Copper Chloride		200	93	✓
Copper Nitrate		200	93	—
Copper Sulfate		210	99	✓
Crude Oil (sweet & sour)		210	99	NR
Cyclohexanol		100	38	NR
Detergents		120	49	✓
Diallylphthalate		120	49	—
O-Dichlorobenzene		150	66	NR
Diesel Fuel		200	93	NR
Diethylene Triamine		NR	NR	
Dipropylene Glycol		150	66	✓
Ethyl Acetate		120	49	✓
Ethyl Acrylate		120	49	✓
Ethyl Alcohol		100	38	✓
Ethyl Benzene		100	38	NR
Ethyl Chloride		NR	NR	
Ethyl Ether		100	38	NR
Ethylene Dichloride		NR	NR	
Ethylene Glycol		210	99	✓
Fatty Acids		100	38	NR
Ferric Chloride		170	77	✓
Ferric Nitrate		150	66	✓
Ferric Sulfate		210	99	—

Chemical Solution	Concentration[1]	Temperature Limit °F	Temperature Limit °C	Gasket Suitability[3]
Formaldehyde		75	24	✓
Formic Acid		NR	NR	
Fuel Oil		210	99	NR
Gasoline		150	66	NR
Glycerin		210	99	✓
Green Liquor (paper)		100	38	✓
Heptane		150	66	NR
Hexane		100	38	NR
Hydraulic Oils		200	93	NR
Hydrobromic Acid		NR	NR	
Hydrochloric Acid	1% or less	75	24	✓
	>1%	NR	NR	
Hydrofluoric Acid		NR	NR	
Hydrofluosilic Acid	0-25%	NR	NR	
Hydrogen Chloride Gas Dry		150	66	NR
Hydrogen Peroxide	0-30%	NR	NR	
Hydrogen Sulfide		150	66	✓
Iodine (Sat @ R.T.)		120	49	✓
Isopropyl Alcohol		120	49	✓
Jet Fuel		200	93	NR
Kerosene		210	99	NR
Lactic Acid		170	77	NR
Latex Solutions		210	99	—
Lead Nitrate		170	77	✓
Linseed Oil		200	93	NR
Lithium Chloride		210	99	—
Lithium Hydroxide		150	66	—
Magnesium Carbonate		170	77	—
Magnesium Chloride		210	99	✓
Magnesium Hydroxide		210	99	✓

Chemical Solution	Concentration[1]	Temperature Limit °F	Temperature Limit °C	Gasket Suitability[3]
Magnesium Nitrate		200	93	—
Magnesium Sulfate		210	99	✓
Maleic Acid		170	77	NR
Maleic Anhydride		150	66	NR
Methyl Alcohol		100	38	✓
Methyl Chloride		NR	NR	
Methyl Ethyl Ketone		100	38	✓
Methyl Isobutyl Ketone		100	38	NR
Methylene Chloride		NR	NR	
Mineral Oil		210	99	NR
Monochlorobenzene		100	38	NR
Naphtha		210	99	NR
Natural Gas		210	99	NR
Nickel Chloride		210	99	✓
Nickel Nitrate		180	82	✓
Nickel Sulfate		210	99	✓
Nitric Acid[2]	1-10%	75	24	✓
Nitric Acid	10-70%	NR	NR	
Oil (crude)		210	99	NR
Oleic Acid		200	93	NR
Perchloric Acid[2]	0-70%	75	24	NR
Perchloroethylene		100	38	NR
Phenol	<1%	75	24	NR
	>1%	NR	NR	
Phosphoric Acid	0-2%	100	38	✓
	2-25%	75	24	✓
	25-50%	75	24	✓
	50-85%	NR	NR	
Polyvinyl Alcohol Emulsion		100	38	—
Potassium Chloride		210	99	✓

(continued)

TABLE 1.9: EPOXY PIPE AND FITTINGS—AMERON (continued)

Chemical Solution	Concentration(1)	Temperature Limit °F	°C	Gasket Suitability(3)
Potassium Cyanide		210	99	✓
Potassium Fluoride	0-30%	150	66	—
Potassium Hydroxide	0-50%	100	38	✓
Potassium Nitrate		210	99	✓
Potassium Sulfate		210	99	✓
Propylene Glycol		210	99	✓
Sodium Bromide		210	99	—
Sodium Bisulfate		200	93	✓
Sodium Carbonate	0-10%	210	99	✓
	0-50%	150	66	✓
Sodium Chlorate(2)		210	99	—
Sodium Chloride		210	99	✓

Chemical Solution	Concentration(1)	Temperature Limit °F	°C	Gasket Suitability(3)
Sodium Cyanide	0-6%	210	99	✓
Sodium Hydroxide	0-10%	100	38	✓
	10-50%	NR	NR	
Sodium Hypochlorite	0-5¼%	NR	NR	
Sodium Nitrate		210	99	✓
Sodium Sulfate		210	99	✓
Sodium Sulfide		210	99	✓
Styrene		75	24	NR
Sulfamic Acid	0-25%	100	38	—
Sulfuric Acid	1-2%	75	24	✓
Sulfuric Acid	2-95%	NR	NR	
Sulfur Dioxide Gas Dry		150	66	✓

Chemical Solution	Concentration(1)	Temperature Limit °F	°C	Gasket Suitability(3)
Tannic Acid	0-15%	210	99	✓
Tartaric Acid	0-10%	210	99	✓
Tetrachloroethylene		150	66	NR
Toluene		100	38	NR
Trichloroethylene		NR	NR	
Triethanolamine		150	66	✓
Vinegar		150	66	✓
Water (distilled or deionized)		210	99	✓
Water (salt)(4)		210	99	✓
Water (fresh)(4)		210	99	✓
Xylene		150	66	NR
Zinc Chloride		200	93	✓

Chemical Solution	Concentration(1)	Temperature Limit °F	°C	Gasket Suitability(3)
Zinc Sulfate		200	93	✓

(1)Where no concentration is shown, recommendations apply to any concentration up to 100% or to saturation.
(2)Series 5000 pipe can be expected to provide a longer service life in this environment.
(3)General fluid compatibility of standard polymer used in O-ring gasket for Bondstrand Series 1200 piping.
(4)For water contaminated with oil or fuel, standard polymer provides suitable performance at temperatures up to 180°F (82°C).
✓ Standard Gasket OK
NR Not Recommended
— Not Tested

TABLE 1.10: EPOXY RESIN—DURIRON

DURCON 6 is a solid, cast thermosetting epoxy which is silica filled. The following is a list of typical applications for DURCON 6.

Acetic Acid, 70%, 200°F
Acetic Acid, Glacial, 200°F
Acetone, boiling
Acetyl Chloride, boiling
Alcohol, 175°F
Alum, 200°F
Aluminum Chloride, 200°F
Ammonium Bisulfite, 150°F
Ammonium Chloride, 200°F
Ammonium Sulfate, 200°F
Amyl Acetate, 200°F
Amyl Alcohol, 175°F
Amyl Chloride, 200°F
Aniline, 150°F
Anodizing Solutions, 200°F
Antimony Trichloride, 150°F
Benzaldehyde, 200°F
Benzene, boiling
Benzene Hexachloride, 175°F
Black Liquor, 200°F
Brine, 200°F
Butyric Acid, 200°F
Calcium Chlorate, 150°F
Calcium Chloride, 200°F
Carbon Tetrachloride, boiling
Chloracetic Acid, 125°F
Chlorinated Water, 150°F
Chlorine Dioxide, 150°F
Chlorine, Wet, 150°F
Chlorobenzene, 175°F
Chromic Acid, 30%, ambient
Citric Acid, 200°F
Copper Sulfate, 200°F
Cupric Chloride, 200°F
Dichlorobutane, 200°F
Dimethyl Formamide, 200°F
Diethyl Sulfate, 200°F
Ethyl Alcohol, boiling
Ethyl Ether, boiling
Ethyl Nitrate, boiling
Ethylene Dichloride, 150°F
Fatty Acids, 200°F
Ferric Chloride, 150°F
Ferric Nitrate, 200°F
Ferric Sulfate, 200°F
Formaldehyde, boiling
Formic Acid, boiling
Hydrobromic Acid, 40%, 200°F
Hydrochloric Acid, 10%, 200°F
Hydrochloric Acid, 20%, 200°F
Hydrochloric Acid, 30%, 200°F
Hydrochloric Acid, conc., boiling
Hydrocyanic Acid, 125°F
Hypochlorous Acid, 125°F
Lactic Acid, 200°F
Magnesium Chloride, 200°F
Magnesium Sulfate, 200°F
Maleic Acid, 200°F
Malic Acid, 200°F
Mercuric Chloride, 200°F
Metal Plating Solutions, 150°F
Methyl Alcohol, boiling
Methyl Ethyl Ketone, boiling
Nickel Chloride, 200°F
Nickel Sulfate, 200°F
Nitric Acid, 10%, 175°F
Nitric Acid, 50%, ambient
Nitrobenzene, 150°F
Oleic Acid, 200°F
Oxalic Acid, 200°F
Perchloroethylene, 200°F
Phenol, 125°F
Phosphoric Acid, 85%, 200°F
Phosphorous Oxychloride, 150°F
Phthalic Acid, 200°F
Potassium Nitrate, 200°F
Rayon Spin Bath, 200°F
Sea Water, 200°F
Sodium Bicarbonate, 175°F
Sodium Bisulfate, 200°F
Sodium Chloride, 200°F
Sodium Nitrate, 200°F
Sodium Perchlorate, 100°F
Sodium Sulfate, 200°F
Sodium Thiosulfate, 200°F
Stannic Chloride, 200°F
Sulfite Liquors, 150°F
Sulfur Chloride, 150°F
Sulfuric Acid, 30%, 200°F
Sulfuric Acid, 70%, 150°F
Sulfuric Acid, 80%, 125°F
Tannic Acid, 200°F
Tartaric Acid, 200°F
Thiophenol, 200°F
Toluene, 175°F
Trichloroacetic Acid, 125°F
Trichloroethylene, boiling
Urea, 200°F
Vinegar, 200°F
Water, boiling
Zinc Chloride, 200°F
Zinc Sulfate, 200°F

TABLE 1.11: EPOXY RESINS—SHELL CHEMICAL

These amine-cured EPON resin coatings are unique because they cure at room temperature. They are outstanding for their resistance to heat, solvents, salt water, and most other corrosive materials, and have notable resistance to mechanical shock and abrasion. EPON resin coatings exhibit excellent adhesion and flexibility over wood, ferrous and nonferrous metals, and green or dry concrete. These coatings have outstanding weatherability and the high solids content which is possible at application viscosity.

Applications for these coatings are as finishes for wood, metal, and concrete in marine and other severely corrosive environment, as chemical resistant finishes for installed equipment where high-temperature baking is impractical. Coating formulations must be supplied as two-package systems, i.e., the curing agent packaged separately from the base component containing the EPON resin. The usable working life is a 10 to 15 hour period after the curing agent is added.

A high degree of cure is obtained overnight, but about five to seven days are required for maximum chemical and solvent resistance properties to develop. More rapid cures can be obtained by force-drying or baking. The most important reaction involves the crosslinking of the EPON resin with the polyfunctional amine curing agent. The epoxy coating systems referred to below are as follows:

System 1: A four-coat system based on two coats of a long oil linseed ester red lead primer plus two coats of a long oil soya ester topcoat for a total film thickness of 6 to 8 mils.

System 2: A four-coat system based on two coats of EPON resin 1001/EPON curing agent C-111 red lead primer plus two coats of the EPON resin 1001/C-111 topcoat for a total film thickness of 6 to 8 mils.

System 3: A four-coat system based on two coats of EPON resin 1001/EPON curing agent V-15 red lead primer plus two coats of the EPON resin 1001/V-15 topcoat for a total film thickness of 6 to 8 mils.

System 4: A two-coat system based on EPON resin 815/EPON curing agent H-2 applied to a total film thickness of 8 to 10 mils.

Code: R = Recommended for immersion service
R(S) = Recommended for spillage only
NR = Not recommended

	Coating Systems			
	1*	2	3	4
Oxidizing Agents				
Hydrogen peroxide, 30%	NR	NR	NR	NR
Sodium hypochlorite, 5%	R(S)	R	R	R
Calcium hypochlorite, 5%	R(S)	R	R	R
Chromic acid, 40%	NR	NR	NR	NR
Chromic acid, 5%	NR	NR	NR	NR
Sulfur dioxide solutions	R(S)	R	NR	R
Chlorine water	R(S)	R	R	R
Gases (Moist)				
Carbon dioxide	R	R	R	R
Sulfur dioxide	NR	R	R	R
Chlorine	NR	NR	NR	NR
Hydrogen sulfide	NR	R	R	R
Acids				
Sulfuric, 10%	R(S)	R(S)	NR	R
Sulfuric, concentrated	NR	NR	NR	NR
Hydrochloric, 10%	R(S)	R	R(S)	R
Hydrochloric, concentrated	NR	R(S)	R(S)	R(S)
Nitric, 10%	R(S)	R(S)	R(S)	R(S)
Nitric, concentrated	NR	NR	NR	NR
Phosphoric, 10%	R(S)	R(S)	R(S)	R
Phosphoric, concentrated	NR	NR	NR	NR

(continued)

TABLE 1.11: EPOXY RESINS—SHELL CHEMICAL (continued)

	Coating Systems			
	1*	2	3	4
Hydrofluoric, 10%	NR	R(S)	R(S)	R(S)
Hydrofluoric, 30%	NR	NR	NR	NR
Lower fatty, e.g., acetic, 20%	NR	NR	NR	NR
Lower fatty, e.g., acetic, concentrated	NR	NR	NR	NR
Higher fatty, e.g., oleic	NR	R	NR	R
Organic food, e.g., citric	R(S)	R	R	R
Alkalies				
Sodium hydroxide, dilute	R(S)	R	R	R
Sodium hydroxide, concentrated	R(S)	R	R	R
Calcium hydroxide	R	R	R	R
Ammonium hydroxide, dilute	R	R	R	R
Ammonium hydroxide, concentrated	R(S)	R(S)	R(S)	R
Ammonium salts	R	R	R	R
Sodium carbonate	R	R	R	R
Salt Solutions (5%–10% concentration)				
Alum	R	R	R	R
Ferrous sulfate	R(S)	R	R	R
Copper sulfate	R(S)	R	R	R
Sodium chloride	R	R	R	R
Calcium chloride	R	R	R	R
Sodium sulfate	R	R	R	R
Sodium phosphate	R	R	R	R
Sodium acetate	R	R	R	R
Water				
Tap	NR	R	R	R
Distilled	NR	NR	NR	R
Sea	NR	R	R	R
Solvents				
Chlorinated hydrocarbons (except methylene chloride)	NR	R	R(S)	R
Aromatic hydrocarbons	R(S)	R	R	R
Aliphatic hydrocarbons	R(S)	R	R	R
Alcohol (methyl, ethyl, and butyl)	R(S)	R	R	R
Ethers	R(S)	R	R	R
Esters	NR	R(S)	R(S)	R
Ketones	NR	R(S)	R(S)	R**
Phenol	NR	R(S)	R(S)	R(S)
Furfuryl alcohol	NR	R(S)	R(S)	R(S)
Furfural	NR	R(S)	R(S)	R(S)
Fats and Oils				
Mineral	R(S)	R	R(S)	R
Animal	R(S)	R	R(S)	R
Vegetable	R(S)	R	R(S)	R
Halogens (Moist)				
Chlorine	NR	NR	NR	NR
Bromine	NR	NR	NR	NR
Iodine	NR	NR	NR	NR

*Esters are not recommended for continuous immersion service, only limited service. **MIBK and above.

TABLE 1.12: FIBERGLASS REINFORCED EPOXY AND VINYL ESTER PIPING SYSTEMS—A.O. SMITH-INLAND

RED THREAD II Pipe: An unlined fiber glass reinforced epoxy resin pipe with the ability to solve corrosion problems in light chemical service at temperatures up to 210°F. GREEN THREAD Pipe: Fiber glass reinforced epoxy resin pipe with a glass mat reinforced epoxy resin liner. Provides superior corrosion resistance at temperatures up to 225°F. POLY THREAD Pipe: Fiber glass reinforced vinyl ester resin pipe with a glass mat reinforced vinyl ester resin liner intended for use in corrosive services at temperatures to 200°F. Final liner thickness not less than 20 mils. Vinyl esters have better chemical resistance than epoxies in high acid concentrations and to oxidizing agents.

Chemical Resistance

N.R.—Not Recommended N.T.—Not Tested

MAXIMUM RECOMMENDED TEMPERATURE °F FOR PRODUCTS LISTED

CHEMICAL	Red Thread II	Green Thread	Poly Thread
Acetic Acid, 10%	150	200*	200
Acetic Acid, 25%	N.R.	120	200
Acetic Acid, 50%	N.R.	120	150*
Acetic Acid, 75%	N.R.	120	150*
Acetic Acid, Glacial	N.R.	75	75
Acetone	N.R.	120	N.R.
Acrylic Acid, 95%	N.R.	100	N.R.
Air (Wet or Dry)***	210	225	200
Aluminum Chloride, 1%	210	225	200
Aluminum Potassium Sulfate, 56%	210	225	N.T.
Aluminum Sulfate, 50%	210	225	200
Ammonia Gas-Dry***	150	225	N.T.
Ammonium Hydroxide, 10%	100	150	120
Ammonium Hydroxide, 28%	100	100	150
Ammonium Persulfate, 30%	N.T.	75	200
Ammonium Nitrate, 25%	210	225	200
Anolyte	N.R.	150	N.T.
Beer	210	225	N.T.
Benzene	120*	150	75*
Benzene Sulfonic Acid, 50%	N.T.	N.T.	150
Benzene Sulfonic Acid, 75%	N.T.	N.T.	150
Benzene Sulfonic Acid, 100%	N.T.	N.R.	N.R.
Black Liquor (Pulp Mill)	150	225	N.T.
Boric Acid, 4%	210	225	200
Boric Acid, 20%	200	225	200
Bromoform	N.R.	N.R.	N.T.
Bromine Water, 4%	N.R.	N.R.	N.T.
Butyl Acetate	75	150	N.T.
Butyl Cellosolve	150	150	N.T.
Calcium Chloride, 37.5%	210	225	200
Calcium Hypochlorite, Sat'd.	N.R.	N.R.	150
Carbon Disulfide	120	120	N.T.
Carbon Tetrachloride	150	150	150*
Chloroacetic Acid, 10%	100	120	N.T.
Chloroacetic Acid, 25%	N.T.	N.T.	120
Chloroacetic Acid, 50%	N.T.	N.T.	150
Chloroacetic Acid, Glacial	N.R.	N.R.	N.T.
Chlorobenzene	100*	150*	N.R.
Chloroform	N.R.	N.R.	N.T.
Chlorothene	100	120	75
Chlorine Gas, Wet†***	N.R.	N.R.	150
Chlorine Saturated Brine ✓	N.R.	N.R.	150
Chlorinated Water—0-100 ppm Cl_2	150	225	200
Chlorinated Water-100-200ppmCl_2	N.R.	200	200
Chlorinated Water — Saturated ✓	N.R.	N.R.	150
Chromic Acid, 5%	N.R.	N.R.	150
Chromic Acid, 10%	N.R.	N.R.	150
Chromic Acid, 30%	N.R.	N.R.	N.R.
Citric Acid, 32%	210	225	N.T.
Coca-Cola (Syrup)	100	150	N.T.
Copper Sulfate, 17%	210	205*	200
Cresol 5%	75	120	N.T.
Cresol 10%	N.T.	75	N.T.
Dichlorobenzene (Ortho)	150	150	N.T.
Diethylene Triamine	N.R.	N.R.	N.R.
Dimethyl Formamide	N.R.	N.R.	N.T.

MAXIMUM RECOMMENDED TEMPERATURE °F FOR PRODUCTS LISTED

CHEMICAL	Red Thread II	Green Thread	Poly Thread
Dioxane	N.R.	75	N.T.
Distillery Stillage	150	150	N.T.
Distillery Syrup	150	150	N.T.
Divinyl Benzene	100*	100*	N.T.
Dowanol EE	75	75	N.T.
Dowanol EM	N.R.	N.R.	N.R.
Dowfax 9N9-Surfactant (Nonyl-Phenol-Ethylene Oxide Condensate)	100*	100*	N.T.
Dow Latex 560	210*	225	N.T.
Dow Latex 700	210*	225	N.T.
Dow Latex 2144	210*	225	N.T.
Ethyl Acetate	75	120	N.T.
Ethyl Acrylate	120	120	N.T.
Ethyl Alcohol	75*	120*	N.T.
Ethyl Benzene	120	150	N.T.
Ethyl Ether	100*	100*	N.T.
Ethylene Glycol, 100%	210	225	N.T.
Ethylene Glycol—50% in Water	210	225	N.T.
Ferric Chloride, 10%	150	205	200
Ferric Chloride 40%	150	205	200
Ferric Sulfate, 10%	210	225	200
Ferric Sulfate, 40%	210	225	200
Formaldehyde	75	120*	N.T.
Formic Acid, 88%	N.R.	N.R.	75
Freon 12 or 22 (Gas or Liquid)	N.T.	75	N.T.
Gasoline, 100 Octane	210	225	75*
Glycerine	210	225	N.T.
Glyoxal	N.T.	120*	N.T.
Green Liquor (Pulp Mill)	100	205*	N.T.
Hexane	100	100*	75*
Hydrobromic Acid, 10%	N.R.	150(1)	200
Hydrobromic Acid, 20%	N.R.	150(1)	200
Hydrobromic Acid, 51%	N.R.	100(1)	150
Hydrochloric Acid, 1%**	75	150(1)	200
Hydrochloric Acid, 10%	N.R.	150(1)	200
Hydrochloric Acid, 20%	N.R.	150(1)	200
Hydrochloric Acid, 36.5%	N.R.	75(1)	150
Hydrofluoric Acid, 1%	N.T.	N.T.	150
Hydrofluoric Acid, 5%	N.T.	N.T.	150
Hydrofluoric Acid, 10%	N.R.	75(1)	75
Hydrofluosilicic Acid, 25%	N.R.	100(1)	200
Hydrogen Chloride—Gas, Dry***	150	150	N.T.
Hydrogen Peroxide, 10%	N.R.	N.R.	75*
Hydrogen Peroxide, 27.5%	N.R.	N.R.	75*
Hydrogen Sulfide Gas***	150	150*	N.T.
Iodine (Sat'd. at Room temp.)	120	150	N.T.
Isopropyl Alcohol	100*	120*	N.T.
Jet Fuel (Super Refined Kerosene)	150	150*	N.T.
Kerosene	210	225	N.T.
Lactic Acid, 50%	120*	225	N.T.
Lithium Chloride (Sat'd at Room Temperature)	210	225	200
Lithium Hydroxide (Sat'd. at Room Temperature)	150	205*	N.T.
Magnesium Chloride, 24% ($MgCl_2 6H_2O$)	210	225	200

(continued)

TABLE 1.12: FIBERGLASS REINFORCED EPOXY AND VINYL ESTER PIPING SYSTEMS—A.O. SMITH-INLAND (continued)

CHEMICAL	MAXIMUM RECOMMENDED TEMPERATURE °F FOR PRODUCTS LISTED Red Thread II	Green Thread	Poly Thread
Magnesium Hydroxide, 4.9%	120	205	N.T.
Maleic Acid, 35%	150	150	N.T.
Maleic Anhydride	150	150	N.T.
Methanol, 100%	75	75*	N.T.
Methyl Alcohol, 20-50%	120	150	120
Methyl Alcohol, 80%	120	150	120
Methyl Alcohol, 100%	75	75	N.R.
Methyl Ethyl Ketone	75	150	N.T.
Methyl Isobutyl Ketone	100	150	N.T.
Methylene Chloride	N.R.	N.R.	N.R.
Mineral Oil	210	225	200
Monochlorobenzene	100*	150*	N.R.
Naphtha (High Flash)	210	225	200
Natural Gas***	210	225	N.T.
Nickel Chloride, 6% ($NiCl_2 3\frac{1}{2}H_2O$)	210	225	200
Nickel Chloride, 50%	210	225	200
Nickel Sulfate ($NiSO_4 6H_2O$), 32%	210	225	200
Nickel Sulfate, 30%	210	225	200
Nitric Acid, 1%**	75	120(1)	200
Nitric Acid, 10%	75	100(1)	150
Nitric Acid, 25%	N.R.	75(1)	75
Nitric Acid, 35%	N.R.	N.T.	75
Nitric Acid, 50%	N.R.	N.T.	75
Nitric Acid, 70%	N.R.	N.T.	N.R.
Oil—Crude	210	225	N.T.
Oil—Sour Crude	210	225	N.T.
Perchloroethylene 1,1,2,2	100	100*	N.T.
Phenol, 1% (In Water)	75	150(1)	150
Phenol, 5% (In Water)	N.T.	150(1)	150
Phenol, 10% (In Water)	N.R.	N.R.	N.R.
Phenol, 88% (In Water)	N.R.	N.R.	N.R.
Phosphoric Acid (H_3PO_4), 2%**	100	225(1)	200
Phosphoric Acid (H_3PO_4), 25%	75	150(1)	200
Phosphoric Acid (H_3PO_4), 50%	75	150(1)	200
Phosphoric Acid (H_3PO_4) 85%	N.R.	75(1)	200
Pickling Acid, 5% H_2SO_4, 0.025% Coal Tar Inhibitor in Water	N.R.	120(1)	200
Plating Solution—Nickel, 17% Nickel Sulfate, 5% Nickel Chloride, 3% Boric Acid in Water	210	225	200
Plating Solution—Silver Strike, 3½% Silver Cyanide, 5% Potassium Cyanide, 1½% Potassium Carbonate in Water	210	225	200
Polyglycol E-200	100	150*	N.T.
Polyglycol P-400	210	225	N.T.
Potassium Cyanide, 5%	210	225	N.T.
Potassium Fluoride, 30%	150	150	200
Potassium Hydroxide, 50%	100	150(1)	N.T.
Potassium Permanganate, 5%	150	200	200
Potassium Permanganate, 10%	N.R.	150(1)	200
Potassium Sulfate, 1%	210	225	200
Propane Gas***	N.T.	N.T.	N.T.
Propylene Glycol	210	225	N.T.
Pydroil	210	225	N.T.

CHEMICAL	MAXIMUM RECOMMENDED TEMPERATURE °F FOR PRODUCTS LISTED Red Thread II	Green Thread	Poly Thread
Sodium Bromide, 25%	210	225	200
Sodium Carbonate, 10%	210	205	N.T.
Sodium Carbonate, 50%	150	205	N.T.
Sodium Chlorate, 50%	210	225	200
Sodium Chloride, 10%	210	225	200
Sodium Cyanide, 6%	210	225	N.T.
Sodium Hydroxide, 1%**	N.T.	150(1)	120
Sodium Hydroxide, 2%	100	150(1)	100
Sodium Hydroxide, 5%	100*	150(1)	100
Sodium Hydroxide, 10%	100*	150(1)	100
Sodium Hydroxide, 20%	N.T.	150(1)	100
Sodium Hydroxide, 30%	N.T.	150(1)	150
Sodium Hydroxide, 50%	100	150(1)	150
Sodium Hypochlorite, 5¼%	N.R.	N.R.	#
Sodium Hypochlorite, 10%	N.R.	N.R.	#
Sodium Persulfate, 30%	N.T.	75	200
Sodium Sulfide, 15%	210	225	N.R.
Soybean Fatty Acid	210	225	N.T.
Spent Acid From Chlorine Dioxide Generators	N.R.	N.R.	N.T.
Styrene	75	75	N.T.
Sulfamic Acid, 25%	100	150	200
Sulfuric Acid, 1-2%	75	205(1)	200
Sulfuric Acid, 10%	N.R.	150(1)	200
Sulfuric Acid, 25%	N.T.	150(1)	200
Sulfuric Acid, 50%	N.R.	150(1)	200
Sulfuric Acid, 70%	N.R.	100(1)	200
Sulfuric Acid, 80%	N.R.	N.T.	180
Sulfuric Acid, 85%	N.R.	N.R.	150
Sulfuric Acid, 95%	N.R.	N.R.	N.R.
Sulfurous Acid, 6%	N.R.	75(1)	150
Sulfur Dioxide Gas—Dry***	150	150	N.T.
Sulfur Dioxide Gas—Wet†***	N.T.	N.T.	150*
Sulfur Dioxide Saturated Water	N.T.	N.T.	200
Tannic Acid, 15.5%	210	225	200
Tartaric Acid, 11%	210	225	N.T.
Tetrachloroethane 1,1,2,2,	N.R.	N.T.	N.T.
Tetrachloroethylene 1,1,2,2	150	150	N.T.
Toluene	100	100	75
Toluene Sulfonic Acid, 75%	N.T.	N.T.	150
Tomato Catsup	N.T.	205	N.T.
Tomato Puree	N.T.	205	N.T.
Transformer Oil	210	225	N.T.
Trichloroethane 1,1,1	150	150*	N.T.
Trichloroethylene 1,1,2	N.R.	120	N.T.
Triethanolamine	150	150*	N.T.
Vinegar (Cider)	(See Acetic Acid Data)		
Vinyl Acetate Monomer	N.R.	N.R.	N.T.
Vinyl Ester Resin 45% Styrene	75*	75*	75*
Water (Distilled or Deionized)	200	205	200
Water (pH 2-13)	210	225	200
Water—Salt, 10%	210	225	200
Water—Salt (Brine)	210	225	200
Xylene	150	150	75
Zinc Chloride, 50%	210	225	200

† Avoid use of any of the above piping systems where contact with liquid chlorine or liquid sulfur dioxide is a possibility. Dry gases under pressure can condense to liquids in cool weather. This situation should be avoided. Liquid chlorine and liquid sulfur dioxide should not be confused with water solutions of these gases.

*Maximum temperature tested at time of printing, could be serviceable at higher temperatures. Many solutions are under test at higher temperatures.

**For very low acid and caustic concentrations see "Water (pH 2-13)" for recommended service temperatures.

***Consult your A.O. Smith-Inland representative concerning all gas applications if the pipeline is not buried at least 3 feet deep.

#Consult your local A.O. Smith-Inland representative.

✓ Saturated at atmospheric pressure. Higher concentrations or supersaturation caused by higher pressure in the system may increase attack.

(1) Grooved adapters and 8" and larger reducer bushings are not recommended. Exposed surfaces and/or threads of Green Thread fittings must be covered with adhesive during installation. Use adhesive as thread locking compound in these services.

TABLE 1.13: FIBERGLASS REINFORCED FURAN POLYMER—QUAKER OATS CHEMICALS

QUACORR is the trademark for furfuryl alcohol based resin/catalyst systems developed by the Quaker Oats Company for the manufacture of fiberglass reinforced plastic (FRP) equipment. QUACORR laminates exhibit a broad range of solvent and chemical resistance combined with excellent physical, flame spread, and smoke development properties.

The QUACORR® Media Guide provides guidelines for the proper application of QUACORR FRP equipment in corrosive media.

The data in this bulletin have been compiled from laboratory testing of QUACORR 1001/2001 laminates prepared in accordance with U.S. Department of Commerce Product Standard 15-69. Laminates were evaluated using the ASTM C-581 test method which requires total immersion of the laminates in test media. Data were obtained from coupons exposed to media for a minimum of three months and, in most cases, one year and compared to unexposed control laminates. Recommendations are based on an evaluation of the following properties: weight change, thickness change, visual appearance, flexural strength, flexural modulus, and Barcol hardness. Based on the results of one year testing in the media specified in ASTM Test C-581, this corrosion guide can also be used for QUACORR 1500 FR.

KEY

S	-	Satisfactory
U	-	Unsatisfactory
R.T.	-	Room Temperature (70°F to 90°F)
B.P.	-	Boiling Point
SAT.	-	Saturated
CONC.	-	Concentrated

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
ACETIC ACID	25%	R.T.	X	
	25%	150	X	
	25%	B.P.(214)	X	
ACETIC ACID (GLACIAL)	100%	R.T.	X	
	100%	150	X	
	100%	B.P.(240)	X	
ACETIC ACID, SODIUM CHLORIDE, POTASSIUM CHLORIDE, XYLENE, DICHLOROPHENOL, BROMO-DICHLOROPHENOL, ACETIC ANHYDRIDE, SODIUM HYDROXIDE, METHANOL, TRICHLOROBENZENE	Unknown	150	X	
ACETIC ANHYDRIDE	100%	150	X	
ACETIC ANHYDRIDE, SODIUM CHLORIDE, POTASSIUM CHLORIDE, XYLENE, DICHLOROPHENOL, BROMODICHLOROPHENOL, ACETIC ACID, SODIUM HYDROXIDE, METHANOL, TRICHLOROBENZENE	Unknown	150	X	
ACETONE	100%	150[1]	X	
ACETONITRILE	100%	R.T.	X	
ACRYLIC ACID	100%	R.T.	X	
ACRYLIC ACID, SULFURIC ACID, METHACRYLATES, METHANOL, WATER[2]	6:60:5:5:24	176	X	
ACRYLONITRILE	100%	150	X	
ALCOHOLS (HEAVY), MALEIC ACID, FUMARIC ACID, SODIUM HYDROXIDE, SODIUM BISULFITE, HEPTANE, HEXANE (pH 1-12)	Unknown	190	X	
ALKYD RESIN	100%	R.T.	X	
ALKYL CHLORIDE (TRACE), HYDROCHLORIC ACID (AQUEOUS)	Unknown	R.T.	X	
ALLYL CHLORIDE	100%	R.T.	X	
ALUMINUM FLUORIDE	Sat.	150	X	
ALUMINUM POTASSIUM SULFATE	5%	R.T.	X	
	5%	150	X	
	5%	B.P.(212)	X	
AMINES (ORGANIC), NITRO COMPOUNDS, HYDROCHLORIC ACID	Unknown	R.T.	X	

1. Tested under pressure.
2. Recommendation based on successful case histories.

(continued)

TABLE 1.13: FIBERGLASS REINFORCED FURAN POLYMER—QUAKER OATS CHEMICALS (continued)

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
AMMONIUM ACETATE	Sat.	R.T.	X	
AMMONIUM BROMIDE	Sat.	150	X	
AMMONIUM HYDROGEN SULFATE, SULFURIC ACID	Dilute	250	X	
AMMONIUM HYDROXIDE[1.]	20%	R.T.	X	
ANILINE	100%	150	X	
AQUA REGIA				X
BENZALDEHYDE	100%	150	X	
BENZENE	100%	150	X	
BENZYL CHLORIDE	100% 100%	R.T. 150	X X	
o-BENZYL-p-CHLOROPHENOL	100% 100%	R.T. 150	X X	
BLACK PULP MILL LIQUOR[2.]	- -	R.T. 150	X X	
BORAX SOLUTION[1.]	Sat.	150	X	
BROMINE (FREE)[3.]				X
BROMODICHLOROPHENOL, SODIUM CHLORIDE, POTASSIUM CHLORIDE, XYLENE, DICHLOROPHENOL, ACETIC ACID, ACETIC ANHYDRIDE, SODIUM HYDROXIDE, METHANOL, TRICHLOROBENZENE	Unknown	150	X	
BUTYL ACETATE	100%	113	X	
BUTYL ALCOHOL	100%	B.P.(243)	X	
BUTYRALDEHYDE	100%	150	X	
CALCIUM HYPOCHLORITE				X
CARBON DISULFIDE[4.]	100%	B.P.(115)	X	

1. QuaCorr service in this media should be discussed with Technical Service.
2. Consult Technical Service on temperatures higher than 150°F.
3. Maximum allowable concentrations have not been defined. QuaCorr service at low concentrations may be satisfactory. Testing is recommended.
4. Recommendation based on successful case histories.

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
CARBON TETRACHLORIDE	100% 100%	150 B.P.(170)	X X	
CARBON TETRACHLORIDE, CHLOROFORM, WATER	75:24:1	144	X	
CELLOSOLVE ACETATE	100%	113	X	
CELLOSOLVE SOLVENT	100%	113	X	
CHLORAL ALCOHOLATE	Varied	68-158	X	
CHLORINATED AROMATIC SOLVENT	Unknown	176-194	X	
CHLORINATED SOLVENTS (TRACE), TRICHLOROETHANE, HYDROCHLORIC ACID (DILUTE)	Unknown	R.T.	X	
CHLORINE (FREE)[1.]				X
CHLOROACETIC ACID (MONO)	100%	R.T.	X	
CHLOROACETIC ACID (TRI)	50%	R.T.	X	
CHLOROFORM	100%	B.P.(144)	X	
CHLOROFORM, CARBON TETRACHLORIDE, WATER	24:75:1	144	X	
CHLOROPHENOL (MIXED ISOMERS)	100% 100%	R.T. 150	X X	
p-CHLOROPHENOL	95% 95%	R.T. 150	X	 X
CHLOROSULFONIC ACID[1.]	100%	R.T.		X
CHLOROTHENE N.U.	100%	R.T.	X	
CRESOL (MIXED ISOMERS)	100%	150	X	
CYCLOHEXANE	100%	150	X	
CYCLOHEXANONE	100% 100%	150 B.P.(312)	X X	
CYCLOHEXYLAMINE	100%	150	X	
DEMINERALIZED WATER	100% 100% 100%	R.T. 150 B.P.(212)	X X X	
DICHLORETHANE (1,2)	100%	150	X	

1. Maximum allowable concentrations have not been defined. QuaCorr service at low concentrations may be satisfactory. Testing is recommended.

(continued)

TABLE 1.13: FIBERGLASS REINFORCED FURAN POLYMER—QUAKER OATS CHEMICALS (continued)

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
DICHLOROBENZENE[1]	98%	100-120	X	
o-DICHLOROBENZENE, HYDROCHLORIC ACID (DILUTE), SODIUM HYDROXIDE, MALEIC ACID, FUMARIC ACID, ISOPROPYL ALCOHOL	Unknown	190	X	
o-DICHLOROBENZENE, 3-13% SODIUM HYDROXIDE (pH > 10)	Unknown	190	X	
o-DICHLOROBENZENE, SODIUM HYDROXIDE, ISOPROPYL ALCOHOL, MALEIC ACID, FUMARIC ACID	Unknown	190	X	
DICHLOROPHENOL (2,4)	100%	150	X	
DICHLOROPHENOL, SODIUM CHLORIDE, ACETIC ACID, POTASSIUM CHLORIDE, METHANOL, XYLENE, BROMODICHLOROPHENOL, ACETIC ANHYDRIDE, SODIUM HYDROXIDE, TRI-CHLOROBENZENE	Unknown	150	X	
DIESEL FUEL	100%	150	X	
DIETHYL CARBONATE	100%	B.P.(257)	X	
DIETHYLAMINE	100%	R.T.	X	
DIMETHYL FORMAMIDE[2]	100%	R.T.		X
DIMETHYL PHTHALATE	100%	300	X	
DIMETHYL PROPANOLAMINE	100%	150	X	
DISTILLED WATER	100%	150	X	
	100%	B.P.(212)	X	
ETHYL ACETATE	100%	R.T.	X	
	100%	150	X	
	100%	B.P.(171)	X	
ETHYLACETOACETATE	Sat.	113	X	
ETHYL ACRYLATE	100%	R.T.	X	
ETHYL ALCOHOL (ETHANOL)	95%	R.T.	X	
	95%	150	X	
	95%	B.P.(173)	X	

1. Tested in combination with other media.
2. Maximum allowable concentrations have not been defined. QuaCorr service at lower concentrations may be satisfactory. Testing is recommended.

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
2-ETHYL BUTYRIC ACID	100%	113	X	
ETHYLENE CHLOROHYDRIN, HYDROCHLORIC ACID, WATER	5:20:75	160-180	X	
ETHYLENE DIAMINE	100%	R.T.	X	
	100%	150		X
ETHYLENE DIBROMIDE	100%	150	X	
ETHYLENE DICHLORIDE	100%	150	X	
ETHYLENE GLYCOL	100%	113	X	
FLUOBORIC ACID[1]	100%	150		X
FLUOSILICIC ACID	5%	150	X	
FORMALDEHYDE	37%	113	X	
FORMALIN	40%	150	X	
FORMIC ACID[1]	88%	R.T.		X
FUEL OIL	100%	150	X	
FUMARIC ACID, HYDROCHLORIC ACID (DILUTE), SODIUM HYDROXIDE, MALEIC ACID, ISOPROPYL ALCOHOL, o-DICHLOROBENZENE	Unknown	190	X	
FUMARIC ACID, MALEIC ACID, SODIUM HYDROXIDE, SODIUM BISULFITE, HEPTANE, HEXANE, HEAVY ALCOHOLS (pH 1-12)	Unknown	190	X	
FUMARIC ACID, SODIUM HYDROXIDE, MALEIC ACID, o-DICHLOROBENZENE, ISOPROPYL ALCOHOL	Unknown	190	X	
FUNDAL[2]		150	X	
FUNDAL, METHYL PARATHION	50:50	120	X	
FURFURYL ALCOHOL RESIN	100%	R.T.	X	
GAS OIL, MINERAL SPIRIT, KEROSENE, PENTACHLOROPHENOL	31:32:32:5	150	X	

1. Maximum allowable concentrations have not been defined. QuaCorr service at lower concentrations may be satisfactory. Testing is recommended.
2. 1 part Fundal to 7 parts water.

(continued)

TABLE 1.13: FIBERGLASS REINFORCED FURAN POLYMER—QUAKER OATS CHEMICALS (continued)

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
GLYOXAL	40%	150	X	
GREEN PULP MILL LIQUOR[1]	- -	R.T. 150	X X	
n-HEPTANE	100% 100% 100%	R.T. 150 B.P.(208)	X X X	
HEPTANE, MALEIC ACID, FUMARIC ACID, SODIUM HYDROXIDE, SODIUM BISULFITE, HEXANE, HEAVY ALCOHOLS (pH 1-12)	Unknown	190	X	
HEXANE, MALEIC ACID, FUMARIC ACID, SODIUM BISULFITE, HEPTANE, HEAVY ALCOHOLS (pH 1-12)	Unknown	190	X	
HYDROBROMIC ACID	48%	R.T.	X	
HYDROCHLORIC ACID	15% 15% 25%[2] 30%[2]	R.T. 150 150 150	X X X X	
HYDROCHLORIC ACID (AQUEOUS), ALKYL CHLORIDE (TRACE)	Unknown	R.T.	X	
HYDROCHLORIC ACID, ETHYLENE CHLOROHYDRIN, WATER	20:5:75	160-180	X	
HYDROCHLORIC ACID, NITRO COMPOUNDS, AMINES (ORGANIC)	Unknown	R.T.	X	
HYDROCHLORIC ACID, PHOSPHOROUS ACID, WATER	6:75:19	R.T.	X	
HYDROCHLORIC ACID, PHOSPHOROUS ACID, WATER	6:75:19	150	X	
HYDROCHLORIC ACID (DILUTE), SODIUM HYDROXIDE, MALEIC ACID, FUMARIC ACID, o-DICHLOROBENZENE, ISOPROPYL ALCOHOL	Unknown	190	X	
HYDROCHLORIC ACID, SULFUR, SULFUR MONOCHLORIDE (VAPORS)	Unknown	200	X	
HYDROCHLORIC ACID (DILUTE), TRICHLOROETHANE, CHLORINATED SOLVENTS (TRACE)	Unknown	R.T.	X	

1. Consult Technical Service on temperatures higher than 150°F.
2. Recommendation based on successful case histories.

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
HYDROCHLORIC ACID (DILUTE), VINYL CHLORIDE, WATER	Unknown	R.T.	X	
HYDROFLUORIC ACID[1]	15%	R.T.		X
HYDROGEN PEROXIDE[2]	1%	R.T.		X
HYPOCHLOROUS ACID[2]				X
ISOPHORONE	100%	113	X	
ISOPROPYL ALCOHOL, HYDROCHLORIC ACID (DILUTE), SODIUM HYDROXIDE, MALEIC ACID, FUMARIC ACID, o-DICHLOROBENZENE	Unknown	190	X	
ISOPROPYL ALCOHOL, MALEIC ACID (DILUTE)	Unknown	190	X	
ISOPROPYL ALCOHOL, SODIUM HYDROXIDE, o-DICHLOROBENZENE, MALEIC ACID, FUMARIC ACID	Unknown	190	X	
ISOPROPYL ETHER	100%	113	X	
ISOPROPYL MYRISTATE, SULFURIC ACID	95:5	185	X	
KELEX LIGAND (SOLVENT EXTRACTION), SULFURIC ACID, KEROSENE	Unknown	75	X	
KEROSENE	100% 100% 100%	R.T. 150 B.P.(266)	X X X	
KEROSENE, GAS OIL, MINERAL SPIRIT, PENTACHLOROPHENOL	32:31:32:5	150	X	
KEROSENE, SULFURIC ACID, KELEX LIGAND	Unknown	75	X	
LIGAND, KELEX (SOLVENT EXTRACTION); SULFURIC ACID; KEROSENE	Unknown	75	X	
LITHIUM CHLORIDE	34%	B.P.(280)	X	
MAGNEFITE ACID PULP MILL LIQUOR[3]	- -	R.T. 150	X X	
MALEIC ACID, FUMARIC ACID, SODIUM HYDROXIDE, SODIUM BISULFITE, HEPTANE, HEXANE, HEAVY ALCOHOLS (pH 1-12)	Unknown	190	X	

1. Consult Technical Service on hydrofluoric acid applications.
2. Maximum allowable concentrations have not been defined. QuaCorr service at low concentrations may be satisfactory. Testing is recommended.
3. Consult Technical Service on temperatures higher than 150°F.

(continued)

TABLE 1.13: FIBERGLASS REINFORCED FURAN POLYMER—QUAKER OATS CHEMICALS (continued)

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
MALEIC ACID, HYDROCHLORIC ACID (DILUTE), SODIUM HYDROXIDE, FUMARIC ACID, o-DICHLOROBENZENE, ISOPROPYL ALCOHOL	Unknown	190	X	
MALEIC ACID (DILUTE), ISOPROPYL ALCOHOL	Unknown	190	X	
MALEIC ACID, SODIUM HYDROXIDE, FUMARIC ACID, o-DICHLOROBENZENE, ISOPROPYL ALCOHOL	Unknown	190	X	
METHACRYLATES, SULFURIC ACID, ACRYLIC ACID, METHANOL, WATER[1]	5:60:6:5:24	176	X	
METHALLYL CHLORIDE	Crude	185	X	
METHALLYL CHLORIDE, SODIUM CARBONATE, TRIETHYLAMINE SALTS, METHALLYL ETHER OF o-NITROPHENOL, WATER	Unknown	170	X	
METHALLYL ETHER OF o-NITROPHENOL (CRUDE), METHALLYL CHLORIDE, SODIUM CARBONATE, TRIETHYLAMINE SALTS, WATER	Unknown	170	X	
METHANOL	100%	B.P.(150)	X	
METHANOL, ACETIC ACID, SODIUM CHLORIDE, POTASSIUM CHLORIDE, XYLENE, ACETIC ANHYDRIDE, DICHLOROPHENOL, SODIUM HYDROXIDE, BROMODICHLOROPHENOL, TRICHLOROBENZENE	Unknown	150	X	
METHANOL, SULFURIC ACID, ACRYLIC ACID, METHACRYLATES, WATER[1]	5:60:6:5:24	176	X	
METHYLATED SPIRIT, INDUSTRIAL	100% 100%	R.T. 150	X X	
METHYL CELLOSOLVE	100%	113	X	
METHYLENE CHLORIDE[1]	100%	100	X	
METHYL ETHYL KETONE	100% 100% 100%	R.T. 150 B.P.(176)	X X X	
METHYL ISOBUTYL KETONE	100% 100%	R.T. 200	X X	

1. Recommendation based on successful case histories.

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
METHYL PARATHION, FUNDAL	50:50	120	X	
METHYL SULFATE	100%	150	X	
METHYLSULFONIC ACID[1]	70%	150		X
MINERAL SPIRIT, GAS OIL, KEROSENE, PENTACHLOROPHENOL	32:31:32:5	150	X	
MONOCHLOROBENZENE	100% 100% 100%	R.T. 150 B.P.(270)	X X X	
MONOETHANOLAMINE	100%	113	X	
MORPHOLINE	100%	150	X	
NAPTHA	100%	150	X	
NITRIC ACID[2]	5% 5%	R.T. 150	X X	
NITROBENZENE	97%	150	X	
NITRO COMPOUNDS, AMINES (ORGANIC), HYDROCHLORIC ACID	Unknown	R.T.	X	
OLEUM (CONC. H_2SO_4)				X
PENTACHLOROPHENOL, GAS OIL, KEROSENE, MINERAL SPIRIT	5:31:32:32	150	X	
PERCHLOROETHYLENE	100% 100% 100% 100%	R.T. 150 235-250 B.P.(250)	X X X X	
PESTICIDE (FUNDAL)[3]		150	X	
PHENOL	5% 80%[4]	150 150	X	 X
PHENOLIC RESIN	100%	R.T.	X	
PHOSPHORIC ACID	15% 15% 15% 90%	R.T. 150 B.P.(214) 150	X X X	 X

1. Maximum allowable concentrations have not been defined. QuaCorr service at lower concentrations may be satisfactory. Testing is recommended.
2. Not recommended for concentrations over 5%.
3. 1 part Fundal to 7 parts water.
4. Not recommended at high concentrations or high temperatures. Consult Technical Service for concentrations above 5% and temperatures in excess of 150°F.

(continued)

TABLE 1.13: FIBERGLASS REINFORCED FURAN POLYMER—QUAKER OATS CHEMICALS (continued)

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
PHOSPHORIC ACID SCRAP LIQUOR (pH 1-3), SODIUM PHOSPHATE	Unknown	200	X	
PHOSPHOROUS ACID, HYDROCHLORIC ACID, WATER	75:6:19	R.T.	X	
	75:6:19	150	X	
PHOSPHOROUS BROMIDE[1]				X
PHOSPHOROUS CHLORIDE	Sat.	150	X	
PHOSPHORUS OXYCHLORIDE (PHOSPHORYL CHLORIDE)	100%	R.T.	X	
	100%	150	X	
POTASSIUM CARBONATE	Sat.	150	X	
POTASSIUM CHLORIDE, SODIUM CHLORIDE, XYLENE, DICHLOROPHENOL, ACETIC ACID, BROMODICHLOROPHENOL, ACETIC ANHYDRIDE, SODIUM HYDROXIDE, METHANOL, TRI-CHLOROBENZENE	Unknown	150	X	
POTASSIUM FERRICYANIDE	Sat.	150	X	
POTASSIUM HYDROXIDE	50%	R.T.	X	
	50%	150	X	
POTASSIUM PERMANGANATE[1]	Sat.	150		X
POTASSIUM PEROXIDE[1]				X
POTASSIUM PYROPHOSPHATE (TKPP)[2]	60%	R.T.	X	
	60%	150	X	
PULP MILL LIQUOR (BLACK)[3]	-	R.T.	X	
	-	150	X	
PULP MILL LIQUOR (GREEN)[3]	-	R.T.	X	
	-	150	X	
PULP MILL LIQUOR (RED)[3]	-	R.T.	X	
	-	150	X	
PULP MILL LIQUOR (WHITE)[3]	-	R.T.	X	
	-	150	X	
PYRIDINE	10%	150	X	
	50%	150		X
	100%	R.T.		X

1. Maximum allowable concentrations have not been defined. QuaCorr service at low concentrations may be satisfactory. Testing is recommended.
2. Tested in combination with other media.
3. Consult Technical Service on temperatures higher than 150°F.

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
QUATERNARY AMMONIUM SALTS	Varied	200	X	
RED PULP MILL LIQUOR[1]	-	R.T.	X	
	-	150	X	
SILICON TETRACHLORIDE	100%	R.T.	X	
SLIMETROL	100%	150	X	
SLIMICIDE	100%	150	X	
SODIUM BISULFITE, MALEIC ACID, FUMARIC ACID, SODIUM HYDROXIDE, HEPTANE, HEXANE, HEAVY ALCOHOLS (pH 1-12)	Unknown	190	X	
SODIUM CARBONATE	10%	R.T.	X	
	10%	150	X	
	10%	B.P.(214)	X	
	Sat.	150	X	
SODIUM CARBONATE, METHALLYL CHLORIDE, METHALLYL ETHER OF o-NITROPHENOL, TRIETHYLAMINE SALTS, WATER	Unknown	170	X	
SODIUM CARBONATE, SODIUM HYDROSULFIDE (2.5%), SULFUROUS ACID	Unknown	176	X	
SODIUM CHLORIDE	Sat.	R.T.	X	
	Sat.	150	X	
	Sat.	B.P.(225)	X	
SODIUM CHLORIDE, POTASSIUM CHLORIDE, XYLENE, DICHLOROPHENOL, ACETIC ACID, BROMODICHLOROPHENOL, ACETIC ANHYDRIDE, SODIUM HYDROXIDE, METHANOL, TRI-CHLOROBENZENE	Unknown	150	X	
SODIUM CHROMATE	Sat.	150	X	
SODIUM HYDROXIDE	5%	R.T.	X	
	5%	150	X	
	10%	150	X	
	20%	R.T.	X	
	20%	150	X	
	25%	150	X	
	50%	150	X	
SODIUM HYDROXIDE (3-13%), o-DICHLORO-BENZENE (pH > 10)	Unknown	190	X	

1. Consult Technical Service on temperatures higher than 150°F.

(continued)

TABLE 1.13: FIBERGLASS REINFORCED FURAN POLYMER—QUAKER OATS CHEMICALS (continued)

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
SODIUM HYDROXIDE, o-DICHLOROBENZENE, ISOPROPYL ALCOHOL, MALEIC ACID, FUMARIC ACID	Unknown	190	X	
SODIUM HYDROXIDE, HYDROCHLORIC ACID (DILUTE, MALEIC ACID, FUMARIC ACID, o-DICHLOROBENZENE, ISOPROPYL ALCOHOL	Unknown	190	X	
SODIUM HYDROXIDE, MALEIC ACID, FUMARIC ACID, SODIUM BISULFITE, HEPTANE, HEXANE, HEAVY ALCOHOLS, (pH 1-12)	Unknown	190	X	
SODIUM HYDROXIDE, SODIUM CHLORIDE, ACETIC ACID, POTASSIUM CHLORIDE, XYLENE, DICHLOROPHENOL, BROMODICHLOROPHENOL, ACETIC ANHYDRIDE, METHANOL, TRICHLOROBENZENE	Unknown	150	X	
SODIUM HYPOCHLORITE[1.]	.1%	R.T.	X	
SODIUM PHOSPHATE, PHOSPHORIC ACID SCRAP LIQUOR (pH 1-3)	Unknown	200	X	
SODIUM SULFIDE (HYDRO)	2%	176	X	
SODIUM SULFIDE-HYDRO (2.5), SODIUM CARBONATE, SULFUROUS ACID	Unknown	176	X	
STANNIC CHLORIDE	100%	150	X	
STYRENE	100%	R.T.	X	
SULFONIC ACID (CONCENTRATED), SULFURIC ACID, SULFUR DIOXIDE	Unknown	160-180	X	
SULFUR, MOLTEN	-	300	X	
SULFUR, HYDROCHLORIC ACID, SULFUR MONOCHLORIDE (VAPORS)	Unknown	200	X	
SULFUR CHLORIDE (MONO)	100%	150	X	
SULFUR DIOXIDE, SULFONIC ACID, SULFURIC ACID	Unknown	160-180	X	
SULFUR MONOCHLORIDE (VAPORS), SULFUR, HYDROCHLORIC ACID	Unknown	200	X	
SULFUR TRIOXIDE[2.]				X

1. Not recommended at higher concentrations.
2. Maximum allowable concentrations have not been defined. QuaCorr service at low concentrations may be satisfactory. Testing is recommended.

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
SULFURIC ACID	25%	R.T.	X	
	25%	150	X	
	25%	B.P.(216)	X	
	50%[1.]	150	X	
	50%[1.]	250	X	
	60%[2.]	150		X
SULFURIC ACID, ACRYLIC ACID, METHANOL, METHACRYLATES, WATER[1.]	60:6:5:5:24	176	X	
SULFURIC ACID, ISOPROPYL MYRISTATE	5:95	185	X	
SULFURIC ACID, KEROSENE, KELEX LIGAND	Unknown	75	X	
SULFURIC ACID, SULFONIC ACID, SULFUR DIOXIDE	Unknown	160-180	X	
SULFUROUS ACID, SODIUM HYDROSULFIDE (2.5%), SODIUM CARBONATE	Unknown	176	X	
TETRAHYDROFURAN	100%	R.T.	X	
TETRAHYDROFURFURYL ALCOHOL	100%	R.T.	X	
TETRAPOTASSIUM PYROPHOSPHATE	60%	R.T.	X	
	60%	150	X	
THIONYL CHLORIDE	100%	R.T.	X	
TOLUENE	100%	R.T.	X	
	100%	150	X	
	100%	B.P.(230)	X	
TOLUENE DIISOCYANATE	100%	R.T.	X	
TOLUENE SULFONIC ACID (IN WATER)	70%	R.T.	X	
	85%	R.T.	X	
TOLUENE SULFONIC ACID (IN METHANOL)	70%	R.T.	X	
TOLUENE SULFONIC ACID (PARA)	100%	180	X	
TRICHLOROACETIC ACID	50%	R.T.	X	
TRICHLOROBENZENE, ACETIC ACID, SODIUM CHLORIDE, POTASSIUM CHLORIDE, XYLENE, DICHLOROPHENOL, BROMODICHLOROPHENOL, ACETIC ANHYDRIDE, SODIUM HYDROXIDE, METHANOL	Unknown	150	X	

1. Recommendation based on successful case histories.
2. Sulfuric acid recommended to maximum of 50% concentration and 250°F.

(continued)

TABLE 1.13: FIBERGLASS REINFORCED FURAN POLYMER—QUAKER OATS CHEMICALS (continued)

QUACORR MEDIA GUIDE

MEDIA	CONCENTRATION	TEST TEMP. °F	S	U
TRICHLOROETHANE (1,1,1)	100%	R.T.	X	
TRICHLOROETHANE (MIXED ISOMERS)	100%	R.T.	X	
TRICHLOROETHANE, CHLORINATED SOLVENTS (TRACE), HYDROCHLORIC ACID (DILUTE)	Unknown	R.T.	X	
TRICHLOROETHYLENE	100% 100%	150 B.P.(189)	X X	
TRIETHANOLAMINE	100%	113	X	
TRIETHYLAMINE SALTS, METHYL ETHER OF o-NITROPHENOL, METHALLYL CHLORIDE, SODIUM CARBONATE, WATER	Unknown	170	X	
TRISODIUM PHOSPHATE	Sat.	150	X	
VINYL CHLORIDE, HYDROCHLORIC ACID (DILUTE), WATER	Unknown	R.T.	X	
WATER (DEMINERALIZED)	100% 100% 100%	R.T. 150 B.P.(212)	X X X	
WATER (DISTILLED)	100% 100%	150 B.P.(212)	X X	
WHITE PULP MILL LIQUOR[1].	- -	R.T. 150	X X	
XYLENE (MIXED ISOMERS)	100%	B.P.(284)	X	
XYLENE, SODIUM CHLORIDE, POTASSIUM CHLORIDE, DICHLOROPHENOL, ACETIC ACID, BROMODICHLOROPHENOL, ACETIC ANHYDRIDE, SODIUM HYDROXIDE, METHANOL, TRICHLOROBENZENE	Unknown	150	X	
ZIRCONIUM RAFFINATE (ZIRCONIUM OXYCHLORIDE, HCl, MIBK, THIOCYANIC ACID)	100%	R.T.	X	
ZIRCONIUM RAFFINATE (ZIRCONIUM OXYCHLORIDE, HCl, MIBK, THIOCYANIC ACID)	100%	150	X	

1. Consult Technical Service on temperatures higher than 150°F.

TABLE 1.14: FIBERGLASS REINFORCED ISOPHTHALIC POLYESTER AND VINYL ESTER—MORRISON MOLDED FIBER GLASS

EXTREN is a proprietary combination of fiberglass reinforcements and thermosetting polyester or vinyl ester resin systems produced in standard structural shapes and sheets by Morrison Molded Fiber Glass Company. EXTREN is widely used in industrial construction and maintenance, commercial construction, and as components of industrial equipment and commercial products. The information below is based on data collected from several years of actual industrial applications. In addition it is based on conservative evaluation of the changes which occur in certain properties of replicate laminates after exposures of one year or longer, both in the laboratory and the field, according to the American Society for Testing Materials (ASTM C-581). These properties include hardness, flexural strength, and flexural modulus. Surface stability is also a major characteristic and must be evaluated.

CHEMICAL RESISTANCE – EXTREN

Series 500 and 525—Isophthalic polyester
Series 625—Vinyl ester

NR = Not resistant
R = Resistant

	SERIES 500-525		SERIES 625	
CHEMICAL	R T	160°F	R T	160°F
Acetaldehyde	NR	NR	NR	NR
Acetic Acid 0-25%	R	R	R	R
Acetic Acid 25-50%	R	NR	R	R
Acetic Anhydride	NR	NR	NR	NR
Acetone	NR	NR	NR	NR
Acrylonitrile	NR	NR	NR	NR
Alcohol, Butyl	NR	NR	R	NR
Alcohol, Ethyl 10%	NR	NR	R	150°
Alcohol, Ethyl 100%	NR	NR	R	NR
Alcohol, Isopropyl 10%	NR	NR	R	150°
Alcohol, Isopropyl 100%	NR	NR	R	NR
Alcohol, Methyl 10%	NR	NR	R	150°
Alcohol, Methyl 100%	NR	NR	NR	NR
Alcohol, Methyl Isobutyl	NR	NR	R	150°
Alcohol, Secondary Butyl	NR	NR	R	150°
Alum	R	R	R	R
Aluminum Chloride	R	R	R	R
Aluminum Hydroxide 5%	R	NR	R	120°
Aluminum Nitrate	R	R	R	R
Aluminum Potassium Sulfate	R	R	R	R
Ammonia, Aqueous 0-10%	NR	NR	R	100°
Ammonia, Gas	NR	NR	R	100°
Ammonium Bicarbonate	R	NR	R	120°
Ammonium Bisulfite	NR	NR	R	120°
Ammonium Carbonate	NR	NR	R	120°
Ammonium Citrate	R	NR	R	120°
Ammonium Flouride	NR	NR	R	100°
Ammonium Hydroxide 5%	R	NR	R	120°
Ammonium Hydroxide 10%	R	NR	R	120°
Ammonium Hydroxide 20%	NR	NR	R	120°
Ammonium Nitrate	R	R	R	R
Ammonium Persulfate	NR	NR	R	120°
Ammonium Phosphate	NR	NR	R	120°
Ammonium Sulfate	R	R		R
Arsenious Acid	R	NR	R	R
0-Benzoyl Benzoic Acid	NR	NR	R	R
Barium Acetate	NR	NR	R	R
Barium Carbonate	R	NR	R	R
Barium Chloride	R	NR	R	R
Barium Hydroxide	NR	NR	R	120°
Barium Sulfate	R	R	R	R
Barium Sulfide	NR	NR	R	R
Beer	R	NR	R	120°
Benzene	NR	NR	NR	NR
5% Benzene in Kerosene	R	NR	R	R
Benzene Sulfonic Acid	R	R	R	R
Benzoic Acid	R	NR	R	R
Benzyl Alcohol	NR	NR	R	R
Benzyl Chloride	NR	NR	NR	NR
Brass Plating Solution: (3% Copper Cyanide 6% Sodium Cyanide 1% Zinc Cyanide 3% Sodium Carbonate)	NR	NR	R	R
Butyl Acetate	NR	NR	NR	NR
Butyric Acid 0-50%	R	NR	R	R
Butylene Glycol	R	R	R	R
Cadmium Chloride	R	NR	R	R
Cadmium Cyanide Plating Solution: (3% Cadmium Oxide 10% Sodium Cyanide 1% Caustic Soda)	NR	NR	R	120°
Calcium Bisulfite	R	R	R	R
Calcium Carbonate	R	NR	R	R
Calcium Chlorate	R	R	R	R
Calcium Chloride	R	R	R	R

(continued)

TABLE 1.14: FIBERGLASS REINFORCED ISOPHTHALIC POLYESTER AND VINYL ESTER–MORRISON MOLDED FIBER GLASS (continued)

	SERIES 500-525		SERIES 625	
CHEMICAL	R.T.	160°F	R.T.	160°F
Calcium Hydroxide	R	NR	R	120°
Calcium Hypochlorite	R	NR	R	120°
Calcium Nitrate	R	R	R	R
Calcium Sulfate	R	R	R	R
Calcium Sulfite	R	R	R	R
Caprylic Acid	R	NR	R	R
Carbon Dioxide	R	R	R	R
Carbon Disulfide	NR	NR	NR	NR
Carbon Monoxide	R	R	R	R
Carbon Tetrachloride	NR	NR	R	100°
Carbonic Acid	R	NR	R	R
Castor Oil	R	R	R	R
Carbon Methyl Cellulose	NR	NR	R	120°
Chlorinated Wax	NR	NR	R	R
Chlorine Dioxide/Air	R	NR	R	R
Chlorine Dioxide, Wet Gas	NR	NR	R	R
Chlorine, Dry Gas	NR	NR	R	R
Chlorine, Wet Gas	NR	NR	R	R
Chlorine, Liquid	NR	NR	NR	NR
Chlorine, Water	NR	NR	R	R
Chloroacetic Acid 0-50%	NR	NR	R	100°
Chlorobenzene	NR	NR	NR	NR
Chloroform	NR	NR	NR	NR
Chlorosulfonic Acid	NR	NR	NR	NR
Chromic Acid 20%	NR	NR	R	R
Chromic Acid 30%	NR	NR	NR	NR
Chromium Sulfate	R	R	R	R
Citric Acid	R	R	R	R
Coconut Oil	R	NR	R	R
Copper Chloride	R	R	R	R
Copper Cyanide	NR	NR	R	R
Copper Fluoride	NR	NR	R	R
Copper Nitrate	R	R	R	R
Copper Plating Solution: (Copper Cyanide 10.5% Copper 14% Copper Cyanide 6% Rochelle Salts)	NR	NR	R	R
Copper Brite Plating (Caustic Cyanide)	NR	NR	R	120°
Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	NR	NR	R	R
Copper Matte Dipping Bath: (30% Ferric Chloride 19% Hydrochloric)	NR	NR	R	R

	SERIES 500-525		SERIES 625	
CHEMICAL	R.T.	160°F	R.T.	160°F
Copper Pickling Bath: (10% Ferric Sulfate 10% Sulfuric Acid)	NR	NR	R	R
Copper Sulfate	R	R	R	R
Corn Oil	R	NR	R	R
Corn Starch — Slurry	R	NR	R	R
Corn Sugar	R	R	R	R
Cottonseed Oil	R	NR	R	R
Crude Oil, Sour	R	NR	R	R
Crude Oil, Sweet	R	NR	R	R
Cyclohexane	R	NR	R	R
Detergents, Sulfonated	R	NR	R	R
Di-Ammonium Phosphate	NR	NR	R	R
Dibromophenol	NR	NR	NR	NR
Dibutyl Ether	NR	NR	R	NR
Dichloro Benzene	NR	NR	NR	NR
Dichloroethylene	NR	NR	NR	NR
Diesel Fuel	R	NR	R	R
Diethylene Glycol	R	NR	R	R
Dimethyl Phthalate	NR	NR	R	R
Dioctyl Phthalate	NR	NR	R	R
Dipropylene Glycol	R	NR	R	R
Dodecyl Alcohol	NR	NR	R	R
Esters, Fatty Acids	R	R	R	R
Ethyl Acetate	NR	NR	NR	NR
Ethyl Benzene	NR	NR	NR	NR
Ethyl Ether	NR	NR	NR	NR
Ethylene Glycol	R	R	R	R
Ethylene Dichloride	NR	NR	NR	NR
Fatty Acids	R	R	R	R
Ferric Chloride	R	R	R	R
Ferric Nitrate	R	R	R	R
Ferric Sulfate	R	R	R	R
Ferrous Chloride	R	R	R	R
Ferrous Nitrate	R	R	R	R
Ferrous Sulfate	R	R	R	R
8-8-8 Fertilizer	R	NR	R	R
Fertilizer (Urea Ammonium Nitrate)	NR	NR	R	120°
Flue Gas	NR	NR	R	R
Fluoboric Acid	NR	NR	R	120°
Fluosilicic Acid 0-20%	NR	NR	R	R
Formaldehyde	R	NR	R	R
Formic Acid	R	NR	R	R

(continued)

TABLE 1.14: FIBERGLASS REINFORCED ISOPHTHALIC POLYESTER AND VINYL ESTER—MORRISON MOLDED FIBER GLASS (continued)

CHEMICAL	SERIES 500-525 R T	SERIES 500-525 160°F	SERIES 625 R T	SERIES 625 160°F
Fuel Oil	R	NR	R	R
Gas, Natural	R	NR	R	R
Gasoline, Auto	R	NR	R	R
Gasoline, Aviation	R	NR	R	R
Gasoline, Ethyl	R	NR	R	R
Gasoline, Sour	R	NR	R	R
Gluconic Acid	R	NR	R	R
Glucose	R	R	R	R
Glycerine	R	R	R	R
Glycol, Ethylene	R	R	R	R
Glycol, Propylene	R	R	R	R
Glycolic Acid	R	NR	R	R
Gold Plating Solution: (63% Potassium Ferrocyanide .2% Potassium Gold Cyanide .8% Sodium Cyanide)	NR	NR	R	R
Heptane	R	NR	R	R
Hexane	R	NR	R	R
Hexylene Glycol	R	R	R	R
Hot Stack Gasses	—	NR	—	340°
Hydraulic Fluid	R	NR	R	R
Hydrobromic Acid 0-25%	R	NR	R	R
Hydrochloric Acid 0-37%	R	NR	R	R
Hydrocyanic Acid	R	NR	R	R
Hydrofluoric Acid 10%	NR	NR	R	120°
Hydrofluosilicic Acid	NR	NR	R	R
Hydrogen Bromide, Wet Gas	NR	NR	R	R
Hydrogen Chloride, Dry Gas	NR	NR	R	R
Hydrogen Chloride, Wet Gas	NR	NR	R	R
Hydrogen Peroxide	NR	NR	R	120°
Hydrogen Sulfide Dry	R	NR	R	R
Hydrogen Sulfide, Aqueous	R	NR	R	R
Hydrogen Fluoride, Vapor	NR	NR	R	R
Hydrosulfite Bleach	NR	NR	R	120°
Hypochlorous Acid 0-10%	NR	NR	R	R
Iron Plating Solution: (45% $FeCl_2$, 15% $CaCl_2$ 20% $FeSO_4$: 11% $(NH_4)_2SO_4$)	NR	NR	R	R
Iron and Steel Cleaning Bath (9% Hydrochloric 23% Sulfuric)	NR	NR	R	R
Isopropyl Amine	NR	NR	R	NR
Isopropyl Palmitate	R	R	R	R
Jet Fuel	R	NR	R	R

CHEMICAL	SERIES 500-525 R T	SERIES 500-525 160°F	SERIES 625 R T	SERIES 625 160°F
Kerosene	R	NR	R	R
Lactic Acid	R	NR	R	R
Laural Chloride	NR	NR	R	R
Lauric Acid	R	NR	R	R
Lead Acetate	R	NR	R	R
Lead Nitrate	R	NR	R	R
Lead Plating Solution: (.8% Fluoboric Acid .4% Boric Acid)	NR	NR	R	R
Levulinic Acid	R	NR	R	R
Linseed Oil	R	R	R	R
Lithium Bromide	R	R	R	R
Lithium Sulfate	R	R	R	R
Magnesium Bisulfite	R	NR	R	R
Magnesium Carbonate	R	NR	R	R
Magnesium Chloride	R	R	R	R
Magnesium Hydroxide	NR	NR	R	140°
Magnesium Sulfate	R	R	R	R
Maleic Acid	R	R	R	R
Mercuric Chloride	R	NR	R	R
Mercurous Chloride	R	NR	R	R
Methylene Chloride	NR	NR	NR	NR
Methyl Ethyl Ketone	NR	NR	NR	NR
Methyl Isobutyl Carbitol	NR	NR	NR	NR
Methanol (see alcohol)	R	NR	R	R
Methyl Isobutyl Ketone	NR	NR	NR	NR
Methyl Styrene	NR	NR	NR	NR
Mineral Oils	R	R	R	R
Molybdenum Disulfide	R	NR	R	R
Monochloro Acetic Acid	NR	NR	NR	NR
Monoethanolamine	NR	NR	NR	NR
Motor Oil	R	R	R	R
Myristic Acid	—	—	R	R
Naphtha	R	R	R	R
Naphthalene	R	NR	R	R
Nickel Chloride	R	R	R	R
Nickel Nitrate	R	R	R	R
Nickel Plating: (8% Lead .8% Fluoboric Acid 4% Boric Acid)	NR	NR	R	R
Nickel Plating: (11% Nickel Sulfate 2% Nickel Chloride 1% Boric Acid)	R	NR	R	R

(continued)

TABLE 1.14: FIBERGLASS REINFORCED ISOPHTHALIC POLYESTER AND VINYL ESTER—MORRISON MOLDED FIBER GLASS (continued)

CHEMICAL	SERIES 500-525 R T	SERIES 500-525 160°F	SERIES 625 R T	SERIES 625 160°F
Nickel Plating: (44% Nickel Sulfate 4% Ammonium Chloride 4% Boric Acid)	R	NR	R	R
Nickel Sulfate	R	R	R	R
Nitric Acid 0-5%	R	R	R	R
Nitric Acid 20%	NR	NR	R	120°
Nitric Acid Fumes	NR	NR	R	R
Nitrobenzene	NR	NR	NR	NR
Octanoic Acid	R	NR	R	R
Oil, Sour Crude	R	R	R	R
Oil, Sweet Crude	R	R	R	R
Oleic Acid	R	R	R	R
Oleum (Fuming Sulfuric)	NR	NR	NR	NR
Olive Oil	R	R	R	R
Oxalic Acid	R	R	R	R
Peroxide Bleach (2% Sodium Peroxide 96% .025% Epsom Salts 5% Sodium Silicate, 42°BE 1.4% Sulfuric Acid, 66°BE)	R	R	R	R
Phenol	NR	NR	NR	NR
Phenol Sulfonic Acid	NR	NR	NR	NR
Phosphoric Acid	R	R	R	R
Phosphoric Acid Fumes	R	R	R	R
Phosphorous Pentoxide	R	R	R	R
Phosphorous Trichloride	NR	NR	NR	NR
Phthalic Acid	R	R	R	R
Pickling Acids (Sulfuric and Hydrochloric)	R	R	R	R
Picric Acid, Alcoholic	R	R	R	R
Polyvinyl Acetate Latex	R	NR	R	R
Polyvinyl Alcohol	R	NR	R	R
Polyvinyl Chloride Latex w/35 (Parts DOP)	NR	NR	R	120°
Potassium Aluminum Sulfate	R	R	R	R
Potassium Bicarbonate	R	NR	R	140°
Potassium Bromide	R	NR	R	R
Potassium Carbonate	R	NR	R	140°
Potassium Chloride	R	R	R	R
Potassium Dichromate	R	NR	R	140°
Potassium Ferricyanide	R	R	R	R
Potassium Ferrocyanide	R	R	R	R
Potassium Hydroxide	NR	NR	R	120°
Potassium Nitrate	R	R	R	R

CHEMICAL	SERIES 500-525 R T	SERIES 500-525 160°F	SERIES 625 R T	SERIES 625 160°F
Potassium Permanganate	R	NR	R	140°
Potassium Persulfate	R	NR	R	R
Potassium Sulfate	R	R	R	R
Propionic Acid 1-50%	NR	NR	R	120°
Propionic Acid 50-100%	NR	NR	NR	NR
Propylene Glycol	R	R	R	R
Pulp Paper Mill Effluent	R	NR	R	R
Pyridine	NR	NR	NR	NR
Salicylic Acid	NR	NR	R	R
Sebacic Acid	NR	NR	R	R
Selenous Acid	NR	NR	R	R
Silver Nitrate	R	R	R	R
Silver Plating Solution: (4% Silver Cyanide 7% Potassium Cyanide 5% Sodium Cyanide 2% Potassium Carbonate)	NR	NR	R	R
Soaps	R	NR	R	R
Sodium Acetate	R	NR	R	R
Sodium Benzoate	R	NR	R	R
Sodium Bicarbonate	R	R	R	R
Sodium Bifluoride	R	NR	R	R
Sodium Bisulfate	R	R	R	R
Sodium Bisulfite	R	R	R	R
Sodium Bromate	R	R	R	R
Sodium Bromide	R	R	R	R
Sodium Carbonate 0-25%	R	NR	R	R
Sodium Chlorate	R	NR	R	R
Sodium Chloride	R	R	R	R
Sodium Chlorite	R	NR	R	R
Sodium Chromate	R	R	R	R
Sodium Cyanide	R	NR	R	R
Sodium Dichromate	R	R	R	R
Sodium Di-Phosphate	R	R	R	R
Sodium Ferricyanide	R	R	R	R
Sodium Ferrocyanide	R	R	R	R
Sodium Fluoride	NR	NR	R	120°
Sodium Fluoro Silicate	NR	NR	R	120°
Sodium Hexametaphosphates	NR	NR	R	120°
Sodium Hydroxide 0-5%	NR	NR	R	120°
Sodium Hydroxide 5-25%	NR	NR	R	120°
Sodium Hydroxide 50%	NR	NR	R	NR

(continued)

TABLE 1.14: FIBERGLASS REINFORCED ISOPHTHALIC POLYESTER AND VINYL ESTER–MORRISON MOLDED FIBER GLASS (continued)

CHEMICAL	SERIES 500-525 R.T.	SERIES 500-525 160°F	SERIES 625 R.T.	SERIES 625 160°F
Sodium Hydrosulfide	R	NR	R	R
Sodium Hypochlorite	R	NR	R	120°
Sodium Lauryl Sulfate	R	NR	R	R
Sodium Mono-Phosphate	R	R	R	R
Sodium Nitrate	R	R	R	R
Sodium Silicate	R	NR	R	R
Sodium Sulfate	R	R	R	R
Sodium Sulfide	R	NR	R	R
Sodium Sulfite	R	NR	R	R
Sodium Tetra Borate	R	R	R	R
Sodium Thiocyanate	NR	NR	R	R
Sodium Thiosulfate	R	NR	R	R
Sodium Tripolyphosphate	R	NR	R	R
Sodium Xylene Sulfonate	R	NR	R	R
Sorbitol Solutions	R	NR	R	R
Sour Crude Oil	R	R	R	R
Soya Oil	R	R	R	R
Stannic Chloride	R	R	R	R
Stannous Chloride	R	R	R	R
Stearic Acid	R	R	R	R
Styrene	NR	NR	NR	NR
Sugar, Beet and Cane Liquor	R	NR	R	R
Sugar, Sucrose	R	R	R	R
Sulfamic Acid	R	NR	R	R
Sulfanilic Acid	R	NR	R	R
Sulfated Detergents	R	NR	R	R
Sulfur Dioxide, Dry or Wet	NR	NR	R	R
Sulfur Trioxide/Air	NR	NR	R	R
Sulfuric Acid 0-30%	R	R	R	R
Sulfuric Acid 30-50%	NR	NR	R	R
Sulfuric Acid 50-70%	NR	NR	R	120°
Sulfurous Acid	NR	NR	R	100°
Superphosphoric Acid (76% P_2O_5)	R	NR	R	R
Tall Oil	R	NR	R	140°
Tannic Acid	R	NR	R	120°
Tartaric Acid	R	R	R	R
Thionyl Chloride	NR	NR	NR	NR
Tin Plating (18% Stannous Fluoroborate, 7% Tin, 9% Fluoroboric Acid, 2% Boric Acid)	NR	NR	R	R
Toluene	NR	NR	NR	NR
Toluene Sulfonic Acid	NR	NR	R	R
Transformer Oils:				
(Mineral Oil Types	R	R	R	R
Chloro-Phenyl Types)	NR	NR	NR	NR
Trichlor Acetic Acid	R	NR	R	R
Trichlorethylene	NR	NR	NR	NR
Trichlorophenol	NR	NR	NR	NR
Tricresyl Phosphate	NR	NR	R	100°
Tridecylbenzene Sulfonate	R	NR	R	R
Trisodium Phosphate	R	NR	R	R
Turpentine	NR	NR	R	100°
Urea	R	NR	R	140°
Vegetable Oils	R	R	R	R
Vinegar	R	R	R	R
Vinyl Acetate	NR	NR	NR	NR
Water				
Deionized	R	R	R	R
Demineralized	R	R	R	R
Distilled	R	R	R	R
Fresh	R	R	R	R
Salt	R	R	R	R
Sea	R	R	R	R
White Liquor (Pulp Mill)	R	NR	R	R
Xylene	NR	NR	NR	NR
Zinc Chlorate	R	R	R	R
Zinc Nitrate	R	R	R	R
Zinc Plating Solution: (9% Zinc Cyanide, 4% Sodium Cyanide, 9% Sodium Hydroxide)	NR	NR	R	120°
Zinc Plating Solution: (49% Zinc Fluoroborate, 5% Ammonium Chloride, 6% Ammonium Fluoroborate)	R	NR	R	R
Zinc Sulfate	R	R	R	R

TABLE 1.15: FIBERGLASS REINFORCED POLYBUTYLENE TEREPHTHALATE—CELANESE PLASTICS

A series of thermoplastic polyesters, polybutylene terephthalate, was developed by Celanese and introduced under the trademark CELANEX. CELANEX® resins are highly crystalline, and exhibit a unique combination of properties including high strength, rigidity and toughness, low creep even at elevated temperatures, minimal moisture absorption and exceptional dimensional stability, resistance to the effects of a wide range of chemicals, oils, greases and solvents, excellent electrical properties and outstanding processing characteristics.

Chemical Resistance of CELANEX Glass-Reinforced Resins

Material	Time (Days)	Temp. °F	% Change Tensile Strength	% Change Weight	% Change Diameter*
Inorganic Chemicals					
10% Ammonium Hydroxide	90	73	−13	+0.6	+0.3
	180	73	−58	+0.3	0.0
	360	73	−73.5	+0.9	+0.6
	9	180	−92	+2.1	+0.3
	24	180	−99	−4.2	+0.1
1% Sodium Hydroxide	90	73	−47	+0.8	+0.6
	180	73	−72	+0.5	+0.1
	360	73	−84	+0.3	+0.7
	24	180	−96	−1.9	0.0
10% Sodium Chloride	90	73	−6	+0.3	+0.2
	180	73	−6	+0.2	+0.1
	360	73	−4	+0.4	+0.2
10% Hydrochloric Acid	90	73	−4	−0.1	+0.2
	180	73	−12	+0.1	+0.1
	360	73	−20	+0.2	+0.1
	24	180	−24	−0.6	0.0
	64	180	−68	−2.4	−1.0
3% Sulfuric Acid	90	73	−7	+0.2	+0.2
	180	73	−10	+0.2	−0.1
	360	73	−8	+0.2	+0.1
	24	180	−25	+0.2	+0.1
	64	180	−65	+0.2	+0.1
40% Sulfuric Acid	90	73	−2	+0.4	0.0
	180	73	−4	+0.0	+0.1
	360	73	−4	+0.1	+0.1
Water (Tap)	90	73	−5	−0.3	+0.1
	180	73	−3	+0.3	+0.1
	360	73	−5	+0.3	+0.1
	60	100	−3	—	—
Buffer, pH10	90	73	−6	+0.3	+0.1
	180	73	−9	0.0	+0.2
	360	73	−9	+0.7	+0.2
Buffer, pH 4	90	73	−4	+0.3	+0.1
	180	73	−7	+0.3	+0.1
	360	73	−8	+0.4	+0.1
Organic Chemicals					
5% Acetic Acid	90	73	0	+0.3	+0.2
	180	73	−5	+0.3	+0.1
	360	73	−5.5	+0.2	+0.2
	30	180	−41	+0.7	+0.2
	60	180	−77	+1.1	+0.2
Benzene	90	73	−4	+0.5	+0.1
	180	73	−4	+0.4	+0.1
	360	73	−4	+0.8	+0.2
	60	120	−29	+4.4	+0.5
	240	120	−40	+5.9	+0.9
Acetone	90	73	−15	+1.0	+0.2
	180	73	−20	+2.0	+0.2
	360	73	−27	+2.4	+0.6
	60	120	−35	+3.4	+0.7
	240	120	−32	+3.6	+0.7
Toluene	90	73	−8	—	+0.1
	180	73	−7	—	+0.1
	360	73	−8	+0.4	+0.1
	60	180	−36	+4.2	+0.8
	240	180	−39	+4.3	+0.8
BTX	90	73	−5	+0.4	+0.1
	180	73	−3	+0.5	+0.1
	360	73	−10	—	+0.1
Heptane	90	73	−4	+0.2	+0.0
	180	73	−4	+0.1	0.0
	360	73	−2	—	0.0
	60	180	−14	+0.5	+0.1
	240	180	−17	+0.6	+0.2
Carbon Tetrachloride	90	73	0	+0.1	0.0
	180	73	0	+0.1	0.0
	360	73	0	+0.1	+0.1
Diethyl Ether	90	73	−6	+0.3	+0.1
	180	73	−1	+0.3	+0.1
	360	73	−4	+0.5	+0.1
50% Ethylene Glycol/Water	90	73	−3	+0.3	+0.1
	180	73	−3	+0.4	+0.1
	360	73	−3	+0.3	+0.1
95% Ethanol/Water	24	180	−50	+2.4	+0.4
	90	73	−3	+0.2	+0.1
	180	73	−6	+0.3	+0.3
	360	73	−5	+0.4	+0.1
Perchloroethylene	60	180	−30	+6.5	+0.6
	180	180	−32	+6.7	+0.6
Freon 113	51	73	−1	+0.1	0.0
	180	73	−2	−0.1	0.0
	360	73	−3	−0.1	0.0
Gasoline (Amoco, Unleaded)	180	73	−1.6	+0.2	0.0
	360	73	−2.2	+0.2	+0.1
	135	140	−7.4	+1.4	+0.3
	240	140	−16.4	+1.9	+0.3
Automatic Transmission Fluid, (Type B)	180	73	−1	+0.1	+0.1
	360	73	−3	—	+.1
	30	200	−31	+0.3	0.0
	48	200	−51	+0.4	+.1
Delco 222 Brake Fluid	180	73	+1	0.0	0.0
	360	73	−1	—	+.1
	30	200	−43	+2.0	+0.3
	48	200	−60	−2.2	+.4
Motor Oil (10-20-40)	180	73	−3	+0.1	+0.1
	360	73	−3	—	+0.1
	60	200	−43	+0.2	0.0
	100	200	−61	+0.2	−0.1
Lubricating Grease	180	73	−6	—	+0.2
	360	73	−4	+0.1	+0.1
	60	200	−34	+0.1	−0.1
	100	200	−64	+0.3	−0.1
Hydraulic Fluid (Skydrol 500B)	180	73	0	0.0	0.0
	360	73	−1	—	+0.1
	60	180	−2	+0.3	+0.1
	240	180	−5.5	+0.5	+0.1
Turbine Lubricating Oil (Texaco Sato 15)	180	73	−0.5	−0.1	+0.1
	360	−17.3	—	—	+0.1
Houton - Cosmo Lubric 2425	180	73	+1	0.0	0.0
	360	73	−16.7	—	0.0
1% Soap Solution	180	73	−5	—	—
	360	73	−24	—	+0.1
Presoak Sol. (Axion)	180	73	−4	—	—
	360	73	−5	—	+0.1
Calgon Water Softener Sol.	180	73	−6	—	—
	360	73	−8	—	+0.1
Buffer, pH7	180	73	−5	+0.3	+0.1
	360	73	−9	+0.3	+0.1
Calgonite Dishwasher Sol.	180	73	−3	—	—
	360	73	−23	+1.3	+0.2
Laundry Detergent	180	73	−4	—	—
	360	73	−24	—	0.1

*1/8" x 2" diameter discs.

TABLE 1.16: FIBERGLASS REINFORCED POLYESTER PANELS—RESOLITE

RESOLITE CR panels are fiberglass-reinforced, polyester sheets in flat and various corrugated and ribbed configurations. The polyester resin used in RESOLITE CR panels was developed to withstand chemical abuse in heavy-duty application.

Acids	Concentration Percent	Expected resistance to: Vapor & Mist Contam. Air	Expected resistance to: Splash & Spills
Acetic	5	S	S
	0-75	S	S
	0-50	S	S
	50-75	S	T
	100	S	T
Aqua Regia		S	T
Benzene Sulfonic	all	S	S
Benzoic	all	S	S
Boric	all	S	S
Butyric	all	S	S
Chloroacetics; Mono, di and tri	0-100	S	
	0-50	S	T
	50-100	S	U
Chromic	0-30	S	S
	30-50	S	T
Citric	all	S	S
Fatty	all	S	S
Fluosilicic	0-30	S	S
Formic*	0-25	S	S
	0-50	S	T
Hydrobromic	all	S	S
Hydrochloric	all	S	S
Hydrocyanic	all	S	S
Hypochlorous	0-10	S	S
Hydrofluoric	0-20	S	T
Lactic	all	S	S
Maleic	all	S	S
Nitric*	0-35	S	S
	35-60	S	T
	over 60	T	T
Nitrous	0-10	S	S
Oleic	all	S	S
Oxalic	all	S	S
Perchloric	all	S	T
Phosphoric	all	S	S
Stearic	all	S	S
Sulfuric	0-80	S	S
	over 80*	T	T
Tartaric	all	S	S
Tannic	all	S	S

Wet Gases and Fumes	Concentration Percent	Vapor & Mist Contam. Air	Splash & Spills
Carbon Dioxide		S	
Carbon Monoxide		S	
Chlorine		S	
Ammonia		S	
Bromine		S	
Fluorine		S	
Hydrogen		S	
Hydrogen Chloride		S	
Hydrogen Fluoride*		S	
Hydrogen Bromide		S	
Hydrogen Sulfide		S	
Oxidizing Gases		S	
Reducing Gases		S	
Steam		S	
Sulfur Dioxide		S	
Sulfur Trioxide		T	
Chlorine Dioxide		S	
Sulfur		S	

Salts	Concentration Percent	Expected resistance to: Vapor & Mist Contam. Air	Expected resistance to: Splash & Spills
Arsenates	all	S	S
Bicarbonates	all	S	S
Bifluorides	all	S	S
Bisulfates	all	S	S
Bisulfites	all	S	S
Borates	all	S	S
Bromides	all	S	S
Carbonates	all	S	S
Chlorates	all	S	S
Chlorides	all	S	S
Chromates	all	S	S
Dichromates	all	S	S
Fluorides	all	S	T
Hydrosulfides	all	S	T
Iodides	all	S	S
Nitrates	all	S	S
Perchlorates	all	S	S
Persulfates	all	S	S
Phosphates	all	S	S
Phosphites	all	S	S
Silicates	all	S	S
Silico-fluorides	all	S	S
Sulfates	all	S	S
Sulfides	all	T	T
Sulfites	all	S	S

Solvents and Organics	Concentration Percent	Vapor & Mist Contam. Air	Splash & Spills
Acetone	100	S	T
Alcohols (all)	100	S	S
Benzene	100	S	S
Benzaldehyde	100	S	T
Benzoyl Chloride	100	S	T
Carbon Tetrachloride	100	S	S
Chlorobenzenes	100	S	T
Chloroform*	100	S	S
Ethers	100	S	T
Acetones	100	S	T
Ethylene Chloride	100	S	T
Formaldehyde	37	S	S
Gasoline	100	S	S
Glycols	100	S	S
Heptane	100	S	S
Hexane	100	S	S
Kerosene	100	S	S
Methyl Ethyl Ketone	100	S	T
	0-50	S	S
Naphtha	100	S	S
Naphthalene	100	S	S
Phenol*	all	T	T
Perchlorethylene	100	S	S
Trichlorethylene	100	S	S
Thionyl Chloride	100	S	T
Styrene	100	S	S
Sulfuryl Chloride	100	S	T
Toluene	100	S	S
Xylene	100	S	S
Oils	100	S	S
Ethylene-dichloride	100	S	T
Ethylacetate	100	S	T

Alkalies	Concentration Percent	Expected resistance to: Vapor & Mist Contam. Air	Expected resistance to: Splash & Spills
Ammonium Hydroxide**	10	S	S
	0-30	S	T
Barium Hydroxide	10	S	T
Calcium Hydroxide	0-50	S	T
Potassium Hydroxide	0-50	S	T
Sodium Hydroxide	0-10	S	S
	0-50	S	T

Miscellaneous	Concentration Percent	Vapor & Mist Contam. Air	Splash & Spills
Calcium Hypochlorite**	20	S	S
Chlorine Water	SAT	S	S
Chlorine Dioxide	all	S	S
Hydrogen Peroxide	3	S	S
	all	S	T
Sodium Hypochlorite*	15	S	T
Underground			S
Water Distilled		S	S
Mine Waters		S	S
Sea Water		S	S
Cooling Tower Water		S	S
Metal Plating Solutions	(acid)	S	S
Pickling Solutions	(acid)	S	S
Metal Plating Solutions	(alkaline)	S	T
Phosphorus Oxychloride	all	S	T
Phosphorus Trichloride	all	S	T
Pickling Solutions	(alkaline)	S	T
Stripping Solutions		S	S
Petroleum Ether		S	S
Marine Atmosphere		S	—
Humidity, 100%		S	—
Chlorites		S	S
Cyclohexane		S	S
Caprylic Acid		S	S
Palmitic		S	S
Ethyl Acetate		S	T
Coal Dust, moist		S	S
Iodine Vapor		S	—
Nut Oils Olive Oils		S	S
Weed Killers, organic		S	T
Fungicides, organic		S	T
Insecticides, organic		S	T
Anthracene Oil		S	S
Sulfur, wettable		S	S
DDT		S	S

*May cause slight bleaching. **May cause slight staining.

LEGEND:
S = Satisfactory with expected long and economic life
T = Tests suggested. Under some conditions materials may not be suitable.
U = Unsatisfactory for continuous service.

TABLE 1.17: FLUOROPOLYMER—ALLIED ENGINEERED PLASTICS

HALAR ECTFE is a melt processable fluoropolymer from Allied Corporation. It possesses a unique combination of properties as a result of its chemical structure—a 1:1 alternating copolymer of ethylene and chlorotrifluoroethylene. HALAR fluoropolymer offers excellent chemical resistance, good electrical properties, broad use temperature range—from cryogenic to 340°F, and meets the requirements of the UL-94 V-O vertical flame test in thicknesses as low as 7 mils. It is a tough material with excellent impact strength over its broad use temperature range. HALAR ECTFE also maintains useful properties on exposure to cobalt 60 radiation at dosages of 200 megarads. It is one of the best fluoropolymers for abrasion resistance. HALAR fluoropolymer is a thermoplastic which can be processed by virtually any technique applicable with polyethylene. It can be extruded, injection molded, blow molded, rotomolded, and applied by ordinary fluidized bed or electrostatic coating techniques. It is available in a range of viscosity grades for extrusion and molding applications. HALAR ECTFE powders are available in three different particle sizes optimized for specific coating processes.

HALAR® ECTFE

CHEMICAL RESISTANCE

R - Recommended
NR - Not Recommended
-- - No Available Data

Chemical	Temperature 73°F	150°F	250°F	300°F
Acetic Acid, 10%	R	R	R	--
Acetic Acid, 20%	R	R	R	--
Acetic Acid, 50%	R	R	R	--
Acetic Acid, 80%	R	R	--	--
Acetic Acid, Glacial	R	R	--	--
Acetic Anhydride	R	--	--	--
Acetone	R	R	NR	NR
Acetyl Chloride	R	R	--	--
Acetylene	R	R	--	--
Acetyl Nitrile	R	R	--	--
Acrylonitrile	R	--	--	--
Adipic 105 Acid	R	R	--	--
Alcohol, Amyl	R	R	R	R
Alcohol, Benzyl	R	R	R	R
Alcohol, Butyl, Primary	R	R	R	R
Alcohol, Butyl, Secondary	R	R	R	R
Alcohol, Diacetone	R	R	NR	NR
Alcohol, Ethyl	R	R	R	R
Alcohol, Hexyl	R	--	--	--
Alcohol, Isopropyl	R	R	R	R
Alcohol, Methyl	R	R	R	R
Alcohol, Propyl	R	R	R	R
Allyl Chloride	R	R	R	R
Alum	R	R	R	R
Alum, Ammonium	R	R	R	R
Alum, Chrome	R	R	--	--
Alum, Potassium	R	R	R	R
Aluminum Chloride	R	R	R	R
Aluminum Fluoride	R	R	R	R
Aluminum Hydroxide	R	R	R	R
Aluminum Nitrate	R	R	R	R
Aluminum Oxychloride	R	R	--	--
Aluminum Sulfate	R	R	R	R
Ammonia, Gas	R	R	R	R
Ammonia, Aqua, 10%	R	R	R	--
Ammonium Acetate	R	R	--	--
Ammonium Bifluoride	R	R	R	R
Ammonium Bisulfide	R	R	R	R
Ammonium Carbonate	R	R	R	R
Ammonium Chloride	R	R	R	R
Ammonium Dichromate	R	--	--	--
Ammonium Fluoride, 10%	R	R	R	R
Ammonium Fluoride, 25%	R	R	R	R
Ammonium Hydroxide	R	R	R	R
Ammonium Metaphosphate	R	R	R	R
Ammonium Nitrate	R	R	R	R
Ammonium Persulphate	R	R	--	--
Ammonium Phosphate	R	R	R	R
Ammonium Sulfate	R	R	R	R
Ammonium Sulfide	R	R	R	R
Amyl Acetate	R	R	NR	NR
Amyl Chloride	R	R	R	R
Aniline	R	NR	NR	NR
Anthraquinone	R	R	--	--
Anthraquinone Sulfonic Acid	R	R	--	--
Antimony Trichloride	R	--	--	--
Aqua Regia	R	R	R	--
Arsenic Acid	R	R	R	R
Barium Carbonate	R	R	R	R
Barium Chloride	R	R	R	R
Barium Hydroxide	R	R	R	R
Barium Nitrate	R	--	--	--
Barium Sulfate	R	R	R	R
Barium Sulfide	R	R	R	R
Beer	R	R	--	--
Beet Sugar Liquors	R	R	--	--
Benzaldehyde, 10%	R	R	NR	NR
Benzaldehyde, Above 10%	R	NR	NR	NR
Benzene, Benzol	R	R	NR	NR
Benzene Sulfonic Acid, 10%	R	R	NR	NR
Benzoic Acid	R	R	R	--
Bismuth Carbonate	R	--	--	--
Black Liquor	R	R	R	R
Bleach, 12.5% Active Cl_2	R	R	R	R
Bleach, 5.5% Active Cl_2	R	R	R	R

(continued)

TABLE 1.17: FLUOROPOLYMER—ALLIED ENGINEERED PLASTICS (continued)

Chemical	Temperature 73°F	150°F	250°F	300°F
Borax	R	R	R	R
Boric Acid	R	R	R	R
Brine, Acid	R	R	R	R
Bromic Acid	R	R	R	--
Bromine, Liquid	R	R	--	--
Bromine, Vapor 25%	R	R	NR	NR
Bromine, Water	R	R	R	--
Bromobenzene	R	NR	NR	NR
Bromotoluene	R	R	NR	NR
Butadiene	R	R	R	--
Butane	R	R	R	--
Butyl Acetate	R	R	NR	NR
Butyl Alcohol	R	R	R	R
Butyl Cellosolve	R	--	--	--
Butylene	R	R	R	R
Butyl Phenol	R	R	R	--
Butyl Stearate	R	--	--	--
Butyric Acid	R	R	R	--
Cadmium Cyanide	R	R	--	--
Calcium Bisulfide	R	R	R	R
Calcium Bisulfite	R	R	R	R
Calcium Carbonate	R	R	R	R
Calcium Chlorate	R	R	R	R
Calcium Chloride	R	R	R	R
Calcium Hydroxide	R	R	R	R
Calcium Hypochlorite	R	R	R	R
Calcium Nitrate	R	R	R	R
Calcium Oxide	R	R	R	R
Calcium Sulfate	R	R	R	R
Cane Sugar Liquors	R	R	--	--
Caprylic Acid	R	R	--	--
Carbon Dioxide, Wet	R	R	R	R
Carbon Dioxide, Dry	R	R	R	R
Carbon Disulfide	R	--	--	--
Carbon Monoxide	R	R	--	--
Carbon Tetrachloride	R	R	R	R
Carbonic Acid	R	R	R	R
Castor Oil	R	R	R	R
Caustic Potash	R	R	R	R
Cellosolve	R	R	R	R
Cellosolve Acetate	R	--	--	--
Chloracetic Acid	R	R	R	--
Chloral Hydrate	R	R	--	--
Chloramine	R	--	--	--
Chlorine Gas, Dry	R	R	NR	NR
Chlorine Gas, Wet	R	R	R	--
Chlorine, Liquid	R	R	R	--
Chlorine Water, Saturated	R	R	R	--
Chloracetic Acid	R	R	R	--
Chlorobenzene	R	R	NR	NR

Chemical	Temperature 73°F	150°F	250°F	300°F
Chlorobenzyl Chloride	R	NR	NR	NR
Chloroform	R	R	R	--
Chlorosulfonic Acid	R	--	--	--
Chromic Acid, 10%	R	R	R	--
Chromic Acid, 30%	R	R	R	--
Chromic Acid, 40%	R	R	R	--
Chromic Acid, 50%	R	R	R	--
Citric Acid	R	R	R	R
Coconut Oil	R	R	R	R
Coke Oven Gas	R	R	R	--
Copper Carbonate	R	R	--	--
Copper Chloride	R	R	R	R
Copper Cyanide	R	R	R	R
Copper Fluoride	R	R	R	R
Copper Nitrate	R	R	R	R
Copper Sulfate	R	R	R	R
Corn Syrup	R	R	R	R
Cottonseed Oil	R	R	R	R
Cresol	R	R	NR	NR
Cresylic Acid, 50%	R	R	NR	NR
Croton Aldehyde	R	NR	NR	NR
Crude Oil	R	R	R	R
Cupric Fluoride	R	R	R	R
Cupric Sulfate	R	R	R	R
Cuprous Chloride	R	R	R	--
Cyclohexane	R	R	R	R
Cyclohexanol	R	R	NR	NR
Cyclohexanone	R	NR	NR	NR
Detergents	R	R	R	R
Detergent Solution (Heavy Duty)	R	R	R	R
Dextrin	R	R	R	--
Dextrose	R	R	R	--
Dichlorobenzene	R	NR	NR	NR
Dichoroethylene	R	NR	NR	NR
Diesel Fuels	R	R	R	R
Diethylamine	R	NR	NR	NR
Diethyl Cellosolve	R	R	R	R
Diethyl Ether	R	--	--	--
Diglycolic Acid	R	--	--	--
Dimethylamine	R	NR	NR	NR
Dimethyl Hydrazine	R	NR	NR	NR
Dioctyl Phthalate	R	NR	NR	NR
Dioxane	R	R	NR	NR
Dioxane, 1,4	R	R	NR	NR
Disodium Phosphate	R	R	R	R
Divinylbenzene	R	NR	--	--
Epsom Salt	R	R	R	R
Ethyl Acetate	R	R	--	--
Ethyl Acetoacetate	R	--	--	--

(continued)

TABLE 1.17: FLUOROPOLYMER–ALLIED ENGINEERED PLASTICS (continued)

Chemical	Temperature 73°F	150°F	250°F	300°F
Ethyl Acrylate	R	R	NR	NR
Ethyl Chloride	R	R	R	R
Ethyl Chloroacetate	R	--	--	--
Ethyl Ether	R	R	--	--
Ethylene Bromide	R	R	R	R
Ethylene Chloride	R	R	R	R
Ethylene Chlorohydrin	R	NR	NR	NR
Ethylene Diamine	R	NR	NR	NR
Ethylene Dichloride	R	NR	NR	NR
Ethylene Glycol	R	R	R	R
Ethylene Oxide	R	R	R	R
Fatty Acids	R	R	R	R
Ferric Chloride	R	R	R	R
Ferric Nitrate	R	R	R	R
Ferric Sulfate	R	R	R	R
Ferrous Chloride	R	R	R	R
Ferrous Nitrate	R	R	R	R
Ferrous Sulfate	R	R	R	R
Fluorine Gas, Wet	R	--	--	--
Fluoboric Acid	R	--	--	--
Fluosilicic Acid	R	R	R	R
Formaldehyde, 35%	R	R	--	--
Formaldehyde, 37%	R	R	--	--
Formaldehyde, 50%	R	--	--	--
Formic Acid	R	R	R	--
Formic Acid (Anhydrous)	R	R	R	--
Freon F-11	R	R	--	--
Freon F-12	R	R	--	--
Freon F-21	R	R	--	--
Freon F-22	R	R	--	--
Freon F-113	R	R	--	--
Freon F-114	R	R	--	--
Fruit Juices, Pulp	R	R	--	--
Gallic Acid	R	R	--	--
Gas, Natural	R	R	R	R
Gasoline, Leaded	R	R	R	R
Gasoline, Unleaded	R	R	R	R
Gasoline, Sour	R	R	R	R
Gelatin	R	R	R	--
Gin	R	R	R	R
Glucose	R	R	R	R
Glycerine, Glycerol	R	R	R	R
Glycolic Acid	R	R	--	--
Glycols	R	R	R	R
Heptane	R	R	R	R
Hexane	R	R	R	R
Hydrobromic Acid, 20%	R	R	R	R
Hydrobromic Acid, 50%	R	R	R	R
Hydrochloric Acid, Conc 37%	R	R	R	R
Hydrocyanic Acid	R	R	R	R
Hydrocyanic Acid, 10%	R	R	R	R
Hydrofluoric Acid Dilute	R	R	R	R
Hydrofluoric Acid, 30%	R	R	R	--
Hydrofluoric Acid, 40%	R	R	R	--
Hydrofluoric Acid, 50%	R	R	R	--
Hydrofluosilicic Acid	R	R	R	R
Hydrogen	R	R	R	R
Hydrogen Cyanide	R	R	R	R
Hydrogen Perixide	R	--	--	--
Hydrogen Peroxide, 50%	R	R	--	--
Hydrogen Peroxide, 90%	R	R	--	--
Hydrogen Phosphide	R	R	--	--
Hydrogen Sulfide, Dry	R	R	R	R
Hydrogen Sulfide, Aqueous Sol.	R	R	--	--
Hydroquinone	R	R	R	--
Hypochlorous Acid	R	R	R	R
Iodine	R	R	R	--
Iodine Solution, 10%	R	R	R	--
Isopropyl Ether	R	--	--	--
Isooctane	R	--	--	--
Jet Fuel, JP-4	R	R	R	R
Jet Fuel, JP-5	R	R	R	R
Kerosene	R	R	R	R
Lactic Acid, 25%	R	R	--	--
Lactic Acid, 80%	R	--	--	--
Lard Oil	R	R	R	R
Lauric Acid	R	R	R	--
Lauryl Chloride	R	R	R	--
Lead Acetate	R	R	R	R
Lead Chloride	R	R	R	R
Lead Nitrate	R	R	R	R
Lead Sulfate	R	R	R	R

(continued)

TABLE 1.17: FLUOROPOLYMER–ALLIED ENGINEERED PLASTICS (continued)

Chemical	Temperature 73°F	150°F	250°F	300°F
Lemon Oil	R	R	R	--
Lime Sulfur	R	R	--	--
Linoleic Acid	R	R	R	--
Linoleic Oil	R	R	R	--
Linseed Oil	R	R	R	--
Linseed Oil, Blue	R	R	R	--
Lithium Bromide	R	R	--	--
Lubricating Oil, ASTM #1	R	R	R	R
Lubricating Oil, ASTM #2	R	R	R	R
Lubricating Oil, ASTM #3	R	R	R	R
Magnesium Carbonate	R	R	R	R
Magnesium Chloride	R	R	R	R
Magnesium Hydroxide	R	R	R	R
Magnesium Nitrate	R	R	R	R
Magnesium Sulfate	R	R	R	R
Maleic Acid	R	R	R	--
Malic Acid	R	R	R	--
Mercuric Chloride	R	R	R	--
Mercuric Cyanide	R	R	R	--
Mercuric Sulfate	R	R	R	--
Mercurous Nitrate	R	R	R	--
Mercury	R	R	R	R
Methane	R	R	R	--
Methoxyethyl Oleate	R	--	--	--
Methylamine	R	NR	NR	NR
Methyl Bromide	R	R	R	R
Methyl Cellosolve	R	R	R	R
Methyl Chloride	R	R	R	R
Methyl Chloroform	R	R	NR	NR
Methyl Ethyl Ketone	R	R	NR	NR
Methyl Isobutyl Ketone	R	R	NR	NR
Methyl Methacrylate	R	--	--	--
Methyl Sulfate	R	R	R	R
Methyl Sulfuric Acid	R	R	--	--
Methylene Bromide	R	NR	NR	NR
Methylene Chloride	R	NR	NR	NR
Methylene Iodine	R	NR	NR	NR
Milk	R	R	R	--
Mineral Oil	R	R	R	R
Molasses	R	R	--	--
Motor Oil	R	R	R	R
Naphtha	R	R	R	R

Chemical	Temperature 73°F	150°F	250°F	300°F
Naphthalene	R	R	--	--
Natural Gas	R	R	--	--
Nickel Acetate	R	--	--	--
Nickel Chloride	R	R	R	R
Nickel Nitrate	R	R	R	R
Nickel Sulfate	R	R	R	R
Nicotine	R	R	--	--
Nicotinic Acid	R	R	R	--
Nitric Acid, 10%	R	R	R	R
Nitric Acid, 30%	R	R	R	--
Nitric Acid, 40%	R	R	R	--
Nitric Acid, 50%	R	R	NR	NR
Nitric Acid, 70%	R	R	NR	NR
Nitric Acid, 100%	R	R	NR	NR
Nitrobenzene	R	R	NR	NR
Nitrous Acid, 10%	R	R	R	--
Nitrous Oxide	R	--	--	--
Oils, Vegetable	R	R	R	R
Oleic Acid	R	R	R	--
Oleum	R	NR	NR	NR
Oxalic Acid	R	R	NR	NR
Oxalic Acid, 50%	R	R	NR	NR
Oxygen, Gas	R	R	R	R
Ozone	R	R	R	R
Palmitic Acid	R	R	R	--
Palmitic Acid, 10%	R	R	R	--
Paraffin	R	R	--	--
Perchloric Acid, 10%	R	R	--	--
Perchloric Acid, 70%	R	R	--	--
Perphosphate	R	--	--	--
Petroleum Oils, Sour	R	R	--	--
Petroleum Oils, Refined	R	R	--	--
Phenol	R	R	NR	NR
Phenyl hydrazine	R	--	--	--
Phosphoric Acid, 10%	R	R	R	R
Phosphoric Acid, 50%	R	R	R	--
Phosphoric Acid, 85%	R	R	R	--
Phosphorus Yellow	R	--	--	--
Phosphorus Pentoxide	R	R	R	--
Phosphorus Trichloride	R	R	R	--
Photographic Solutions	R	R	--	--

(continued)

TABLE 1.17: FLUOROPOLYMER—ALLIED ENGINEERED PLASTICS (continued)

Chemical	Temperature 73°F	150°F	250°F	300°F
Picric Acid	R	--	--	--
Plating Solutions, Brass	R	R	--	--
Plating Solutions, Cadmium	R	R	--	--
Plating Solutions, Chrome	R	R	--	--
Plating Solutions, Copper	R	R	--	--
Plating Solutions, Gold	R	R	--	--
Plating Solutions, Lead	R	R	--	--
Plating Solutions, Nickel	R	R	--	--
Plating Solutions, Rhodium	R	R	--	--
Plating Solutions, Silver	R	R	--	--
Plating Solutions, Tin	R	R	--	--
Plating Solutions, Zinc	R	R	--	--
Potash	R	R	R	R
Potassium Alum	R	R	R	R
Potassium Aluminum Sulfate	R	R	R	R
Potassium Bichromate	R	R	R	--
Potassium Bisulfate	R	R	R	--
Potassium Borate	R	R	--	--
Potassium Bromide	R	R	R	R
Potassium Carbonate	R	R	R	R
Potassium Chlorate Aqueous	R	R	R	R
Potassium Chloride	R	R	R	R
Potassium Chromate	R	R	R	R
Potassium Chlorate	R	R	R	R
Potassium Cyanide	R	R	R	R
Potassium Dichromate	R	R	R	R
Potassium Ferricyanide	R	R	R	R
Potassium Ferrocyanide	R	R	R	R
Potassium Hydroxide	R	R	--	--
Potassium Iodide	R	R	R	--
Potassium Nitrate	R	R	R	R
Potassium Perchlorate	R	--	--	--
Potassium Permanganate, 10%	R	R	R	R
Potassium Permanganate, 25%	R	R	R	R
Potassium Persulfate	R	R	--	--
Potassium Sulfate	R	R	R	R
Propane	R	R	R	R
Propylene Oxide	NR	NR	NR	NR
Pyridine	NR	NR	NR	NR
Pyrogallic Acid	R	R	--	--
Salicylic Acid	R	R	--	--
Salicylaldehyde	R	NR	NR	NR
Silicic Acid	R	--	--	--

Chemical	Temperature 73°F	150°F	250°F	300°F
Silicone Oil	R	--	--	--
Silver Cyanide	R	R	R	R
Silver Nitrate	R	R	R	R
Silver Sulfate	R	R	R	--
Soaps	R	R	--	--
Sodium Acetate	R	R	R	R
Sodium Alum	[illegible]	R	R	R
Sodium Benzoate	R	R	R	R
Sodium Bicarbonate	R	R	R	R
Sodium Bichromate	R	R	--	--
Sodium Bisulfate	R	R	R	R
Sodium Bisulfite	R	R	R	R
Sodium Bromide	R	R	R	R
Sodium Carbonate	R	R	R	R
Sodium Chlorate	R	R	R	R
Sodium Chloride	R	R	R	R
Sodium Cyanide	R	R	R	R
Sodium Dichromate	R	R	--	--
Sodium Fluoride	R	R	R	R
Sodium Hydroxide, 15%	R	R	R	R
Sodium Hydroxide, 30%	R	R	R	--
Sodium Hydroxide, 50%	R	R	R	--
Sodium Hydroxide, 70%	R	R	--	--
Sodium Hypochlorite	R	R	R	R
Sodium Iodide	R	R	--	--
Sodium Metaphosphate	R	R	R	R
Sodium Nitrate	R	R	R	R
Sodium Nitrite	R	R	R	R
Sodium Perchlorate	R	--	--	--
Sodium Peroxide	R	R	R	R
Sodium Phosphate, Alkaline	R	R	R	R
Sodium Phosphate, Acid	R	R	R	R
Sodium Phosphate, Neutral	R	R	R	R
Sodium Silicate	R	R	R	R
Sodium Sulfate	R	R	R	R
Sodium Sulfide	R	R	R	R
Sodium Sulfite	R	R	R	R
Sodium Thiosulfate	R	R	R	R
Sour Crude Oil	R	R	R	R
Stannic Chloride	R	R	R	R
Stannous Chloride	R	R	R	R
Starch	R	R	--	--
Stearic Acid	R	R	--	--
Stoddard's Solvent	R	R	R	R

(continued)

TABLE 1.17: FLUOROPOLYMER–ALLIED ENGINEERED PLASTICS (continued)

Chemical	Temperature 73°F	150°F	250°F	300°F
Succinic Acid	R	R	R	--
Sulfate Liquors	R	--	--	--
Sulfite Liquor	R	--	--	--
Sulfur	R	R	R	--
Sulfur Chloride	R	--	--	--
Sulfur Dioxide, Dry	R	R	R	--
Sulfur Dioxide, Wet	R	R	--	--
Sulfuric Acid, 10%	R	R	R	--
Sulfuric Acid, 30%	R	R	R	--
Sulfuric Acid, 50%	R	R	R	--
Sulfuric Acid, 60%	R	R	R	--
Sulfuric Acid, 70%	R	R	R	--
Sulfuric Acid, 80%	R	R	R	--
Sulfuric Acid, 90%	R	R	--	--
Sulfuric Acid, 93%	R	R	--	--
Sulfuric Acid, 94%	R	R	--	--
Sulfuric Acid, 95%	R	R	--	--
Sulfuric Acid, 96%	R	R	--	--
Sulfuric Acid, 98%	R	R	--	--
Sulfuric Acid, 100%	R	--	--	--
Sulfurous Acid	R	R	R	--
Tall Oil	R	R	R	R
Tannic Acid	R	R	R	--
Tanning Liquors	R	R	R	--
Tar	R	R	R	R
Tartaric Acid	R	R	R	--
Tetraethyl Lead	R	R	R	R
Tetrahydrodurane	NR	NR	NR	NR
Tetrahydrofuran	NR	NR	NR	NR
Thionyl Chloride	R	R	--	--
Thread Cutting Oils	R	R	R	R
Toluene, Toluol	R	R	NR	NR
Tomato Juice	R	R	R	--

Chemical	Temperature 73°F	150°F	250°F	300°F
Transformer Oil	R	R	R	--
Transformer Oil DTE/30	R	R	--	--
Tributyl Phosphate	R	NR	NR	NR
Trichloroacetic Acid	R	R	NR	NR
Trichloroethylene	R	R	R	R
Triethanolamine	R	NR	NR	NR
Triethylamine	R	R	NR	NR
Triosodium Phosphate	R	R	R	R
Turpentine	R	R	R	R
Urea	R	R	R	--
Urine	R	R	--	--
Vaseline	R	R	--	--
Vinegar	R	R	R	--
Vinegar, White	R	R	R	--
Vinyl Acetate	R	R	R	--
Water	R	R	R	R
Water, Acid Mine	R	R	R	R
Water, Demineralized	R	R	R	R
Water, Distilled or Fresh	R	R	R	R
Water, Salt	R	R	R	R
Water, Sea	R	R	R	R
Water, Sewage	R	R	R	R
Whiskey	R	R	R	R
White Liquor	R	R	R	--
Wines	R	R	R	--
Xylene (Xylol)	R	R	--	--
Zinc Chloride	R	R	R	R
Zinc Nitrate	R	R	R	R
Zinc Sulfate	R	R	R	R

TABLE 1.18: FURAN RESIN—KOCH ENGINEERING, MAURICE A. KNIGHT DIVISION

CHEMICAL RESISTANCE OF PERMANITE

Meaning of Symbols

E—Excellent resistance; suitable for general service—all concentrations and temperatures.

G—Good resistance; suitable for most services—most concentrations and temperatures to 212°F.

F—Fair resistance; suitable for some services—dilute concentrations and temperatures to 90°F.

NR—Not recommended for this service under most conditions.

Chemical	*Resistance*
Acetic Acid (to 85%)	E
Acetic Acid, Glacial	G
Acetic Anhydride	G
Acetaldehyde	E
Acetone	E
Aluminum Chloride	E
Aluminum Sulfate	E
Ammonium Bromide	E
Ammonium Carbonate	E
Ammonium Chloride	E
Ammonium Fluoride	E
Ammonium Hydroxide	E
Ammonium Nitrate	E
Ammonium Phosphate	E
Ammonium Sulfate	E
Amyl Acetate	E
Aniline	F
Aniline Hydrochloride	G
Aqua Regia	NR
Barium Chloride	E
Barium Hydroxide	E
Beer	E
Benzene	E
Benzene, Monochlor	E
Benzene, o-Dichlor	E
Benzene, 1, 2, 4—Trichlor	E
Benzoyl Chloride	E
Benzyl Alcohol	G
Borax	E
Boric Acid	E
Bromine	NR
Bromine Water	G
Butyl Alcohol	E
Calcium Bisulfite	E
Calcium Chloride	E
Calcium Hydroxide	E
Calcium Hypochlorite	F
Carbon Bisulfide	E
Carbon Tetrachloride	E
Castor Oil	E
Chlorine (dry)	G
Chlorine (wet)	G
Chlorine Water	G
Chloroform	E
Chromic Acid (dilute)	F
Chromic Acid (concentrated)	NR
Citric Acid	E
Coconut Oil	E
Copper Cyanide	E
Copper Sulfate	E
Corn Oil	E
Cottonseed Oil	E
Cresylic Acid	NR
Cupric Chloride	E
Dibutyl Phthalate	E
Ethyl Acetate	E
Ethyl Alcohol	E
Ethyl Ether	E
Ethylene Dichloride	E
Ferric Acid Salts (to 45% conc.)	E
Ferric Salts	E
Ferrous Salts	E
Formaldehyde	E
Formic Acid	E
Fuel Oil	E
Furfural	E
Furfuryl Alcohol	E
Gasoline	E
Glycerine	E
Hydrobromic Acid	E
Hydrochloric Acid	E
Hydrofluoric Acid (to 50% conc.)	E
Hydrofluoric Acid (50 to 70% conc.)	G
Hydrofluosilicic Acid	E
Hydrogen Peroxide (to 3% conc.)	F
Hydrogen Peroxide (over 3% conc.)	NR
Hydrogen Sulfide	E
Iodine	NR
Isoamyl Alcohol	E
Isopropyl Alcohol	E
Kerosene	E
Lactic Acid	E
Lead Acetate	E
Magnesium Chloride	E
Magnesium Sulfate	E
Maleic Acid	E
Manganese Sulfate	E
Methyl Alcohol	E
Methyl Ethyl Ketone	E
Mineral Oils	E
Nickel Chloride	E
Nickel Sulfate	E
Nitric Acid	NR
Oleic Acid	E
Oxalic Acid	E
Paraffin	E
Petroleum Ether	E
Phenol	E
Phosphoric Acid (to 70% conc.)	E
Phosphoric Acid (70 to 85% conc.)	G
Potassium Bisulfate	E
Potassium Carbonate	E
Potassium Chloride	E
Potassium Hydroxide	E
Potassium Iodide	E
Potassium Sulfate	E
Pyridine	F
Pyridine Sulfate	G
Sodium Bicarbonate	E
Sodium Bisulfate	E
Sodium Carbonate	E
Sodium Chloride	E
Sodium Chlorite, Acid Soln.	F
Sodium Hydroxide	E
Sodium Hypochlorite	NR
Sodium Iodide	E
Sodium Sulfate	E
Sodium Sulfide	E
Sodium Sulfite	E
Sodium Thiosulfate	E
Stearic Acid	E
Sulfur Monochloride	E
Sulfuric Acid (to 50% conc.)	E
Sulfuric Acid (50 to 60% conc.)	G
Sulfuric Acid (over 60% conc.)	F
Sulfurous Acid	E
Tannic Acid	E
Tartaric Acid	E
Tin Chloride	E
Trichlorethylene	E
Trisodium Phosphate	E
Toluene	E
Turpentine	E
Vegetable Oils	E
Vinegar	E
Water, Distilled	E
Water, Salt	E
Wine	E
Whiskey	E
Xylene	E
Zinc Chloride	E
Zinc Sulfate	E

TABLE 1.19: ISOPOLYESTER RESINS—AMOCO CHEMICALS

Corrosion resistant isopolyesters are characterized among resin suppliers and users by the molar ratio of the aromatic to the unsaturated acid and by the glycol used in synthesis. In this nomenclature, Amoco's recommendation for a cost-effective resin with outstanding corrosion resistance to a broad range of liquids over a wide temperature range is a 1:1 propylene glycol isopolyester. That is, the resin is made with equal molar amounts of maleic anhydride and isophthalic acid and reacted with a sufficient excess of propylene glycol to ensure esterification to a high molecular weight.

While the basic corrosion resistant resin offers the most versatile range of resistance properties, variations of the basic formulation suitable for specific applications are available from many resin suppliers. The second table shows three laboratory variations of the recommended formulation.

The resin with higher levels of maleic anhydride has greater crosslink density and thus offers very good temperature stability. It should maintain mechanical properties up to 100°C. It also shows better resistance to aromatic solvents than the basic formulation, although its resistance to mineral acids is not quite as good. Its brittleness may be undesirable in some applications.

Adipic acid improves flexibility and neopentyl glycol improves caustic resistance. The gasoline resistance of these formulations is not as consistent as that of the other formulations shown in the second table. Adipic acid generally lowers resistance properties.

Chemical resistance of laboratory synthesized resin*

Medium	Temperature, °C	Composite Rating	Applications
Saturated NaCl	93	Acceptable	Marine, brine
	71	Excellent	
Distilled H_2O	71	Excellent	Pipe, water handling
	49	Acceptable	
10% Na_2CO_3	49	Excellent	
25% H_2SO_4	93	Acceptable	Chemical storage
	71	Good	
5% HCl	71	Excellent	Chemical handling
15% HCl	71	Excellent	Descaler handling
15% H_3PO_4	49	Good	Fertilizer, food handling
85% H_3PO_4	71	Good	Chemical handling
5% HNO_3	71	Good	Chemical handling
25% Acetic Acid	71	Acceptable	Food storage, handling
Vinegar (5% Acetic Acid)	71	Acceptable	Food processing, handling
pH_4 Soil Slurry	38	Excellent	Burial conditions
pH_{10} Soil Slurry	38	Good	
1N NH_4OH	38	Acceptable**	Fertilizers
2% NaOH	23	Good**	Chemical
5% NaOH	23	Complete Failure	
38% Urea	49	Acceptable	Fertilizers
100% Household Bleach	49	Excellent	
Saturated Alum	49	Excellent	
100% Corn Syrup	71	Excellent	Food handling
50% Citric Acid	71	Excellent	Food handling
50% EtOH	71	Good	Food, beverage
50% 34-5-5 Fertilizer in Water	49	Acceptable	Fertilizer
Lead Free Regular Gas	23	Excellent	Gasoline storage
50% Toluene/50% Isooctane	23	Good	Petroleum storage
75% Toluene/25% Isooctane	23	Good	
Benzene	23	Good	Chemical

*1:1 Propylene glycol isopolyester cooked to less than 15 acid number ASTM C581, one year immersion.

**Blistering was apparent.

(continued)

TABLE 1.19: ISOPOLYESTER RESINS—AMOCO CHEMICALS (continued)

Resin formulations for corrosion resistant performance

Isophthalic/Maleic Ratio, Moles	1:1	1:2	1:1	0.7:1
Adipic Acid, Moles	—	—	—	0.3
Glycol	propylene	propylene	neopentyl	neopentyl
% Styrene	45	45	45	45
Clear Casting Properties				
% Elongation	1.6	1.3	2.4	2.7
Heat Distortion Temp., °C	116	132	105	103
Laminate Properties, ASTM C581				
Flexural Strength, 10^3 psi (MPa)	19.5 (134)	14.8 (102)	17.6 (121)	18.6 (128)
Flexural Modulus, 10^6 psi (MPa)	1.074 (7400)	0.887 (6110)	0.843 (5810)	0.795 (5480)
Barcol Hardness	56	53	50	53
Corrosion Resistance, Composite ratings from one year data				
Distilled Water at 71°C	excellent	excellent	excellent	unacceptable
5% HNO_3 at 71°C	good	good	excellent	good
5% HCl at 71°C	excellent	excellent	good	unacceptable
25% H_2SO_4 at 71°C	excellent	acceptable	excellent	good
5% NaOH at 71°C	complete failure	complete failure	unacceptable	unacceptable
#2 Fuel Oil at 23°C	excellent	excellent	excellent	excellent
Ethyl Gasoline at 23°C	excellent	excellent	excellent	unacceptable
Unleaded Regular at 23°C	excellent	excellent	unacceptable	excellent
Benzene at 23°C	good	excellent	unacceptable	unacceptable

A partial list of materials handled and stored in corrosion resistant isopolyesters

Acetic Acid
Acidic Fumes
Acrylic Emulsions
Agricultural Chemicals
Alcohols
Alum
Ammonia
Beer
Brine
Cheese
Chlorine Dioxide
Chlorinated Lye
Coconut Oil
Cod-Liver Oil
Crude Oil
Distilled H_2O
Fatty Acids
Ferric Chloride Solutions
Fertilizers
Fruit Juices
Fuel Oil
Gasoline
Glycols
Grain
Grapes
HCl Solutions
$H_2(NH_4)PO_4$
HNO_3
Hydrogen Sulfide
H_2SO_4 Solutions
H_3PO_4
Lye
Manganese Solution
Meat
Milk
Monomeric Plasticizers
$(NH_4)_2SO_4$
$(NH_4)NO_3$
Pasta
Peanut Oil
Pickles
Potable H_2O
Premium Gasoline
Salt Solution
Salt Spray
Seawater
Sewage
Soap Curd
Soil
Sour Crude Oil
Soybean Oil
Sugar Solution
Sulphur Dioxide
Vegetable Oils
Vinegar
Vinyl Acetate
Water Treatment Chemicals
Wet Gases from Copper Smelting
Whey
Wine
Zinc Chloride

TABLE 1.20: NYLON 6/6 RESINS—CELANESE PLASTICS

CELANESE 1000 series nylons are of the 6/6 type polyamides. They are used in the replacement of metals, offering reduced weight, corrosion resistance, self-extinguishing properties, self-lubricating qualities and colorability at substantially lower cost.

Chemical Resistance Of Celanese Nylons 1000 & 1003

CHEMICAL		EFFECT
Acetaldehyde,	40%	A/B
Acetamide,	50%	A
Acetic acid,	10%	C
	40%	D
Acetone,	100%	A
Alcohols, aliphatic,	100%	A/B
Alcohol, benzyl,	100%	C
Alcohol, phenyl ethyl,	100%	B
Allyl chloride,	100%	C
Aluminum chloride,	10%	A
Aluminum sulfate,	10%	A
Ammonia,	10%	A
Ammonia, gaseous,	—	B/C
Ammonium carbonate,	10%	A
Ammonium chloride,	10%	B
Amyl acetate,	100%	A
Aniline,	100%	B/C
Antimony trichloride,	10%	C
Aspirin,	—	A
Barium chloride,	10%	A
Barium sulfide,	10%	A
Benzaldehyde,	100%	B
Benzene,	100%	A
Benzene sulfonic acid,	—	D
Benzoic acid,	Saturated	B/C
Bitumen,	—	B
Bleaching lye,	—	C
Boric acid,	10%	A
Boron trifluoride,	—	D
Bromine,	100%	D
Bromine water,	30%	D
Butanol,	100%	A
Butyl acetate,	100%	A
Butylene glycol,	100%	A
Butyric acid,	20%	B
Calcium chloride,	10%	A/B
Calcium chloride in alcohol,	20%	D
Calcium hypochlorite,	—	D
Camphor,	—	A
Carbon disulfide,	100%	A
Carbon tetrachloride,	100%	A
Carbonic acid,	10%	A
Chloracetic acid,	10%	D
Chloral hydrate,	—	D
Chlorine,	10%	D
Chlorine water,	—	D
Chlorobenzene,	100%	A
Chloroform,	100%	D
Chlorosulfonic acid,	10-100%	D
Chromic acid,	1%	B/C
	10%	D
Citric acid,	10%	B/C
Creosote,	—	A
Cresols,	—	D
Cresylic acids,	—	D
Cupric chloride,	10%	B
Cupric sulfate,	10%	B
Cyclohexane,	100%	A
Cyclohexanol,	100%	B
Cyclohexanone,	100%	A
Decalin,	—	A
Detergents,	—	A
Dibutyl phthalate,	—	A
Dichlordifluoromethane,	—	A
Diesel oil,	—	A
Diethylene glycol,	90%	A
Dimethyl carbinol,	—	A

CHEMICAL		EFFECT
Dimethyl formamide,	100%	A
Dioctyl phthalate,	—	A
Dioxane,	—	A
Edible fats and oils,	—	A
Ethanol,	96%	A/B
Ether,	100%	A
Ethyl acetate,	100%	A
Ethyl butyrate,	—	A
Ethylene chlorhydrin,	—	D
Ethylene chloride,	100%	A/B
Ethylene diamine,	100%	A/B
Ethylene dichloride,	—	A/B
Ethylene glycol,	—	A/B
Ferric chloride,	10%	B/C
Ferrous chloride,	10%	B
Ferrous sulfate,	10%	B
Fluorine,	—	D
Fluorosilicic acid,	10%	D
'Fluothane',	—	A
Formaldehyde,	40%	A
Formic acid,	3%	C
	10%	D
Fruit juices,	—	A
Gasoline	—	A
Gasoline/Benzene Mixture	80:20%	A
Glycerine,	—	A
Glycerol,	—	A
Glycol,	—	A/B
Heptane,	—	A
Hexane,	—	A
Hydrobromic acid,	10%	D
Hydrochloric acid,	2%	C
	10%	D
Hydrofluoric acid,	4%	D
Hydrogen peroxide,	0.5%	B/C
	3%	D
Hydrogen sulfide,	Saturated	A/B
Hydroquinone,	—	A
Iodine in alcohol,	—	D
Iodine in KI solution,	3%	D
Iso-octane,	—	A
Lactic acid,	10%	B/C
Lead acetate,	10%	B
Lead stearate,	—	A
Linseed oil,	—	A
Magnesium chloride,	10%	A
Magnesium hydroxide,	—	A
Magnesium sulfate,	—	A
Manganese sulfate,	10%	A
Mercuric chloride,	6%	C
Mercury,	—	A
Methanol,	100%	A/B
Methyl acetate,	100%	A
Methyl ethyl ketone,	100%	A
Methylene chloride,	100%	C
Milk,	—	A
Mineral oils,	—	A
Naphthalene,	—	A
Nickel sulfate,	—	A
Nitric acid,	10%	D
Nitro-alcohols,	—	D
Nitrobenzene,	100%	C
Oils of vegetables and spices,	—	A
Oleic acid,	100%	A

(continued)

TABLE 1.20: NYLON 6/6 RESINS—CELANESE PLASTICS (continued)

CHEMICAL		EFFECT
Oleum,	—	D
Oxalic acid,	10%	B/C
Paraffin,	—	A
Perchlorethylene,	100%	B
Perchloric acid,	10%	D
Petroleum ether,	—	A
Phenol,	—	D
Phosphoric acid,	10%	D
Phthalic acid,	Saturated	B
Potassium bicarbonate,	60%	A
Potassium bromide,	10%	A
Potassium carbonate,	60%	A
Potassium chloride,	90%	A
Potassium dichromate,	5%	B/C
Potassium ferricyanide,	30%	A
Potassium ferrocyanide,	30%	A
Potassium hydroxide,	10%	A
	50%	B/C
Potassium nitrate,	10%	A
Potassium permanganate,	1%	D
Potassium sulfate,	100%	A
Potassium sulfide,	90%	A
Pyridine,	—	A
Resorcinol,	100%	D
Salicylic acid,	100%	A
Silicone fluids,	—	A
Silver nitrate,	—	A
Soap solution,	—	A
Sodium acetate,	60%	A
Sodium benzoate,	—	A
Sodium bicarbonate,	50%	A
Sodium bisulfate,	10%	A
Sodium bisulfite,	10%	A
Sodium bromide,	—	A
Sodium carbonate,	10-50%	A
Sodium chlorate,	—	A
Sodium chloride,	10-90%	A
Sodium cyanide,	—	A
Sodium hydroxide,	10%	A
	50%	B/C
Sodium hypochlorite,	15% Cl	D
Sodium nitrate,	10-50%	A

CHEMICAL		EFFECT
Sodium perborate,	—	A/B
Sodium phosphate,	90-100%	A
Sodium silicate,	—	A
Sodium sulfate,	10-90%	A
Sodium sulfide,	25-90%	A
Sodium thiosulfate,	10%	A
Stannic chloride,	—	C
Stannic sulfate,	—	C
Stearic acid,	—	A
Styrene,	—	A
Sulfur,	—	A
Sulfur dioxide,	100%	C
Sulfuric acid,	2%	C
	5% and above	D
Sulfurous acid,	10%	D
Tallow,	—	A
Tar,	—	B
Tartaric acid,	10%	B
Tetrachlorethylene,	—	A
Tetrahydrofuran,	100%	A
Tetralin,	—	A
Thionyl chloride,	—	D
Toluene,	—	A
Transformer oil,	—	A
Trichlorethylene,	—	A/B
Triethanolamine,	—	A
Urea,	—	A
Vaseline,	—	A
Vegetable oils,	—	A
Vinegar,	—	B/C
Vinyl chloride,	100%	A
Water, cold,	—	A
Water, hot,	—	B
Wax, molten,	—	A
White spirit,	—	A
Wines and spirits,	—	A/B
Xylene,	—	A
Xylenol,	—	D
Zinc chloride,	—	C
Zinc oxide,	—	A
Zinc sulfate,	—	A

A. No attack, little or no absorption, little or no effect on mechanical properties.
B. Little or no attack, some absorption causing slight swelling and slight reduction in mechanical properties at 73°F (23°C)
C. Some attack or considerable absorption at 73°F (23°C) material not suitable for contact unless limited product life is acceptable.
D. Material decomposes at 73°F (23°C) in a short time.

TABLE 1.21: NYLON 11 RESIN—RILSAN

RILSAN NYLON 11 – CHEMICAL RESISTANCE

CHEMICAL	CONCENTRATION	RATING 68°F 20°C	RATING 104°F 40°C	RATING 140°F 60°C	BESN BLACK T 194°F 90°C
Acetaldehyde		A	B	X	
Acetic Acid	5%	A	A	A	
Acetic Acid	10%	A	A	B	
Acetic Acid	50%	B		X	X
Acetic Anhydride		B	X	X	X
Acetone	Pure	A	A+	B	
Acetylene		A	A	A	
Aluminum Sulfate	Sat. Sol.	A	A	A	A
Ammonia	Liquid or Gas	A	A	A	
Amonium Hydroxide	Concentrated	A	A	A	A
Ammonium Nitrate		A	A	A	
Ammonium Sulfate	Sat. Sol.	A	A	B	
Amyl Acetate		A	A	A	
Anethole		A			
Aniline	Pure	B+	X	X	X
Barium Chloride		A	A	A	A
Beer		A			
Benzaldehyde		A	B	X	
Benzene		A	A+	B	
Benzyl Alcohol		B	X	X	X
Bromine		X	X		
Butane		A	A	A	
Butyl Alcohol		A+	B	X	
Calcium Arsenate	Concentrated	A	A	A	
Calcium Chloride	Sat. Sol.	A	A	A	A
Calcium Nitrate		A			
Carbon Disulfide		A+	B+	X	
Carbon Tetrachloride		B	X		
Chlorine		X	X	X	X
Chloroform		B	X	X	
Chromic Acid	10%	X	X	X	X
Cider		A			
Citric Acid		A	A	B	X
Copper Sulfate		A	A	A	A
Cresol		X	X	X	
Cyclohexane		A	A	B	
Cyclohexanol		A	B	X	
Cyclohexanone		A	B	X	
D. D. T. Preparations		A			
Diammonium Phosphate		A	A	B	
Dichloroethylene		B	X		
Diethanolamine	20%	A	A+	A+	B

CHEMICAL	CONCENTRATION	RATING 68°F 20°C	RATING 104°F 40°C	RATING 140°F 60°C	BESN BLACK T 194°F 90°C
Diethyl Ether		A			
Dioctylphosphate		A	A	A	
Dioctylphthalate		A	A	A	
Ethanol	Pure	A+	B	X	
Ethyl Acetate		A	A	A	
Ethylene Chlorhydrin		X	X		
Ethylene Glycol		A+	A+	B	X
Ethylene Oxide		A	A	B	X
Fatty Acid Esters		A	A	A	A
Fluorine		X	X	X	X
Formaldehyde	Technical	A	B	X	
Formic Acid		X	X	X	X
Freon 12		A	A		
Freon 22		A	A		
Freon 502		A	A		
Fruit Juices		A	A		
Furfuryl Alcohol		A	A+	B	X
Gas (Coal)		A	A		
Gasoline (High Octane)		A	A	A+	
Glucose		A	A	A	A
Glycerine	Pure	A	A	B	X
Glycol		A	A	B	X
Greases		A	A	A	A
Heptane		A	A	A+	
Hydrogen		A	A	A	A
Hydrogen Peroxide	20%	A	B		
Hydrochloric Acid	10%	A	B	X	X
Hydrochloric Acid	20%	B	X	X	X
Hydroxy Quinoline		A			
Isocyanates		B			
Isopropyl Alcohol		A			
Kerosene		A	A		
Lactic Acid		A	A		B
Linseed Cake		A	A	A	A
Magnesium Chloride	50%	A	A	A	A
Mercury		A	A	A	
Methane		A	A	A	
Methanol	Pure	A+	B	X	
Methyl-Cellosolve		A	A	A	
Methyl Acetate		A	A	A	
Methyl Bromide		A	X		

(continued)

TABLE 1.21: NYLON 11 RESIN–RILSAN (continued)

CHEMICAL	CONCENTRATION	RATING 68°F 20°C	104°F 40°C	140°F 60°C	BESN BLACK T 194°F 90°C
Methyl Chloride		A	X		
Methyl Sulfate		A	B		
Methy Ethyl Ketone		A	A	B	X
Methyl Isobutyl Ketone		A	A	B	X
Milk		A	A	A	A
Monochlorobenzene		B	X	X	X
Mustard		A			
Naphtha		A	A	A+	
Naphthalene		A	A	A	B
Nitric Acid	All Concentration	X	X	X	X
Oils Crude		A	A	A+	
Oils Refined		A	A	A	A
Oleic Acid		A	A	A	B
Oxalic Acid		A	A	B	X
Oxygen		A	A	B	X
Perchloroethylene		B	X		
Phenol		X	X	X	X
Phosphoric Acid	40%	A	B	X	
Picric Acid		B	X	X	X
Potassium Carbonate		A	A	B	
Potassium Hydroxide	50%	A	B	X	X
Potassium Nitrate		A+	B+	X	
Potassium Permanganate	5%	X	X		
Potassium Sulfate		A	A	A	A
Propane		A	A	A	
Pydraul F9		A	A	A	
Pyridine	Pure	B	X	X	X
Soap Solution		A			
Sodium Carbonate	Concentrated	A	A	B	X
Sodium Chloride	Saturated	A	A	A	A
Sodium Hydroxide	50%	A	B	X	X
Sodium Hypochlorite	Concentrated	B	X	X	
Sodium Hypochlorite	Dilute Commercial Grade	A	B	X	
Sodium Sulfide		A	B	B	
Stearin		A	A	A	
Stearic Acid		A	A	A	B
Styrene		A	A+		
Sulfuric Anhydride		B	X	X	
Tartaric Acid	Saturated	A	A	A	B
Tetraethyl Lead		A			
Tetrahydrofurane		A	A	B	
Toluene		A	A+	B	B
Trichloroethane		B	X		
Trichloroethylene		B	X		
Tricresyl Phosphate		A	A	A	B
Tributyl Phosphate		A	A	A	B
Trisodium Phosphate		A	A	A	A
Triphenyl Phosphate		A	A	B	
Turpentine		A	A	A+	
Urea		A	A	B	
Uric Acid		A	A	A	B
Vinegar		A	A	A	A
Water		A	A	A	A
Water Sea		A	A	A	A
Water Soda		A	A	A	A
Wine		A			
Xylene		A	A+	B	B
Zinc Chloride	Sat. Sol.	A	A	B	

+ Swelling Action

A Good - Rilsan is unaffected

B Limited - The extent of attack depends on conditions and can range from swelling to dissolving.

X Unsatisfactory - Rilsan is attacked

BESN BLACK T is a special grade for high temperature applications.

TABLE 1.22: NYLON REINFORCED VINYL HOSE—SETHCO DIVISION, MET PRO CORP.

Sethco's NRV (Nylon Reinforced Vinyl) grade hose may be used at working pressures ranging from 100 to 250 psi (depending upon size). Its flex life exceeds that of rubber and its characteristic inertness satisfies requirements for a wide range of industrial and laboratory applications.

The reinforcing nylon mesh is encapsulated in the walls of the clear vinyl, providing a high strength, smooth surface hose. The imbedded mesh is never in contact with fluid or atmosphere. Working temperatures range from 20° to 175°F as discharge hose and 20° to 140°F as suction hose. The vinyl is fire resistant and self-extinguishing.

Sethco Nylon Reinforced Vinyl Hose Chemical Resistance Guide

Excellent Chemical Resistance for:

Acetic Acid
Air
Alcohols
Aluminum Chloride
Aluminum Sulfate
Alums
Ammonia Gas
Ammonium Chloride
Ammonium Nitrate
Ammonium Phosphate
Ammonium Sulphate
Amyl Alcohol
Animal Oils
Antimony Salts
Arsenic Salts
Barium Salts
Basic Copper Arsenate
Beer
Benzoic Acid
Benzyl Alcohol
Boric Acid
Basic Copper Sulphate
Bordeaux Mixture
Butanol
Butter
Calcium Hydroxide
Calcium Hypochlorite
Calcium Salts
Carbolic Acid
Carbon Monoxide
Caster Oil
Corn Oil
Cottonseed Oil
Caustic Potash (—20%)
Caustic Soda (—20%)
Chloroform
Chromic Acid
Chlorine (Dry)
Chlorine (Water)
Chromium Salts
Copper Chloride
Copper Sulphate
Citric Acid
Cresylic Acid
Cupric Sulphate
Essential Oils
Ethyl Alcohol
Ethyl Chloride
Ethylene Glycol
Fatty Acid
Ferric Chloride
Ferric Sulphate
Fluoboric Acid
Fluo Silicic Acid
Formic Acid
Formaldehyde
Freon
Gallic Acid
Gas (Natural)
Gasoline (Non-Aromatic)
Gelatin
Glue (Depending on type)
Glucose
Glycerine
Hydrochloric Acid
Hydrocyanic Acid
Hydrofluoric Acid
Hydraulic Oil
Hydrogen Gas
Hydrogen Peroxide (Dil.)
Hydrogen Sulphide
Lactic Acid
Lard
Lead Arsenate
Lead Sulphate
Lime
Linseed Oil
Magnesium Chloride
Magnesium Hydroxide
Magnesium Sulphate
Maleic Acid
Milk
Mineral Oil
Molasses
Nickel Chloride
Nicotine
Nitric Acid 20%
Nitrogen Oxide
Nitrous Acid
Oil
Oxalic Acid
Oxygen
Palmitic Acid
Picric Acid
Phosphoric Acid
Potassium Chloride
Potassium Sulphate
Propane
Pyrethrum
Sodium Bisulfite
Sodium Bicarbonate
Sodium Borate
Sodium Carbonate
Sodium Chloride
Sodium Cyanide
Sodium Hydroxide
Sodium Hypochlorite
Sodium Nitrate
Sodium Phosphate
Sodium Silicate
Sodium Sulphide
Sodium Sulphate
Sodium Thiosulphate
Stearic Acid
Stannous Chloride
Sulphur Dioxide
Sulphuric Acid (Dil.)
Sulphurous Acid
Tannic Acid
Tartaric Acid
Tar Oil
Turpentine
Urea
Uric Acid
Vinegar
Water
Whiskey
Wine
Wool Oil
Zinc Chloride
Zinc Hydrate
Zinc Sulphate

Also Recommended for

Aniline
Benzine
Benzol
Borax
Butane
Bromine
Calcium Bisulphide
Calcium Chloride
Carbon Tetrachloride
Caustic Potash (+20%)
Caustic Soda (+20%)
Chlordane
Creosote
Ether
Gasoline (Aromatic)
Hydrogen Peroxide (Con.)
Kerosene
Mercuric Chloride
Methyl Chloride
Oleic Acid
Pentane
Perchloric Acid
Perchlorethylene
Phenolates
Phenols
Stoddard Solvent
Sulphuric Acid (Conc.)
Trichlorethylene
Trichloracetic Acid

Check with manufacturer or test in your plant

Acetic Anhydride
Acetone
Acetyl Bromide
Acetyl Chloride
Ammonium Hydroxide
Amyl Acetate
Aromatic Hydrocarbons
Butyl Acetate
Carbon Bisulfide
Chloracetic Acid
Cresols
Cyclohexanone
Ethyl Acetate
Ethylene Dichloride
Fuel Oil (Aromatic Gas) 100 octane
Fuel Oil
Isopropyl Acetate
Ketones
Laquer Solvent
Naphtha
Nitrobenzene
Paint Solvents
Pyridine
Toluene
Toluol
Xylol
Xylene

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL

KEY PROPERTIES OF PYROITE II

1) Corrosion resistance to most solvents and corrosive chemicals. *(See compatibility chart.)*
2) Erosion resistance and toughness.
3) High dielectric strength.
4) Stability to temperatures from -80°F to over 500°F.
5) Excellent bonding characteristics. Bonds to metals, glass, concrete, fiber glass, plastics, etc.
6) High resistance to thermal cycling.
7) Non-galling capability.

DATA INTERPRETATION

METALS

DEPTH OF CORROSION PER SURFACE	RESULT
◄ .002 in. per year (◄ .05 mm./yr.)	A
◄ .020 in. per year (◄ .5 mm./yr.)	B
◄ .050 in. per year (◄ 1.27 mm./yr.)	C
► .050 in. per year or explosive. Not recommended.	NR
No data	—
Questionable	Q

To convert rate to milligrams per decimeter per year (mdd). mdd = in./yr. X .695 X specific gravity of metal.

PLASTICS

SWELLING OR DIMENSIONAL CHANGE. (ANY DIRECTION.) WHICHEVER IS GREATER.	LOSS OF TENSILE STRENGTH	DESCRIPTION CHEMICAL ATTACK	RESULT
◄10%	◄15%	Little or none	A
◄15%	◄30%	Good resistance (Minor attack)	B
◄20%	◄50%	Limited resistance (Moderate attack)	C
►20%	►50%	Attacked or dissolved within minutes or years. (Not recommended)	NR
No data	No data	No data	—
Questionable			Q

Note: When boiling is indicated, boiling temperature varies with concentration of corrodent.

EXAMPLES OF TYPICAL CALL-OUT

METALS

► .002 in./yr. in any concentration **0.20%** **from** 70°F **to** 212°F	A to 20% to 212°F
◄ .002 in./yr. **at** 20% concentration **at** 212°F	A at 20% at 212°F
◄ .002 in./yr. saturated at 70°F	A
◄ .010 in./yr. in any concentration **between** 20% and 50% **between** 70°F and 140°F	B 20-50% 70-140°F
► .050 in./yr. saturated at 70°F	NR
► .050 in./yr. in any concentration at 70°F	NR any concentration
0 to ► .050 in./yr. saturated at 70°F. Just a few degrees of temperature difference (or percentage points of concentration) can greatly effect corrosion. Combinations marked A NR are critical as to concentration or temperature	A NR

PLASTICS

Little to no chemical attack. ◄10% swelling or ◄15% loss of tensile strength at 100% concentration at 70°F or 200°F (temperature at top of column)	A
Little to no chemical attack. ◄10% swelling or ◄15% loss of tensile strength **from** 0 to 20% concentration at 70°F or 200°F (temperature at top of column)	A to 20%
Good resistance (minor chemical attack) ◄15% swelling or ◄30% loss of tensile strength **from** 20 **to** 50% concentration **from** 70°F **to** 140°F	B 20-50% 70-140°F
Attacked or dissolved. ►20% swelling or ►50% loss of tensile strength in concentrated at 70°F or 200°F (temperature at top of column.)	NR

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Acetamide	A to 250°F	NR (Dimethylacetamide)	A to 70°F	A to 300°F	A to 70°F	—	NR (Dimethylacetamide)	A	A to 70°F
Acetate Solvents Crude	A to 250°F	A to 70°F	A	A to 300°F	A to 70°F	A	A/NR (See specific types)	A	A to 70°F
Acetate Solvents Pure	A to 250°F	A to 70°F	A	A to 300°F	A to 70°F	A	A/NR (See specific types)	A	A to 70°F
Acetaldehyde 100%	A	B to 70°F C 122-212°F	A to 100% to 200°F	A to 200°F	C at 122°F NR at 212°F AB at 70°F	A	NR any concentration	A	C at 122°F NR at 212°F AB at 70°F
Acetic Acid 95% - 100%	A to 250°F	A 50% to 220°F	A A to 80% boiling	A to boiling	B 80% to 70°F AC to 70°F A 5% to 70°F	A	BC to 25% to 210°F BC 50-75% to 150°F C/NR 100% to 100°F	A	B 80% to 200°F AC to 70°F A 5% to 200°F
Acetic Acid Vapors 100% (hot)	A	NR at 230°F	AB to 30% BC 100%	A	NR	A	AC to 80°F NR at 212°F	A	AB to 120°F
Acetic Anhydride 100% (boiling)	A to 250°F	NR Boiling B at 70°F C at 122°F	A 30% & 90% to 180°F AB 90-100% boiling BC 60% at 180°F	A to 300°F	A to 70°F	A	B/NR to 100°F NR boiling	A	A to 120°F
Acetic Acid Glacial 70°F	A	A to 122°F B at 158°F C at 212°F NR at 230°F	A to 70°F AB to 400°F to 150 psi	A to boiling	C	A	C/NR to 100°F	A to boiling	C
Acetone 100%	A	C to 100°F NR at 122°F B 50% to 122°F	A to 100% to 200°F	A to 200°F	NR at 122°F C to 70°F	AB to 200°F	C 10% to 180°F NR 100% at 70°F	A	AB to 180°F
Acetonitrile	A	A to 120°F C at 167°F	A	A to 200°F	A to 70°F	—	NR at 70°F	A	A to 70°F
Acetophenone	A to 250°F	A to 70°F C to 167°F NR at 212°F	AB to 350°F	A to 300°F	C to 70°F	—	NR at 70°F	A	AB to 70°F
Acetylene	A	A to 275°F	A	A to 200°F	A to 70°F	A	—	A	A to 70°F
Acetyl Chloride (dry)	A	A to 120°F	A	A to 200°F	—	—	NR at 130°F	A	A to 70°F
Acid Mine Water	A	A to 120°F	A to 60°F Pits on drying	A	A to 70°F	A	AC to 100°F	A	A to 150°F
Acrylonitrile	A to 70°F	NR A to 70°F B to 122°F C at 167°F	A to 70°F	A to 70°F	A to 70°F	—	AC 2% to 80°F NR 100% to 70°F	A	A to 70°F
Adipic Acid	A to 250°F	A to 275°F	AB ◄ 480°F	A to 125°F	—	—	AC to 70°F	A	AB to 150°F
Alcohols General	A	A	A	A to 300°F	BC to 70°F	A	AB to 100°F	A	AB to 100°F
Alcohol Amyl	A	A to 275°F	A A 5% to 195°F	A to 300°F	NR to 70°F	A	AB to 120°F	A	AB to 120°F
Alcohol Butyl (butanol)	A to 250°F	A to 275°F	A A 5% to 195°F	A to 125°F	NR to 70°F	A	AB to 120°F	A	AB to 120°F
Alcohol Ethyl (ethanol)	A to 250°F	A to 212°F	B to 100% to 200°F	A to 300°F	A to 70% at 70°F A/NR to 70°F Softened	A to 100% to 200°F	AB to 100°F	A	A to 100°F
Alcohol, 2 Aminoethanol	A	C at 70°F NR at 122°F	A to 100% to 212°F B 100% at 250°F	A to 300°F	A to 70°F	AB to 200°F	AB to 80°F	A	A to 120°F
Allyl Alcohol	A to 125°F	—	—	A to 125°F	NR to 70°F	—	AB to 140°F	A	AB to 70°F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL–PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Allyl Chloride	A to 212°F	A to 212°F	AB to 125°F	A to 70°F	–	–	AC to 80°F	A	AB to 100°F
Aluminum Chloride 10%	A	A to 275°F	C Pits A 1%	A 25% to 200°F	A to 70°F	A to 212°F	AB to 140°F AC to 220°F	A	A to 150°F
Aluminum Chloride 10% (boiling)	A	A	NR	A 25% to 200°F	NR	A	AC	A	AB to 150°F
Aluminum Chloride Dry 100%	A	A to 275°F	AC NR at 160°F	A to 125°F	A to 70°F	A to 212°F	AB to 140°F AC to 220°F	A	AC to 220°F
Aluminum Fluoride	A to 300°F (Resin)	A to 275°F	C to 70°F	A to 200°F	AB to 70°F	B C 10%	AB to 100% to 140°F (resin)	A	AB to 140°F (resin)
Aluminum Hydroxide 10%	A	A to 275°F	AB to 70°F	A 100% to 125°F	A 100% to 70°F	B to 70°F	AC to 100% to 200°F	A	A 100% to 200°F
Aluminum Nitrate	A	A 100% to 275°F	A to boiling	A to 200°F	A to 70°F	–	AC to 100% to 160°F	A	A to 160°F
Aluminum Potassium Sulphate 10% (alum)	A	AB to 280°F	AB to 100% to 150°F	A to 200°F	A to 70°F	AC to 300°F	AB to 140°F AC to 250°F	A	A to 250°F
Aluminum Sulphate 100%	A	A	AB to 70°F AC to 212°F	A	A to 70°F	A to 90% to 200°F B 100% to 200°F	AB to 140°F AC to 230°F	A	A to 250°F
Aluminum Sulphate 10%	A	A	AC to 212°F	A	A to 70°F	A to 200°F	AB to 140°F AC to 230°F	A	A to 250°F
Aluminum Sulphate ◄10% boiling	A	AB	A to 200°F	A	–	B	AC	A	A
Aluminum Sulphate ►10% boiling	A	AB	A to 200°F	A	NR	B	–	A	A
Aluminum Chlorohydroxide (wet)	A	–	NR	A to 70°F	A to 70°F	–	AC to 50% to 210°F	A	AB to 50% to 200°F
Amines	A	–	A to 100% to 212°F	A to 125°F	A to 70°F	–	AC to 100% to 80°F some to 210°F	A	A
Ammonia 100% Anhydrous (dry)	A	A to 280°F	A to 70°F AB to 212°F	A to 200°F	A to 70°F	AB	AB to 140°F AC to 180°F	A	A
Ammonia Aqueous (wet)	A	A to 275°F	A to 600°F	A to 200°F	A to 70% B at 122°F C at 212°F	A to 600°F	AB to 70°F C/NR at 150°F NR Liquid	A	A to 70°F B at 212°F
Ammonium Bifluoride	A	A to 275°F	NR 6% at 200°F A to 70°F B 45% at 250°F	A to 70°F	A to 70°F	–	–	A	A to 70°F
Ammonium Carbonate	A	A to 275°F	A 5% to 70°F B sat. to 212°F	A to 70°F	A to 70°F	B to 212°F	AB to 100% to 140°F NR 10% at 160°F	A	A to 140°F
Ammonium Chloride (saturated)	A	A to 275°F	A 75% to 140°F AC Pits on drying	A to 125°F A 25% to 250°F	A to 70°F	B to 800°F	AB to 100% to 140°F AC to 100% to 210°F	A	A to 200°F
Ammonium Chloride 10%	A	A	AC Pits on drying	A	A to 70°F	A to 175°F	AB to 140°F AC to 210°F	A	A
Ammonium Chloride ◄10% boiling	A	A	AC Pits on drying	A	–	B to 200°F	AC	A	A
Ammonium Chloride ►10% boiling	A	A	AC Pits on drying	A	NR	B to 200°F	–	A	AB to 50%

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL–PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Ammonium Fluoride 25%	A (Resin)	A conc. to 275°F	NR to 70°F	A to 200°F	–	A 45% at 265°F	AB to 100% to 140°F (resin)	A	AB to 100% to 180°F (resin)
Ammonium Hydroxide (concentrated)	A	A to 275°F	A to 70°F AB to 212°F	A to 300°F	A to 70°F	AB to 200°F B 10% at 212°F	AB to 100% to 70°F AC 5% to 180°F AC 30% to 150°F C/NR 100% at 140°F	A to 282°F	A to 150°F
Ammonium Nitrate (saturated)	A	A to 275°F	A to 100% to 200°F A 20% at 290°F	A to 125°F	A to 70°F	B	AB to 100% to 140°F AB to 10% to 220°F AB 45% to 200°F	A	A to 150°F
Ammonium Persulphate 5%	A	A 100% to 70°F	A 5% B 100%	A to 125°F	A (sat) to 70°F	B to 100%	AC to 100% to 180°F	A	A (sat) to 180°F
Ammonium Phosphate, Dibasic 5%	A	A 100% to 275°F	AB to 200°F	A to 125°F (to conc.)	A (sat) to 70°F	B to 200°F	AC 25% to 210°F AC 50-65% to 180°F Di & monobasic	A	A (sat) to 180°F
Ammonium Sulphate (saturated)	A	A to 275°F	AB to 300°F Pits on drying	A to 125°F	A to 70°F	B to 50% to 200°F AB 100% to 70°F	AB to 100% to 140°F AC to 100% to 220°F	A	A to 200°F
Ammonium Sulphate 10%	A	A	AB to 200°F	A to 125°F	A to 70°F	B to 200°F	AB to 140°F	A	A to 200°F
Ammonium Sulphate 10% boiling	A to 212°F	A	B Pits on drying	A	–	B	AC to 70°F	A	A to 70°F
Ammonium Sulphite boiling	A to 212°F	–	AB	NR	–	–	AB sat. at 70°F AC fumes	A	A to 70°F
Amyl Chloride	A	A to 275°F	A to 150°F	A to 200°F	A to 70°F	A to 70°F	AB to 100% to 70°F AC to 100% to 120°F NR 100% at 140°F	A	A to 150°F
Amyl Acetate	A	C A to 122°F B to 167°F NR at 230°F	A to 100% 70 - 300°F	A to 300°F	A to 70°F	A to 400°F	AB to 100% to 70°F AC to 100% to 120°F NR 100% at 140°F	A	A to 150°F
Aniline 100%	A to 180°F	A to 70°F B to 150°F C to 212°F	AB to 200°F A 400-500°F	A to 300°F	C at 70°F NR at 122°F	B to 200°F	B/NR to 100% to 70°F	A	C at 70°F NR at 122°F
Aniline Hydrochloride 100%	A to 200°F	AB 10% to 125°F	C/NR	A to 212°F	–	–	AC to 100% to 180°F	A	AB to 100% to 180°F
Antimony Trichloride 100%	A	A to 70°F	C/NR at 70°F A to 212°F	A to 200°F	–	–	AC to 100% to 220°F	A	AB to 100% to 200°F
Aroclor	A	–	B	A to 70°F	A to 70°F	A	–	A	A to 70°F
Aqua Regia	A	A to 70°F	NR	A to 100°F	NR to 70°F	C/NR NR boiling	NR liquid Ac fumes to 150°F	A to 248°F	NR to 70°F
Arsenic Acid	A	A to 275°F	A to 125°F B to 212°F	A to 200°F	A to 70°F	B to 212°F	AC to 100% to 80°F AC 19° Be to 180°F	A	A to 150°F
Asphalt	A	–	A AB to 750°F	A to 70°F	–	–	–	A	–
Asphalt Emulsions	A to 212°F	–	A	A to 70°F	–	–	–	A	A to 70°F
Barium Carbonate	A	A to 275°F	B to 212°F	A to 200°F	A to 70°F	B to 1500°F	AB to 100% to 140°F AC to 100% to 250°F	A	A to 220°F
Barium Chloride (saturated)	A	A to 275°F	A to 70°F Pits on drying	A to 125°F	A to 70°F	B to 212°F	AB to 100% to 140°F AC to 100% to 210°F	A	A to 220°F
Barium Chloride 30%	A	A to 275°F	AB 100% NR 25% at 95°F	A to 125°F	A to 70°F	B to 212°F B 10% to 600°F	AB to 140°F AC to 210°F	A	A to 220°F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL–PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Barium Chloride 5%	A	A to 275°F	AB	A to 125°F	A to 70°F	B to 800°F	AB to 140°F AC to 210°F	A	A to 210°F
Barium Chloride ►5% hot	A	A to 225°F	B hot Pits on drying AB to sat. to 70°F	A to 125°F	—	B to 200°F	AB to 140°F AC to 210°F	A	AB to 210°F
Barium Cyanide	A	—	A to 70°F	A to 70°F	—	—	—	A	—
Barium Hydroxide	A	A to 275°F	AB to 200°F A 10-50% to 212°F	A to 200°F	A to 70°F	B to 1500°F B to 50% to 200°F	B/NR 10% to 160°F	A	A to 150°F
Barium Nitrate	A	—	AB to 200°F	A to 70°F	A to 70°F	—	AB	A	A to 150°F
Barium Sulfate	A to 275°F	A to 275°F	AB to 70°F B 10% to 212°F	A to 300°F	A/NR to 70°F	A	AB to 100% to 140°F AC to 100% to 150°F	A	A/NR to 70°F
Barium Sulfide	A to 275°F	A to 275°F	B to 150°F	A to 200°F	B to 70°F	—	AB to 100% to 140°F AC to 100% to 180°F	A	AB to 140°F
Beer 160°F	A	A	A to 212°F	A to 70°F	A to 70°F	A to 70°F	AB to 140°F AB fumes to 150°F	A	A to 150°F
Beet Sugar Liquor (hot)	A	—	A	A to 70°F	A to 70°F	—	AC to 180°F	A	A to 150°F
Benzaldehyde 100%	A	A to 125°F	AB	A to 200°F	A to 70°F	A	B/NR at 75°F	A	A to 150°F
Benzene 100% (70°F)	A to 125°F	A to 125°F	B to 100% to 212°F	A to 200°F	B/NR to 70°F	AB	AB to 100°F AB vapors at 75°F	A to 200°F	A to 70°F
Benzene (hot)	B to 158°F C to 212°F	B to 158°F C at 212°F	B	A to 200°F	C/NR at 122°F NR at 212°F	AB to 200°F	NR at 140°F	A to 200°F	C/NR at 122°F NR at 212°F
Benzene Sulfonic Acid 100%	A to 212°F	A to 70°F C at 122°F NR at 212°F	B to 100% to 160°F	A to 300°F	B to 122°F C at 212°F	B to 100% to 200°F	AB to 10% to 140°F AC to 100% to 210°F	A	B to 122°F NR at 212°F
Benzoic Acid 10%	A	A to 248°F	B Any concentration 70°F to 212°F	A to 125°F	A to 70°F	B 100% at 70°F AB to 75% to 200°F	AB to 100% to 140°F AC to 100% to 210°F	A	A to 180°F
Benzonitrile	A	—	NR	A to 300°F	—	—	—	A	—
Benzyl Alcohol	A	A to 275°F	A to 70°F	A to 300°F	A to 70°F	—	AC to 100% to 100°F	A	A to 140°F
Benzyl Chloride	A	A to 275°F	AB to 100°F	A to 200°F	A to 70°F	—	AC to 100% to 80°F	A	A to 140°F
Blood	A	—	A	A to 70°F	—	—	A	A	A
Borax (hot)	A	A to 275°F	A	A to 300°F	A to 70°F	AB to 200°F	AB to 100% to 140°F AC to 100% to 210°F	A	A to 140°F
Boric Acid 5% (hot)	A	A to 275°F	AB to 212°F	A to 125°F	A to 70°F	A to 100% to 400°F	AB to 100% to 140°F AC to 100% to 210°F	A to 200°F	A to 210°F
Boric Acid 10% 70°F	A	A to 275°F	A 10% to 70°F AB to 100% at 212°F	A to 125°F	A 100% to 70°F	A 100% to 1400°F	AB to 100% to 140°F AC to 100% to 210°F	A to 200°F	A 100% to 70°F
Bromine Dry Gas	A to 212°F	A to 212°F	NR	A to 200°F	NR to 70°F	A	AB to 100°F AB fumes to 140°F	A	AC to 140°F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Bromine Moist Gas	A - Bromine Water 50% to 212°F	A Bromine Water 25% to 212°F A to 212°F	NR NR Bromine Water	A to 200°F	NR to 70°F BC Bromine Water	A A Bromine Water	AC to 100% to 80°F NR liquid	A A 25% Bromine Water to 200°F	NR to 70°F BC Bromine Water
Butadiene	A	A to 212°F	A	A to 125°F	A to 70°F	–	–	A	A to 140°F
Butane 100%	A	A	A to 185°F	A to 200°F	A to 70°F	A to 250°F	–	A	A to 140°F
Buttermilk	A	–	A	A to 70°F	A to 70°F	A	–	A	A
Butylene	A	A to 275°F	A	A to 200°F	A to 70°F	–	–	A	A
Butyric Acid, Dilute 5%	A to 100% at 150°F AB to 100% at 212°F	AB to 230°F	AB to 150°F	A to 125°F	C concentrated to 70°F	A to 200°F	AB to 80% to 70°F AC to 100% to 100°F AC to 50% to 210°F	A	AB to 100% to 70°F
Butyric Acid hot (concentrated)	AB to 212°F	AB to 230°F	B to 100% to 212°F	A to 125°F	NR►70°F	A to 70°F AB to 212°F	AC to 100% to 100°F	A	AC to 100°F
Butyl Acetate 100%	AB to 212°F	NR at 200°F AB to 125°F C at 167°F	A to 100% to 300°F	A to 300°F	AB to 70°F	A to 100% to 300°F	A/NR to 100% to 70°F NR 100% at 140°F	A	AB to 70°F
Butyl Amine	A	NR n-Butylamine A to 70°F Becomes brittle	A	A to 300°F	–	AB to 200°F	NR at 80°F	A	AB to 140°F
Butyl Ether	A	A	A	A to 300°F	A to 70°F	–	B/NR to 150°F	A	A to 140°F
Butyl Phthalate	A	A to 75°F	–	A to 125°F	–	–	AC to 190°F	A	A
Butyl Chloride 100%	A	A to 275°F	A to 70°F	A to 125°F	–	A	–	A	A
Calcium Bisulfite (hot)	A	A to 275°F	A to 90% to 400°F B 100% to 300°F	A to 125°F	A to 70°F	AB to 100% to 200°F	AB to 100% to 140°F AC to 100% to 180°F	A	A to 180°F
Calcium Carbonate	A	A to 275°F	B to 250°F	A to 200°F	A to 70°F	B to 1500°F	AB to 100% to 140°F AC to 100% to 180°F	A	A to 180°F
Calcium Chloride (saturated)	A	A to 275°F	A 100% to 212°F Pits on drying	A to 300°F	A to 70°F	A to 100% to 200°F C 58% to 345°F	AB to 100% to 140°F AC to 100% to 220°F	A	A to 220°F
Calcium Chloride (dilute)	A	A	B to 80% to 125°F Pits on drying	A to 300°F	A to 70°F	A to 100% to 200°F	AB to 100% to 140°F AC to 100% to 220°F	A	A to 220°F
Calcium Hydroxide 10% (boiling)	A	A to 275°F	AB	A to 125°F	A to 70°F	AB ◄200°F	AC 15% to 180°F AC 25-100% to 210°F	A	A to 180°F
Calcium Hydroxide 20% (boiling)	A	A to 275°F	AB	A to 125°F	A to 70°F	A◄200°F AB to 300°F	–	A	A to 180°F
Calcium Hydroxide 30% (boiling)	A	A to 275°F	B	A to 125°F	A 100% to 70°F	A◄200°F	–	A	A to 180°F
Calcium Hypochlorite 100%	A	A to 275°F	AB to 70°F NR standing solution	A to 125°F	A to 70°F	AB	AB to 100% to 140°F AC to 100% to 180°F	A	A to 180°F
Calcium Hypochlorite 2% (boiling)	A	A to 275°F	AB Pits on drying	A to 125°F	A 100% to 70°F	AB to 20%	–	A	A 100% to 220°F
Carbolic Acid (phenol)	A 100% to 70°F A 10% to 212°F	C 100% to 212°F A 100% to 158°F A 10% to 212°F	NR 70-90% at 400°F B 90% to 212°F B 100% to 700°F	A to boiling	BC to 70°F	A 90% to 212°F A 100% to 600°F	NR 100% at 70°F AC 88% at 70°F AC 2-5% to 80°F AC Fumes to 140°F	A	BC to 70°F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Calcium Nitrate	A	A to 275°F	AB to 130°F	A to 125°F	A to 70°F	AB to 200°F	AB to 50% to 140°F AC to 100% to 210°F	A	A to 200°F
Calcium Sulfate	A	A to 275°F	AB to 200°F A 10% to 212°F	A to 300°F	A to 70°F	B ◄200°F	AB to 100% to 140°F AC to 100% to 200°F	A	A to 200°F
Carbon Dioxide 100%	A	A to 275°F wet or dry	A to 70°F	A to 200°F wet or dry	A to 70°F	A to 200°F	AC to 250°F	A wet or dry	A to 200°F
Carbon Disulfide	A	AB to 122°F	A 90% B 100% to 212°F	A to 300°F	A/C to 70°F NR at 122°F	AB to 200°F	NR 100% AC (fumes) to 150°F	A	A/C to 70°F NR at 122°F
Carbon Monoxide	A	AB to 275°F	A to 1600°F	A to 70°F	A to 70°F	A to 750°F	AC to 250°F	A	A to 250°F
Carbon Tetrachloride (wet)	A to 250°F	A to 275°F	AB to 212°F NR hot moist gas	A to 200°F	A/NR to 70°F C/NR at 122°F	A to 100% to 100°F B 100% 160-250°F	AC to 100% to 150°F	A	A to 100% to 180°F
Carbon Tetrachloride (hot, dry)	A	A to 275°F	AB	A to 200°F	A to 70°F	A to 100% to 100°F B 100% 160-250°F	AC to 200°F	A	A to 200°F
Carbonic Acid (saturated)	A	A to 275°F A to 70°F	A to 1500°F A 30% to 212°F	A to 125°F	AB to 70°F	A ◄70°F AB to 200°F	AC to 210°F	A	AB to 210°F
Caustic Potash (potassium hydroxide)	A	AB to 50% to 175°F	AB to 350°F	A to 200°F	A to 70°F	B 100% to 70°F B 10-60% to 300°F	B/NR to 45% to 150°F	A	A to 180°F
Caustic Soda (sodium hydroxide)	A	A to 250°F Brittle at 250°F	A to 70°F	A to boiling	A to 70°F	B 100% to 70°F B 10-70% to 212°F	AC 5% to 212°F AC 10% to 180°F AC 25% to 120°F AC 50% to 210°F	A to 50% to 248°F	A to 70°F AB to 50% at 200°F
Cellosolves	A	A to 275°F	A	A to 300°F	A to 70°F	AB to 200°F	AB to 220°F	A	A to 220°F
Chloric Acid	A to 212°F	—	C/NR	A to 70°F	—	A	AC to 10% to 120°F	A	A to 120°F
Chlorinated Water (saturated)	A	AB to 225°F	AC Pits on drying	A to 300°F	A to 70°F	A	AC to 195°F	A	A to 200°F
Chlorine (dry)	AB to 250°F	A to 212°F	AB	A to 200°F	—	AB	AC to 250°F	A	AB to 150°F
Chlorine (moist)	AB to 250°F AB fumes to 350°F	A to 212°F AB liquid to 200°F	C ◄125°F NR ►200°F	A to 300°F	C/NR to 70°F NR at 122°F	NR 10% at 70°F B 90% to 160°F A 100% to 600°F	AC to 220°F AC fumes to 350°F	A	AB to 200°F C fumes to 350°F
Chloroacetic Acid	A to 212°F	A conc. to 70°F A 50% to 212°F B conc. at 122°F C conc. at 212°F	A 78-100% at 70°F B 78-100% at 140°F NR 40% at 70°F	A to 200°F	C/NR to 70°F NR at 122°F	B 40% to 212°F A 100% to 250°F	AC to 25% to 210°F AC 50% to 150°F AC conc. to 100°F NR conc. to 140°F	A 50%	AC to 50% to 150°F
Chlorobenzene (dry)	A to 100°F AB to 212°F	A to 70°F B at 122°F C at 212°F	AB	A to 300°F	AC to 70°F C at 122°F NR at 212°F	AB	AB to 100% to 80°F NR 100% to 140°F B/NR 100% to 80°F	A	AC to 70°F C at 122°F NR at 212°F
2 Chloroethanol	A to 100% at 100°F	—	—	A to 300°F	—	—	AC to 100% to 100°F	A	AC to 100% to 70°F
Chloroform	A	A to 212°F	A to 70°F B to 200°F	A to 300°F	A/C to 70° softened NR at 122°F	A 100% to 70°F B to 100% to 200°F	NR 100% at 75°F	A	A/C to 70°F softened NR at 122°F
Chlorophenol 5% Aqueous	A	AB to 150°F	AB vapors to 350°F	A to 70°F	—	—	—	A	A to 150°F
Chlorosulfonic Acid	A to 70°F AB to 122°F	C to 70°F NR at 122°F	B to 125°F Pits	A to 70°F A 5% to 200°F	C/NR to 70°F NR at 122°F	A 20-100% at 70°F A 100% to 200°F	NR 100% at 75°F	A	C/NR to 70°F NR at 122°F
Chlorosulfonic Acid Dilute	AB to 212°F	—	B/NR	A to 200°F	C to 70°F	B to 70°F	—	A	C to 70°F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL–PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Chromic Acid (dilute)	A	A to 120°F	A to 25% B to 15% at 180°F	A to 300°F	B 5% to 70°F C 10% to 70°F	B to 50% to 200°F B to 100% at 70°F	AC 5% to 120°F AC 10% to 100°F AC 20% to 80°F NR 30% at 70°F	A	B 5% to 70°F C 10% to 70°F
Chromic Acid (concentrated)	A to 55% at 212°F	A 50% to 120°F C 50% at 212°F B 50% at 167°F	AC to 125°F NR 10-50% to 212°F	A 50% to 125°F	C/NR 30% to 70°F NR 30% at 122°F	B	NR►50%	A	C/NR 30% to 70°F NR 30% at 122°F
Chromic Acid ◄10% boiling	A	NR	NR	A to 300°F	NR	A to 150°F B to boiling	NR	A	NR
Chromic Acid ►10% boiling	A to 55% Boiling	NR	NR	AB to 31%	NR	A at 70°F B at 150°F C at boiling	NR	A 50% to 248°F	NR
Citric Acid (hot, concentrated)	A	A to 248°F	A at 150°F B/NR to 200°F	A to 200°F	A to 70°F	A to 100% to 200°F	AB to 100% to 140°F AC to 100% to 210°F	A	A to 210°F
Citric Acid (dilute) 15%	A	A to 248°F	A to 50% to 200°F	A to 200°F	A	A to 200°F	AB to 140°F AC to 210°F	A	A to 210°F
Copper Cyanide (saturated)	A	A to 275°F	A 10% boiling B sat. boiling B 20-100% to 212°F	A to 200°F	AC to 70°F	B 10% to 212°F A 100% at 70°F	AC to 10% to 210°F	A	AC to 20% to 210°F
Copper Fluoride	A	A to 275°F	–	A to 200°F	–	–	AB to 100% to 140°F	A	A
Copper Nitrate (hot, concentrated)	A	A to 275°F	B 20-90% to 200°F A to 200°F AB to 300°F	A to 200°F	A to 70°F	B to 100% to 70° NR ►70°F	AB to 100% to 140°F AC to 100% to 210° F	A	A to 180°F
Copper Sulfate (hot, concentrated)	A	A to 275°F	AB to 300°F AB to 90% to 300°	A to 200°F	A to 70°F	A to 100% to 200°F	AB to 100% to 140°F AC to 100% to 250°F	A	A to 220°F
Cottonseed Oil	A	A to 275°F	A	A to 200°F	A to 70°F	–	AB to 100% to 140°F AC to 100% to 200°F	A	A to 220°F
Creosote Hot (wood & coal tar)	A	–	AB to 190°F	A to 70°F	A to 70°F	AB	–	A	A to 220°F
m-Cresol (crude)	A	A to 120°F B at 167°F C at 212°F	A	A to 300°F	A to 70°F	AB to 200°F	AC 10% fumes to 140°F	A	A to 220°F
Crude Oil	A	A to 275°F	A sweet to 825°F	A to 200°F	A to 70°F	–	AC to 220°F	A	A to 220°F
Cresylic Acid 50%	A	C 100% at 212°F AB to 150°F AB 100% to 70°F	A 100% to 300°F	A to 200°F	A sat. 70°F	AB to 70°F	NR liquid AC fumes to 140°F	A	A to 220°F
Cresyldiphenyl Phosphate	A	–	–	–	–	–	–	A	–
Cupric Chloride ◄2%	A	A to 275°F	B Pits on drying	A to 300°F	A to 70°F	A	AB to 140°F AC to 220°F	A	A to 220°F
Cupric Chloride 5%	A	A 5% to 275°F A 25% to 70°F AC sat'd. to 225°F	C/NR Pits on drying NR at 212°F	A 25% to 300°F	A 100% to 70°F	A 100% to 100°F AB to 100% to 212°	AB to 100% to 140°F AC to 100% to 220°F	A	A to 220°F
Cyanic Acid	A	–	A sat. boiling	A to 70°F	A to 70°F	–	–	A	A to 140°F
Cyclohexane	A	A to 275°F	A	A to 125°F	A to 70°F	AB to 200°F	AC to 100% to 120°F AC vapor to 170°F	A	A to 140°F
Cyclohexanol	A	A to 167°F AB to 212°F	A	A to 125°F	A to 70°F	–	–	A	A to 140°F
Cyclohexanone	A to 100°F C to 122°F NR to 212°F	A to 70°F C at 122°F NR at 212°F	A	A to 300°F	C to 70°F	–	AB to 85°F	A	C to 70°F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Detergents (general)	A	–	A to 70°F AB to 170°F	A to 300°F	A to 70°F	AB to 200°F	AB to 100% to 140°F AC to 100% to 220°F	A	A to 200°F
Diacetone Alcohol (acetol)	A	A to 70°F B to 122°F C to 158°F NR at 212°F	A	A to 200°F	AB	–	–	A	AB
Dibutylphthalate	A to 100% to 212°	NR at 75°F	B 100% to 150°F	A to 70°F	–	B	AC to 100% to 200°F	A	AB
Dichlorobenzene	AB to 122°F	AB to 125°F	AB	A to 125°F	C at 70°F A vapors	–	B/NR to 100% to 100°F	A to 70°F	B at 70°F A vapors
Dichloroethane	A to 212°F	A to 70°F B at 122°F C at 212°F	AB to Boiling	A to 70°F	AC to 122°F NR at 212°F	–	B/NR to 100% to 80°F	A	AC to 122°F NR at 212°F
Dichlorodifluoro Methane (Freon 12)	A wet	A to 212°F	B 100% NR wet	A to 70°F	A wet	A	–	A	A wet
Dichloroethylene	AB to 120°F	AB to 125°F	–	A to 200°F	–	–	NR at 80°F	A to 70°F	AB at 70°F
Diesel Fuel	A	A to 275°F	A	A to 200°F	A to 70°F	AB to 200°F	AC to 200°F	A	A to 200°F
Diethanolamine	A	–	A to 100% to 212°F	A to 70°F	–	A to 85°F	AC to 100% to 120°F	A	AB to 160°F
Diethylamine	A to 100°F B to 150°F	A to 70°F B 122-158°F NR at 167°F	AB to 100°F	A to 200°F	–	–	NR 100%	A	AB to 70°F
Diethylene Glycol	A to 150°F AB to 212°F	–	A to 170°F	A to 125°F	B/NR	B	AB to 100% to 140° F AC to 100% to 200° F	A	AC to 100% at 200°F
Diethylether	AB to 70°F B to 122°F	AB to 70°F B at 122°F	B	A to 300°F	–	B	NR at 75°F	A to 70°F	NR
Diisobutylene	A to 100% to 150°F	A to 275°F	A	A to 200°F	–	–	AC to 100% to 100°F	A	AB to 100% at 100°F
Dimethyl Aniline	A	NR at 230°F C 158-212°F A to 70°F B to 122°F	–	A to 300°F	A to 70°F	–	–	A	A to 140°F
Dimethyl Formamide	A	NR at 70°F	A	A to 200°F	–	–	NR	A	A to 70°F
Dimethyl Phthalate	A to 100% to 212°F	NR at 200°F A to 70°F B to 122°F	A	A to 300°F	–	–	AC to 100% to 180°F	A	A to 100% to 180°F
Dimethyl Sulfoxide	A	–	–	A to 300°F	–	–	NR at 75°F AC fumes to 80°F	A	AB to 100°F
Diphenyl	A	–	B 100% at 160°F	–	–	B 100% at 160°F	–	–	A
Diphenyl Ether	A	–	A	A to 125°F	A to 70°F	–	AC to 100% to 120°F	A	A to 140°F
Diphenyl Oxide	A	AB to 125°F	B 100% at 85°F	–	A	B 100% at 85°F	AC to 150°F	–	A
Dipropylene Glycol	A to 180°F	AB to 70°F	–	A to 125°F	NR	–	AC to 100% to 180°F	A	AB to 140°F
Dioctyl Phthalate	A to 212°F	AB to 70°F	A	A to 300°F	–	–	AB to 100% to 140° F AC to 100% to 210° F	A	AB to 140°F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
P-Dioxane	A	C to 122°F NR at 158°F NR Dioxane 1, 4	Q	A to 300°F	NR	–	NR	A	A to 70°F
Dow Therm	A to 260°F	–	A to 70°F AB to 300°F	A to 300°F	–	A	AC to 150°F	A	AB to 200°F
Epichlorohydrin (dry)	A	C to 70°F NR at 122°F	A	A to 300°F	AB	–	C/NR at 80°F	A	AB to 70°F
Ethane	A	–	A to 70°F	A to 70°F	A to 70°F	–	–	A	A to 140°F
Ethanolamine	A	C to 70°F NR at 122°F	A to 100% to 320°F	A to 300°F	A to 70°F	AB to 200°F	AC to 100% to 80°F	A	A to 140°F
Ethers	A	AB to 70°F NR at 200°F	AB to 70°F	A to 125°F	A to 70°F	B to 70°F	AC to 100% to 180°F	A	A to 180°F
Ethyl Acetate	A to 70°F B to 122°F	NR at 212°F A to 70°F B at 122°F	AB to 212°F	A to 300°F	A/NR to 70°F NR at 122°F	A to 100% to 200°F	C/NR to 100% at 80°F	A	A/NR to 70°F NR at 122°F
Ethyl Benzoate	A	–	–	A to 125°F	–	–	–	A	A
Ethyl Benzene	A to 100% at 100°F B to 180°F	–	AB to 150°F	A to 125°F	NR	–	AC to 100% to 100°F	A	AC to 100% to 100°F
Ethyl Butyrate	A	–	AB to 180°F	A to 125°F	–	–	–	A	A
Ethyl Chloride (wet)	A	A to 275°F	A to 600°F	A to 300°F	A to 70°F	B to 100% at 70°F B 100% to 200°F	C/NR 100% at 70°F NR 100% ►70°F	A	A to 70°F
Ethyl Ether	A	–	AB	A to 300°F	AB	B	NR at 75°F	A	AB
Ethyl Sulfate	A	–	NR to 70°F	A to 70°F	A to 70°F	–	AC to 100% to 100°F	–	A to 100°F
Ethylene Bromide	AB to 212°F	A to 275°F	AB	A to 200°F	–	–	NR	A	B to 100°F
Ethylene Chlorhydrin	A to 100% at 250°F	A to 70°F B at 122°F C at 158°F NR at 212°F	AB to 150°F	A to 200°F	–	–	AC to 100% to 200°F	A	A to 100% to 200°F
Ethylene Chloride	A	A to 275°F	A to 70°F	A to 125°F	AB to 70°F	–	NR 100%	A	AB to 70°F
Ethylene Diamine	A	B to 70°F NR at 122°F	A	A to 200°F	A to 70°F	C	AC to 100% to 100°F	A	A to 100°F
Ethylene Dibromide	A to 212°F	A to 275°F	A to 70°F B at 212°F A vapors	–	–	B to 212°F	AC fumes to 80°F	A to 70°F	A to 70°F
Ethylene Dichloride	A to 100°F AC to 150°F	A to 275°F	A to 70°F B to 200°F A vapors	A to 200°F	A/NR to 70°F	AB to 200°F	NR at 75°F	A	AB to 70°F
Ethylene Glycol (dihydroxyethane)	A to 100% to 212°F	A to 275°F	AB to 160°F A to 70°F	A to 200°F	A/NR to 70°F	AB to 70°F	AB to 100% to 140°F AC to 100% to 210°F	A	AB to 100% to 160°F
Ethylene Oxide	A	A to 70°F B at 122°F C at 167°F NR at 212°F	AC to 70°F	A to 200°F	A to 70°F	–	–	A	A
Fatty Acids	A	A to 275°F	A to 500°F	A to 125°F	A to 70°F	A to 500°F	AC to 100% to 220°F	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Ferric Chloride (concentrated)	A to 250°F	A to 275°F	NR	A 50% to 200°F	A 50% to 70°F	AB to 75°F B to 125°F	AB to 100% to 140° F AC to 100% to 210° F	A	A to 180°F
Ferric Chloride ◄1%	A	A to 275°F	AB Pits on drying	A to 250°F	A to 70°F	A	AB to 140°F AC to 210°F	A	A to 220°F
Ferric Chloride ►1%	A	A to 275°F	B/NR to 70°F	A 25% to 250°F	A 50% to 70°F	A to 10% B to 45%	AB to 140°F AC to 210°F	A	A 50% to 220°F
Ferric Chloride ◄1% boiling	A	A	C/NR Pits on drying	A	–	NR	AC	A	AB
Ferric Chloride ►1% boiling	A	A	NR	A	NR	NR	AC	A	AB
Ferric Nitrate 5%	A	A to conc. to 275°F	A to 100% to 70°F A 5% to 200°F B 10-50% to 200°F	A to 200°F	A 100% to 70°F	B 100% at 70°F A 5% to 70°F B 25-50% to 70°F	AB to 100% to 140° F AC to 100% to 210° F	A to conc.	A 100% to 200°F
Ferric Sulfate 5%	A	A to conc. to 275°F	A to 100% to 70°F A 10% to 212°F	A to 200°F	A 100% to 70°F	A 100% to 70°F A to 30% to 125°F B to 30% at 160°F	AC to 100% to 210°F	A to conc.	A 100% to 200°F
Ferrous Chloride	A	A to 275°F	A/NR at 100% B sat'd. at 275°F	A to 200°F	A to 70°F	B to 50% to 200°F B 100% at 70°F	AB to 100% to 140° F AC to 100% to 210° F	A	A to 200°F
Ferrous Sulfate 10%	A	A to conc. to 275°F	B to 100% to 200°F	A to 200°F	A 100% to 70°F	B to 100% to 200°F	AB to 100% to 140° F AC to 100% to 210° F	A to conc.	A 100% to 200°F
Fluoboric Acid	A	A to 275°F A to 70°F	A 30-40% C 100% A 1% at 250°F	A to 70°F	A	A 100% at 70°F	AB to 100% to 140°F AC 10% to 220°F AC 20% to 200°F	A to 70°F	A to 180°F
Fluosilic Acid	A	A to 70°F AB to 275°F	AB to 20% at 70°F AB 90-100% 70-212°F NR 20-30% to 160°F	A to 200°F	AC	B 10-100%	AC to 100% to 70°F NR 32-100% at 140°F AC 30% to 100°F	A	AC
Fluorine Dry Gas	NR	A to 70°F	AB to 450°F NR at 500°F	A to 70°F B to 125°F	–	B to 70°F	NR	A	NR
Fluorine Dry Gas 300°F	NR	NR	AB to 450°F NR at 500°F	NR	–	A	NR	NR	NR
Fluorine Moist Gas	NR	A to 70°F	NR to 90%	NR	–	–	NR	A	NR
Formaldehyde 37% (Formalin)	A	A to 120°F C at 212°F	A to 100% to 70°F AB to 40% to 212°F	A to 200°F	A 100% to 70°F B at 122°F C at 212°F	B to 100% to 200°F	AC 40% to 140°F AC to 25% to 200°F	A	A 100% to 70°F AB at 122°F AC at 212°F
Formic Acid	A	A to 122°F BC at 212°F B 20% at 230°F	A 5% motionless at 150°F C to 100% to 212°F	A to 212°F	A 20% to 70°F C 60% to 70°F C 20% 122-212°F NR 60% 122-212°F	A to 100% to 200°F	AC 10% to 180°F AC 50% to 120°F AC 100% to 100°F NR 100% at 140°F	A	A 20% to 70°F C 60% to 70°F C 20% 122-212°F NR 60% 122-212°F
Freon Dry	A	A to 212°F	A	A to 200°F	A to 70°F	A to 100% to 200°F	AC to 75°F (Freon 11)	A	A
Freon Wet	A	A to 212°F	C	A to 200°F	A to 70°F	A to 100% to 200°F	–	A	A
Fuel Oils	A	AB to 275°F	A to 212°F	A to 300°F	A to 70°F	A to 70°F	AB to 70°F AC to 100°F	A	A
Furan	A	NR	A	A to 200°F	A to 70°F	–	–	A	A
Furfural (Furfuraldehyde)	A	B to 122°F C at 167°F NR at 212°F	A 10% to 212°F AB to 450°F B 30-100% to 212°F	A to 200°F	A to 70°F	B to 100% to 200°F	AC 5% to 150°F AC 10% to 120°F NR ►50%	A	A to 140°F
Gallic Acid	A	A to 70°F B to 120°F	A 5% to 150°F B to 100% to 212°F	A to 200°F	–	B 100% 70°F to 212°F	–	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Gas Natural	A	A to 275°F	A ◄480°F	A to 200°F	A	–	AB to 210°F	A	A to 200°F
Gasoline Leaded Refined	A	A to 275°F	A	A to 300°F	A	A	AB to 140°F AC to 175°F	A	A to 200°F
Gasoline Unleaded Refined	A	A to 275°F	A	A to 300°F	A	A to 325°F	AB to 140°F AC to 175°F	A	A to 200°F
Gelatin	A	–	A to 140°F	A to 70°F	AB	–	AB to 120°F	A	A to 200°F
Glucose	A	A to 275°F	A	A to 200°F	AB	–	AB to 100% to 220°F	A	A to 220°F
Glue	A	–	A to 140°F	A to 70°F	A	–	–	A	A to 200°F
Glycerine (Glycerol)	A	A to 275°F	A to 212°F	A to 125°F	A to 212°F	A to 100% to 200°F A 100% to 600°F	AB to 100% to 220°F AC to 75% to 250°F	A	A to 212°F
Glycolic Acid (Hydroxy Acetic)	A	A to 70°F B to 120°F C to 150°F NR at 211°F	A	A to 200°F	A	–	AB 10% to 200°F AB 30% to 140°F AB 70% to 100°F	A	A to 70% at 140°F
Glycol (Ethylene Glycol)	A	A to 275°F	AB	A to 200°F	A/NR at 70°F	AB	AB to 100% to 140°F AB ◄100% to 210°F	A	AB to 100% to 200°F
Heptane	A	A to 275°F	A	A to 300°F	A	A	AB to 100% to 140°F	A	A
Hexane	A	A to 275°F	A A vapors to 250°F	A to 300°F	AB	A	AB to 100% to 100°F	A	A
Hexamine	A	–	A 80% to 125 °F A 100% at 70°F	–	–	A 10-80% to 125°F	AB to 65°F	A to 70°F	A to 70°F
Hydraulic Fluid (Petroleum)	A	–	A ◄480°F	A to 70°F	A	–	AB to 180°F	A	A
Hydraulic Fluid (Synthetic)	A	–	A ◄480°F	A to 70°F	A	–	AB to 180°F	A	A
Helium	A	–	A ◄480°F	A to 70°F	–	–	–	A	A
Hydrobromic Acid (37% concentrated)	A to 212°F	A to 275°F	NR to 70°F	A conc. to 300°F	B 20% to 70°F NR 37% at 70°F	A 20% at 70°F A/NR to 212°F	AB to 25% to 180°F AB to 62% to 100°F	A to 50%	A to 25% to 180°F B to 50% at 100°F
Hydrochloric Acid (20% to concentrated)	A	A 100% to 275°F	NR	A conc. to 200°F	A 37%	A to 70°F B conc. to 125°F	AB conc. to 140°F AC 37% to 100°F	A to 36% to 248°F	A 37% to 200°F
Hydrochloric Acid 1-20%	A	A to 275°F	NR	A	A to 70°F BC at 122°F	A	BC to 15% to 220°F C/NR 37% at 180°F	A to 248°F	A to 200°F
Hydrochloric Acid ◄1%	A	A to 275°F	NR	A	A	A	AC (fumes) to 250°F	A to 248°F	A to 220°F
Hydrochloric Acid 1% 175°F	A	A to 275°F	NR	A	–	A	AB	A	A
Hydrochloric Acid ½-2% 175°F	A	A to 275°F	NR	A	–	A	AB	A	A
Hydrochloric Acid ►2% 175°F	A	A to 275°F	NR	A	NR	C 10%	BC to 15% C/NR 37%	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Hydrochloric Acid ◄¼% boiling	A	A to 275°F	NR	A	NR	NR	AC	A	A
Hydrochloric Acid ◄1% boiling	A	A to 275°F	NR	A	NR	NR	AC	A	A
Hydrochloric Acid ►1% boiling	A	A 100% to 275°F	NR	A conc.	NR 10%	NR	BC to 15%	A to 36%	A
Hydrocyanic Acid	A	A to 275°F	A to 45°F B at 70°F B 10% boiling	A to 200°F	A	A to 70°F B 100% to 200°F	AB 10% to 150°F	A	A to 160°F
Hydrofluoric Acid ◄40%	A (Resin)	A to 248°F	A 10% air free NR 60% - 9%	A	A	A	AB 10% to 150°F AB 20% to 100°F (resin only)	A	A to 160°F (resin)
Hydrofluoric Acid 35%	A (Resin)	A to 248°F	AB air free	A	A	A	NR at 75°F	A	A (resin)
Hydrofluoric Acid ►40%	A (Resin)	AB 60% to 248°F A 100% to 212°F	AB 100% at 70°F A 93% at 215°F	A 60% to 73°F A 50% to 300°F	AB to 75% at 70°F C 40% at 122°F	AB to 125°F	NR at 75°F	A	AB to 75% at 70°F C 40% at 122°F (resin)
Hydrofluoric Acid boiling	A (Resin)	A	A 1-10%	A 50%	C/NR 40%	B 30% B 50-100% NR 40%	NR	A	C/NR 40%
Hydrofluosilicic Acid	A (Resin)	AB to 275°F A to 70°F	AB 90-100% to 212°F AB to 20% at 70°F B/NR to 30% at 160°F	A to 200°F	AC to 70°F	B 10-100%	AB to 10% to 150°F AB 30% to 100°F (resin)	A	A to 150°F (resin)
Hydrofluorosilicic Acid	A (Resin)	AB to 275°F A to 70°F	AB 90-100% to 212°F AB to 20% at 70°F B/NR to 30% at 160°F	A to 200°F	AC to 70°F	B 10-100%	AB to 10% to 150°F AB 30% to 100°F (resin)	A	A to 150°F (resin)
Hydrogen Gas	A to 300°F	A to 275°F	A to 1700°F	A to 300°F	–	A to 700°F	AB conc. to 250°F	A	A to 250°F
Hydrogen Chloride (dry) Gas	A to 300°F	A to 275°F	A to 500°F C at 700°F	A to 200°F	–	B at 160°F C 212° - 700°F A ◄125°F	AB to 210°F	A	A to 250°F
Hydrogen Chloride (moist) Gas	A to 300°F	A to 275°F	B at 400°F	A to 70°F	–	–	AB to 250°F	A to 70°F	A to 250°F
Hydrogen Cyanide	A to 300°F	A to 275°F	B	A to 200°F	–	–	–	A	A to 250°F
Hydrogen Fluoride (Anhydrous)	A to 180°F (Resin)	–	A to 125°F B to 400°F	–	–	B to 700°F	(wet or dry) AB to 180°F (resin only)	A to 70°F	A to 120°F (resin)
Hydrogen Peroxide	A 30% to 212°F A 3% to 212°F	A 30% to 248°F A 90% to 70°F	B to 40% to 212°F A sat. boiling A 90% to 125°F	A 90% to 150°F	AB 30% to 212°F AC 3% to 70°F BC 3% 122-212°F	A to 90°F	AB 5% to 150°F AB 30% to 140°F AB 50% to 100°F	A to 90%	AB 30% to 212°F AC 3% to 70°F BC 3% 122-212°F
Hydrogen Sulfide (dry)	A	A to 275°F	AB to 600°F	A to 300°F	A	A to 70°F B to 200°F	AB to 220°F	A	A to 220°F
Hydrogen Sulfide (moist)	A	A to 275°F AB solution to 225°F	AC to 100°F	A to 300°F	A	A ◄170°F A solution to 70°F	AB to 220°F	A	A to 220°F
Iodine	A	A (wet or dry) to 158°F	NR 90% B 100%	A to 300°F	B/NR	A to 500°F B◄100% to 212°F	AB (vapors) to 150°F	A	AB to 150°F
Hexanol Tertiary	A	–	A	A to 70°F	A	–	–	A	A
Hydrazine	A	A 48% to 275°F	A	A to 70°F	A	–	NR	A	A
Hypochlorous Acid	A to 212°F	A to 275°F	NR	A to 200°F	–	–	AB 10% to 180°F AB 20% to 150°F AB conc. to 140°F	A	A to 140°F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
ISO Butyl Alcohol	A	–	A	A to 125°F	A	–	AB to 120°F	A to 70°F	A to 150°F
ISO Octane	A	A at 275°F	A	A to 70°F	–	–	–	A to 70°F	A
ISO Propyl Acetate	A	–	B	A to 125°F	A	B	–	A to 70°F	A
ISO Propyl Alcohol	A	–	AB A 25% to 140°F	A to 125°F	A	B	AB to 100% to 100°F	A to 70°F	A to 100°F
ISO Propyl Ether	A	–	A	A to 70°F	–	–	–	A to 70°F	A
Jet Fuel (JP3 JP4 JP5)	A	A to 212°F	A	A to 125°F	A	A	AB to 120°F AC to 210°F	A	A to 210°F
Kerosene	A	A at 275°F	A to 410°F	A to 300°F	A	A	AB to 150°F AC to 210°F	A	A to 210°F
Ketones	A	NR at 200°F C/NR at 70°F	A to 280°F	A to 300°F	C	A	C/NR at 70°F NR ►70°F	A	A
Lactic Acid	A	BC to 122°F NR 75% at 212°F B to 70°F	AB to 70°F B at 212°F	A to 300°F	AB at 70°F C 75% at 122°F NR 75% at 212°F	AB to 70°F B at 212°F	AB to 100% to 210°F	A	A
Lacquers and Lacquer Solvents	A	–	A	A to 70°F	A	A	–	A	A
LPG Propane	A	A	A	A to 200°F	–	–	AB liquid to 44°F	A	A
Lard	A	A at 275°F	A	A to 200°F	AB	–	–	A	A
Latex	A	–	A to 140°F	A to 70°F	A	–	AB to 100% to 100°F (rubber, acrylic, vinyl)	A	A
Lead Acetate	A	A at 275°F	B to 100% 70°F to Boiling	A to 200°F	A	B 70% to 212°F	AB to 100% to 150°F	A	A
Lead Molten ►600°F	NR	NR	B 700% to 950°F	NR	NR	–	NR	NR	NR
Lead Nitrate	A	–	B to 70% to 212°F B 100% at 70°F	A to 125°F	–	B to 212°F	AB to 100% to 220°F	A to 70°F	A
Lead Sulfamate	A	–	AC	A to 125°F	A	–	–	A to 70°F	A
Lime-Sulpher (Calcium Sulfide)	A	AB to 225°F	A	A to 70°F	–	–	–	A to 70°F	A
Linoleic Acid	A	A to 250°F	A	A to 200°F	–	–	AB to 210°F	A	A
Linseed Oil	A	A at 275°F	A to 70°F A+3% H_2So_4 at 390°F	A to 200°F	A	A	AB to 100% to 210°F	A	A to 200°F
Lithium Chloride 30% at 200°F	A	–	B to 70% to 160°F A 20% to 100% at 70°F	A 100% to 125°F	–	A to 60% to 212°F	AB to 100% to 210°F	A	A
Lithium Hydroxide 10% at 200°F	A	–	B 10% & 100% to 212°F	A 100% to 125°F	–	B	–	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Lubricating Oil	A	A to 275°F	A to 170°F	A to 200°F	A	A	AB to 200°F	A	A
Lye (Sodium Hydroxide, Calcium Hydroxide, Potassium Hydroxide)	A	A to 212°F	A 10-20% to 212°F B 30-50% to 212°F Stress Cracks 50-100% ► 400°F	A 1-100% to 125°F A 50% to 250°F	A conc. at 70°F A 5% to 122°F B 40% to 122°F C 40% to 212°F	A 10-70% to 212°F A 100% at 70°F	AB 5-10% to 150°F AB 25-50% to 180°F AB►50% to 210°F	A to 50% to 248°F	A conc. at 70°F A 5% to 122°F B 40% to 122°F C 40% to 212°F
Lime (Calcium Oxide)	A	AB to 250°F	A AB to 200°F	–	A	–	AC to 170°F	A to 70°F	A
Magnesium Carbonate	A	A to 275°F	A 70°F to hot	A to 125°F	A	–	AB to 100% to 150°F AC to 100% to 210°F	A	A
Magnesium Chloride	A	A to 275°F	A to 100% to 70°F B to 40% to 212°F B 100% to 212°F B to 50% at 330°F	A to 300°F	A	A 40% to 212°F A 100% to 125°F	AB to 100% to 220°F	A	A
Magnesium Bisulfate	A	–	A to 70°F AB to 100°F	A to 125°F	–	–	AB to 100% to 180°F	A	A
Magnesium Hydroxide	A	A to 275°F	A 70% to 212°F B 10% to 212°F	A to 125°F	A	B 10% at 70°F A 100% to 212°F	AB to 100% to 220°F	A	A
Magnesium Nitrate	A	A to 275°F	A 70°F to hot	A to 125°F	A	A	AB to 100% to 140°F AB to 100% to 220°F	A	A
Magnesium Sulfate	A	A to 275°F	B 50-60% to 212°F A 40% to 212°F B 100% to 212°F	A to 125°F	A	A 40% to 212°F A 100% to 125°F	AB to 100% to 140°F AB to 100% to 220°F	A	A
Malic Acid	A	A to 250°F	A to 100°F 70°F to 175°F	A to 200°F	–	B at 212°F	AB 10% to 140°F	A	A
Maleic Acid	A	A to 275°F	B to 100% to 212°F	A to 200°F	A	A 10% to 175°F A 100% to 212°F B 20-80% to 212°F	AB to 50% to 220°F AB 80% to 150°F AC 100% to 200°F	A	A
Manganese Chloride	A	–	B 30% to 212°F C 40% at 212°F	A to 70°F	–	B to 40% to 212°F	–	A	A
Manganese Sulfate	A	–	–	A to 70°F	–	–	AB to 100% to 220°F	A	A
Mercuric Chloride	A	A to 248°F	C/NR any concentration	A to 125°F	A	BC 10% B◄2% B ½% Boiling	AB to 100% to 210°F	A	A
Mercuric Cyanide	A	A to 248°F	AB	A to 200°F	A	–	AB to 100% to 140°F	A	A
Mercurous Nitrate	A	A to 248°F	A 100% at 70°F B 10% to 212°F	A to 125°F	AB	–	AB to 100% to 140°F	A	AB
Mercury	A	A to 275°F	A to 600°F	A to 200°F	A	B to 700°F A to 125°F	AB 100% to 250°F	A	A
Methane	A	A to 230°F	A to 600°F	A to 200°F	–	A to 212°F	–	A	A
Methyl Acetate	A to 212°F	–	A A to 60% to 220°F	A to 70°F	–	A	–	A	A to 100°F
Methyl Acetone	A to 212°F	–	A	A to 70°F	C	–	–	A	A to 100°F
Methyl Alcohol (Methanol)	A	A to 275°F	A to 100% to 212°F	A to 125°F	B to 70°F softened C at 122°F	A to 100% to 212°F	AB to 100% to 100°F NR at 140°F	A	AB to 100% to 122°F
Methyl Amine	A	–	A	A to 70°F	A	–	NR 40%	A to 70°F	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL–PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Methyl Bromide	A	A to 275°F	A	A to 200°F	B	–	–	A	A
Methyl Cellosolve	A	A to 275°F	A	A to 200°F	C	–	NR at 80°F	A	A
Methyl Chloride (wet)	A	A to 275°F	A to 212°F	A to 200°F	A	AB	AC to 40°F C/NR at 70°F	A	A
Methyl Chloride (dry)	A	A to 275°F	A to 212°F	A to 70°F	A	AB	–	A to 70°F	A
Methyl Ethyl Ketone	A	C 70°F to 150°F NR at 212°F	A to 100% to 180°F	A to 300°F	C to 70°F softened NR at 122°F	A	C/NR at 70°F	A	A
Methyl Isobutyl Ketone	A	NR A to 70°F B to 122°F C at 167°F	A to 150°F	A to 300°F	C softened	A	NR	A	A
Methylene Chloride	A	B to 122°F	A 80-90% to 212°F B 100% to 212°F	A to 125°F	A	B ◄40% to 212°F A 100% to 212°F	NR at 70°F	A	A
Milk	A	A to 212°F	A to 150°F	A to 212°F	A	–	AB to 140°F AC waste to 210°F	A to 212°F	A
Mineral Oil	A	A to 275°F	A 70°F to hot	A to 300°F	A	–	AB to 100% to 210°F	A	A
Mixed Acids (cold)	A	A to 122°F B at 167°F (50% Sulfuric, 50% Nitric)	AB	A to 200°F	–	–	Suitable for many	A to 200°F	A
Molasses	A	AB to 150°F	A to 210°F	A to 70°F	A	–	AB to 140°F	A	A
Morpholine	A	B at 70°F NR at 158°F	A	A to 300°F	–	–	AB to 80°F NR at 120°F	A	A
Motor Oil	A	A to 275°F	A	A to 300°F	A	–	AB to 220°F	A	A
Mustard	A	–	A Pits on drying	A to 300°F	A	–	AB to 200°F	A	A
Monochloro Benzene (dry)	A	A to 70°F B at 122°F C at 212°F	AB	A to 200°F	AC at 70°F C at 122°F NR at 212°F	AB	NR 100% at 140°F AB to 100% to 75°F B/NR 100% at 80°F	A	AC at 70°F C at 122°F NR at 212°F
Monochlorodifluoro Methane (Freon 22)	A	AB to 212°F	A	A to 300°F	–	–	–	A	A
Monoethanolamine	A to 200°F	C to 70°F NR at 122°F	B 100% to 250°F AB 10% to 90% to 250°F	A to 200°F	A to 70°F	AB to 200°F	AB to 100% to 75°F	A	A to 70°F
Monochloroacetic Acid	A to 212°F	A conc. to 70°F A 50% to 212°F B conc. at 122°F C conc. at 212°F	A 78-100% at 70°F B 78-100% at 140°F NR 40% to 70°F	A to 70°F	C/NR at 70°F NR at 122°F	B 40% to 212°F A 100% to 250°F	AB to 20% to 180°F AB 50-80% to 150°F AC to 100% ◄ 140°F NR 100% at 145°F	A 50%	AC to 100% to 150°F
Naphtha	A	A to 275°F	A to 170°F	A to 300°F	A	AB	AB to 100% to 200°F	A	A
Naphthalene	A	A to 275°F	A 100% to 400°F	A to 300°F	–	A	AB to 100% to 200°F	A	A
Nickel Chloride	A	A to 275°F	NR 10-30% B Pits on drying	A to 125°F	A	AB A 50% at 200°F	AB to 100% to 220°F	A	A
Nickel Nitrate	A	A to 275°F	B 10-60% at 70% AB 70°F to 400°F	A to 125°F	A	B to 600°F B 10% at 70°F	AB to 100% to 220°F	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Nickel Sulphate	A	A to 275°F	B 10% to 212°F AB to 70°F B boiling A 30-40% to 212°F	A to 125°F	A	B to 100% to 212°F	AB to 100% to 210°F	A	A
Nitric Acid	A 50%-212°F	A conc.	A 10-40% to 212°F A 10% to 100% to 110°F	A 70% to 200°F	A 10% to 70°F B 30% to 70° NR 50% to 70°F	NR 40% at 160°F A 10% to conc. at 70°F A 30% to 150°F	AC 2% to 220°F AB 5% to 150°F AB 1-10% to 140°F BC 40% to 80°F	A	A 10% to 140°F B 30% to 70°F NR 50% to 70°F
Nitric Acid Fuming (70% conc.)	C	AB to 122°F C/NR anhydrous 70°F	A to 125°F NR at 212°F	A 70% to 212°F	NR	AB to 70°F NR at 212°F	NR fuming C/NR 50% at 70°F NR 50% at 140°F	A to 248°F A 90% to 73°F	NR
Nitric Acid (Boiling)	50%-212°F	NR 70%	A 50% - B 65% NR conc.	A 25-50% A/NR conc.	NR	B 10% NR 20%	C/NR 5% AC 2% NR►5%	A 70%	NR
Nitrobenzene	AB to 212°F	A to 70°F BC 122-212°F	A 100% to 400°F	A to 300°F	BC to 70°F C to 122°F NR at 212°F	B 100% to 212°F	C/NR to 100% to 100°F	A	BC to 70°F C to 122°F NR at 212°F
Nitrogen	A	A	A to 600°F	A to 300°F	—	A to 600°F	AB at -320°F	A	A
Nitromethane	A to 212°F	A to 122°F	A	A to 200°F	—	—	—	A	A to 100°F
Nitrous Acid	A to 212°F	A to 212°F	B 10% at 212°F AB 10% to 150°F AB 10-100% to 70°F	A to 200°F	—	—	AC to 10% to 150°F	A	A to 100°F
Nitrous Oxide	A	NR at 70°F	B 100%	A to 70°F	—	B 100%	—	A	A
N-octane	A	A to 275°F	—	A to 125°F	A	—	—	A	A
Oils Animal	A	—	A	A to 70°F	—	A	AB to 140°F	A	A
Oils Crude	A	A to 280°F	A 70°F to hot May pit	A to 200°F	—	A	AB to 100% to 210°F (sweet or sour)	A	A
Oils Mineral	A	A to 275°F	A 70°F to hot	A to 200°F	A	A	AB to 100% to 210°F	A	A
Oils Olive	A	—	A	A to 70°F	A	A	AB to 100% to 210°F	A	A
Oils Vegetable	A	A to 275°F	A 70-170°F	A to 70°F	A	A	AB to 100% to 210°F	A	A
Oleic Acid (red oil)	A	A to 248°F	AB 70°F to 300°F B 60% at 120°F	A to 200°F	A	A 100% to 160°F B 100% 180°F to 212°F	AB to 100% to 210°F	A	A
Oxalic Acid	A	A to 120°F C to 200°F NR at 212°F	B 60-90% NR conc. NR 10-90% at 212°F A 10-50% at 100°F	A to 200°F	A to 212°F	B 10-100% 70°F to 212°F	AB to 100% to 210°F	A	A to 212°F
Oxygen	A	A to 275°F	A	A to 200°F	—	—	AB to 75°F	A	A
Ozone	A	A to 275°F	A wet or dry	A to 125°F	—	—	AB to 220°F	A	A
Palmitic Acid	A	A to 248°F	A to 70°F AC to 500°F	A to 200°F	—	—	AB to 100% to 220°F	A	A
Paraffin	A	—	A 70°F to Molten	A to 70°F	A	—	AB chlorinated wax to 150°F	A	A
Pentane	A	—	C C vapors at 175°F	A to 70°F	A	—	—	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL–PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200 °F	KYNAR 200 °F	STAINLESS STEEL 316 70 °F	TEFLON FEP 70 °F	EPOXY 70 °F	HASTELLOY C 70 °F	VINYL ESTER THERMOSET 70 °F	TEFLON PFA 200 °F	PYROITE I 70 °F
Perchlorethylene	A	A to 275 °F	A 90% at 70 °F AB 100% to 500 °F A vapors to 305 °F	A to 200 °F	NR	AB to 200 °F	AC to 100% to 100 °F NR at 120 °F	A	A to 140 °F
Perchloric Acid	A	A 10% to 212 °F A 72% to 122 °F	B 100% at 70 °F NR◄60% at 70 °F	AB to 70 °F AC to 300 °F	–	–	AB to 5% to 180 °F B/NR 10% to 150 °F AB 30% to 80 °F	A	A
Petroleum	A	A to 270 °F	A sour or refined	A to 200 °F	A	–	AB to 200 °F	A	A
Petroleum Ether	A	AB to 150 °F	A to 110 °F	A to 70 °F	A	–	AB to 75 °F	A	A
Phosphoric Acid (pure) Aerated	A	A 100% at 70 °F A 85% to 230 °F A 30% to 275 °F A 30% to 275 °F	NR 90% AB 10-80% to 212 °F B 100% to 160 °F	A 0-100% boiling	A to 50% AB to 100%	A 10-85% to 150 °F	AB to 100% to 210 °F AB (fumes) to 220 °F	A	AB to 100% to 220 °F
Phosphoric Acid (pure) Air Free	A	A 100% at 70 °F A 85% to 230 °F A 30% to 275 °F	B 10-70% 70 °F to 212 °F	A 0-100% boiling	A to 50% AB to 100%	A 10-85% to 150 °F	AB to 100% to 210 °F	A	AB to 100% to 220 °F
Phosphoric Acid Boiling (230 °F)	A	A 85%	A 1-5% B 10% NR►20%	A conc. to 300 °F	NR	AB 10-50% NR 85%	NR	A	NR
Phosphorous	A	–	A to 125 °F	A to 200 °F	–	A to 125 °F	AB to 70% to 100 °F	A	A
Phosphorous Trichloride	A	A to 212 °F	A	A to 300 °F	A	–	NR at 80 °F	A	A
Phosphorous Pentachloride	A to 212 °F	A to 212 °F	–	A to 125 °F	–	–	NR	A	A to 70 °F
Phenol Sulphonic Acid	AB to 65% at 212 °F	AB 65% to 150 °F	B 30-100% to 212 °F	–	–	A 30-100% to 212 °F	AB to 65% to 80 °F NR 100%	A	AB to 65% at 100 °F
Photographic Solutions Developers	A	–	A	A to 70 °F	A	–	AB to 70 °F NR at 140 °F	A	A
Photographic Solutions Hypo Acid Fixing Baths	A	AB to 275 °F	AB Pits to 125 °F	A to 70 °F	–	A to 125 °F	AB to 70 °F NR at 140 °F	A	A
Phthalic Acid (aqueous)	A	A to 212 °F	B 100% to 400 °F A 7% at 360 °F	A to 70 °F	–	B 100% to 300 °F	AB to 100% to 220 °F	A	A
Phthalic Anhydride	A	–	A 100% to 300 °F A vapors at 500 °F	A to 70 °F	–	A 100% to 500 °F	AB sat. to 220 °F	A	A
Picric Acid	A	A to 70 °F	B 100% to 300 °F B 10-100% to 212 °F	AB to 70 °F	A	B 20-100% to 212 °F	AB 1% to 140 °F AB 10% to 120 °F	A	A
Plating Solutions Brass	A	AB	A to 110 °F	A to 70 °F	A to 70 °F B to 100 °F	A to 100 °F	AB to 180 °F	A	A to 180 °F
Plating Solutions Cadmium	A	AB	A to 100 °F	A to 70 °F	A to 70 °F B to 90 °F	A to 90 °F	AB to 220 °F	A	A to 220 °F
Plating Solutions Chrome	A	AB to 150 °F	A bath at 70 °F A 15-50% with .6% H_2So_4	A	C to 70 °F NR at 95 °F	AB to 90 °F	AB to 140 °F	A	C to 70 °F NR at 95 °F
Plating Solutions Copper	A	AB	A cyanides to 120 °F NR acids	A to 70 °F	A to 120 °F except Rochelle & high speed	A to 120 °F except electroless	NR Rochelle at 180 °F AB to 120 °F	A	A to 180 °F
Plating Solutions Gold	A	AB	A cyanides to 150 °F NR acids	A to 70 °F	AB	A	AB to 180 °F	A	A to 180 °F
Plating Solutions Lead	A	AB	A	A to 70 °F	AB	A	AB to 160 °F NR alkaline at 180 °F	A	A to 180 °F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL–PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Plating Solutions Nickel	A	A	A to 70°F AC to 140°F NR electroless	A to 70°F	A to 170°F	A to 140°F except electroless	AB to 180°F	A	A to 180°F
Plating Solutions Silver	A	A to 120°F	A to 120°F	A to 70°F	A to 120°F	A to 120°F	AB to 180°F	A to 70°F	A to 180°F
Plating Solutions Tin	A	AB	C at 100°F	A to 70°F	A to 100°F	A to 100°F	AB to 210°F	A	A to 210°F
Plating Solution Zinc	A	AB	A cyanide at 70°F NR chloride & fluoborate	A to 70°F	A to 150°F	A to 150°F except acid chloride	NR cyanide at 180°F AB to 160°F	A	A to 180°F
Potassium Acetate	A	–	AB to 100°F	A to 70°F	–	–	–	A	A
Potassium Aluminum Sulphate (alum)	A	A to 275°F	AB to 150°F	A to 200°F	A	AC to 300°F	AB to 100% to 220°F	A	A
Potassium Bicarbonate	A	AB to 275°F	B 40% to 212°F B 100% to 70°F	A to 70°F	A	B 40% to 212°F B 100% to 70°F	AB to 50% to 150°F AB to 100% to 140°F	A	A
Potassium Bichromate	A	A to 275°F	A 10-60% to 212°F B conc. to 150°F	A to 200°F	A 10% C 100%	B 100% at 70°F B 10-60% to 212°F B 100% at 1500°F	AB to 100% to 212°F	A	A
Potassium Bromide	A	A to 275°F	B to 70% to 212°F (pits) A sat'd. at 185°F	A to 200°F	A	A to 30% at 70°F B 100% to 212°F	AB to 100% to 140°F AC to 100% to 210°F	A	A
Potassium Carbonate	A	A to 275°F	A to 17% to 240°F B 20-100% to 70°F B 20-70% to 212°F	A to 200°F	A	A 100% at 1500°F A 10-90% to 212°F B 100% at 70°F	AB to 50% to 150°F	A	A
Potassium Chlorate	A	A to 275°F	A 10-60% to 212°F B 70-100% to 70°F	A to 200°F	A	B 30% to 212°F C 50-70% at 212°F	AB to 100% to 140°F	A	A
Potassium Chloride	A	A to 275°F	AB 100% to 70°F A 10-30% to 212°F	A to 250°F	A	A 100% at 350°F B 100% to 70°F AB 10-30% to 212°F	AB to 100% to 210°F	A	A
Potassium Chromate	A	AB to 275°F	B 10-40% to 212°F B 10-100% to 70°F	A to 70°F	C	A 10-40% to 212°F	AB to 40% to 140°F	A to 70°F	A
Potassium Cyanide	A	A to 275°F	B to 100% to 212°F B 10-100% to 70°F B 10-30% to 212°F	A to 200°F	A	B 10-30% to 212°F B 100% at 70°F	AB to 100% to 140°F	A	A
Potassium Dichromate	A	A to 275°F	A 10-60% to 212°F B conc. to 150°F	A to 200°F	A 10% C 100%	B 100% at 70°F B 10-60% to 212°F B 100% at 1500°F	AB to 100% to 210°F	A	A
Potassium Ferricyanide	A	A to 275°F	B 10-60% to 212°F B 10-100% to 70°F	A 30% to 70°F	A	B 10-60% to 212°F	AB to 100% to 210°F	A 30% to 70°F	A
Potassium Ferrocyanide	A	A to 275°F	B 10-100% to 212°F A 5% at 70°F	A to 200°F	–	B 10-90% to 212°F	AB to 100% to 210°F	A	A
Potassium Hydrate	A to 212°F	–	AB to 130°F	–	–	A	–	A to 70°F	A to 100°F
Potassium Hydroxide	A	A to 167°F B to 212°F C to 230°F	A 100% to 70°F B 10-50% to 212°F NR 100% at 500°F NR 60-80% at 212°F	A 50% to 250°F A 100% to 125°F	A	B 10-60% to 300°F B 100% at 70°F	B/NR to 45% to 180°F	A	A
Potassium Hypochlorite	A	AB	C 10% at 70°F B 100% at 70°F NR 30% at 70°F	A to 70°F	–	B 10-100% 70°F to 212°F	–	A to 70°F	A
Potassium Iodide-iodine	A	–	A	–	–	–	AB to 100% to 200°F	A to 70°F	A
Potassium Nitrate	A	A to 275°F	B 10-100% 70°F to 550°F	A to 200°F	A	B 100% at 70°F B 10-80% 70°F to 212°F	AB to 100% to 210°F	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Potassium Oxalate	A	–	B 10-40% to 212°F B 10-100% at 70°F	–	–	–	–	A to 70°F	A
Potassium Permanganate	A	A to 275°F	B 10-40% to 212°F B 100% at 70°F	A 10% to 250°F A conc. to 200°F	A	A 10-100% at 70°F B 10-30% at 212°F	AB to 100% to 210°F	A	A
Potassium Silicide	A	–	A	A to 70°F	–	–	–	A	A
Potassium Sulphate	A	A to 275°F	A 10-20% to 212°F A 10-100% at 70°F	A to 200°F	A	A 10-20% to 212°F B 100% at 70°F	AB to 100% to 210°F	A	A
Potassium Sulphide	A	A to 275°F	AB to 100% to 70°F AB 30% to 212°F	A to 200°F	–	–	AB to 100% to 140°F	A	A
Potassium Sulphite	A	–	A to 70°F AB to 100°F AB 10% to 212°F	A to 70°F	–	–	AB to 100% to 140°F	A	A
Propane	A	A to 275°F	A 70°F to hot	A to 125°F	A	A	AB liquid to 44°F	A	A
Propyl Acetate	A	–	A	A to 70°F	–	–	–	A	A to 100°F
Propyl Alcohol (Propanol)	A	A to 122°F B at 158°F C at 212°F	A	A to 200°F	A	A	–	A	A
Propylene	A	–	A	A to 70°F	–	–	–	A	A
Propylene Chlorohydrin	A	A to 70°F NR at 200°F	–	A to 70°F	–	–	–	A	A to 100°F
Propylene Glycol	A	–	AB	A to 125°F	A/NR	B	AB to 100% to 210°F	A	A
Propylene Oxide	A	C/NR to 70°F	A to 90% to 140°F	A to 125°F	–	–	–	A	A
Pydraul	A	–	A	–	AB	–	–	A to 70°F	AB
Pyridine	A	C 70°F to 120°F NR at 150°F	A 10-100% 70°F to 212°F	A to 300°F	A	B	NR at 75°F	A	A
Pyrogallic Acid	A	AB to 120°F	B 10-100% to 125°F	A to 70°F	A	B 10-100% 70°F to 212°F	–	A	A
Pyroligneous Acid	A	–	B 20-100% at 70°F A 10% to 300°F	–	–	–	–	A to 70°F	A
Quinine Bisulfate	A	–	A dry B wet	–	–	–	–	A to 70°F	A
Quinine Sulfate	A	–	A dry B 10-100% at 70°F	–	A	–	–	A to 70°F	A
Rosin	A	–	A at 70°F light or dark B 70°F - 700°F	–	–	–	–	A molten	A
Resorcinol	A	–	–	A to 125°F	–	–	–	A	A
Salicylic Acid	A	A to 212°F	B 10-100% to 70°F B 100% 70-212°F	A to 125°F	–	B	AB to 100% to 160°F	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Salicylaldehyde	A	A to 122°F B at 158°F C at 212°F	—	A to 125°F	—	—	—	A	A
Salt Brine (Sodium Chloride Solution)	A	A	BC	A to 125°F	A	—	AB to 210°F	A	A to 220°F
Sea Water	A	A to 275°F	A brackish A flowing or not (Pits still) to 250°F	A to 250°F	A	A◄5 ft./sec. Excellent	AB to 210°F	A	A to 220°F
Sewage	A	A to 225°F	A H_2S_e, Free	A to 70°F	A	—	AB to 100°F	A	A to 200°F
Shellac	A	—	A bleached A orange	A to 70°F	A bleached A orange	—	—	A	A
Silicone Oil	A	—	A	A to 70°F	A	—	—	A	A
Silver Bromide	A	—	A Pits on drying	A to 70°F	A	—	—	A	A
Silver Chloride	A	—	NR 10-100%	A to 125°F	—	B	—	A	A
Silver Cyanide	A	A to 212°F	A	A to 200°F	AB	—	AB to 100% to 210°F	A	AB to 200°F
Silvr Nitrate	A	A to 275°F	A 10-60% at 70°F B 10-60% to 212°F B 100% 70-500°F	A to 125°F	A	A 10-60%	AB to 100% to 210°F	A	A to 200°F
Skydrol 500 & 7000	A	—	A	A to 200°F	AB	—	—	A	AB
Soap Solutions	A	A to 70°F	A	A to 70°F	A	A	AB to 140°F	A	A to 180°F
Sodium Acetate	A	A to 275°F	B 10-100% to 175°F B 100% to 500°F A 10% to 300°F	A to 125°F	A	A to 100% to 212°F	AB to 100% to 210°F	A	A to 210°F
Sodium Acid Sulfate	A	—	AB to 150°F	A to 70°F	—	—	—	A to 70°F	A
Sodium Aluminate	A	—	A	A to 70°F	A	B	AB to 100% to 120°F	A	A
Sodium Aluminum Sulfate	A	—	A 10-60% at 212°F	A to 70°F	—	B to 60% to 212°F	AB to 100% to 120°F	A	A
Sodium Benzoate	A	A to 275°F	—	A to 125°F	—	—	AB to 100% to 180°F	A	A
Sodium Bicarbonate	A	A to 275°F	B 10-20% to 212°F A 100% at 70°F A 10-20% to 80°F	A to 300°F	A	A 10-20% to 212°F B 10% at 70°F	AB 10% to 180°F AB 100% to 150°F	A	A
Sodium Bichromate	A	—	B to 100% to 212°F	A to 70°F	—	B 10%	AB 100% to 170°F	A	A
Sodium Bisulfate	A	A to 275°F	B to 50% at 70°F NR 10-40% at 212°F A 100% to 70°F	A to 200°F	A	B to 100% to 125°F C to 100% to 212°F	AB to 100% to 210°F	A	A
Sodium Bisulfite	A	A to 275°F	B 10% to 212°F A 10-90% at 70°F B 100% at 70°F	A to 200°F	A	B to 100% to 212°F	AB to 100% to 210°F	A	A
Sodium Borate (Borax)	A	A to 275°F	AB to 150°F	A to 200°F	A	A	AB to 100% to 210°F	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL–PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Sodium Bromide	AB	A to 275°F	B 10-50% at 175°F A dil. pits on dry	A to 200°F	–	B 10-60% to 212°F	AB to 100% to 210°F	A	AB to 180°F
Sodium Carbonate (soda ash)	A	A to 275°F	A 10-100% to 212°F B 100% to 500°F NR molten	A to 300°F	A 30% to 122°F C sat. to 70°F NR sat. at 122°F	A 10-100% to 212°F B 100% to 1500°F	AB 10-35% to 150°F	A	A 30% to 122°F to 35% at 180°F
Sodium Chlorate	A	A to 275°F	B 10-60% to 212°F B 10-100% at 70°F	A to 200°F	A to 212°F	B 10-60% to 212°F B 10% at 70°F	AB 50% to 210°F AB 100% to 220°F	A	A to 212°F
Sodium Chloride (brine)	A	A to 275°F	NR 10% at 125°F B 20-30% to 212°F A 100% to 70-212°F NR 90% at 70°F	A 10% to 250°F A to conc. to 200°F	A to 212°F	A to 100% to 212°F	AB to 100% to 180°F	A	A to 212°F
Sodium Chromate	A	–	A 10-90% 70-212°F B 100% at 70°F	A 10% to 250°F	C	A 10-100% 70-212°F	AB to 50% to 210°F	A	AB to 50% to 210°F
Sodium Citrate	A	–	B 10% to 212°F B 10-100% at 70°F	A to 70°F	–	B 10-50% A 100%	AB to 25% to 120°F	A to 70°F	AB to 50% to 180°F
Sodium Cyanide	A	A to 275°F	C fused at 1292°F A 10% to 212°F A 10-100% at 70°F NR►30% at 212°F	A to 70°F	A	A	AB to 100% to 210°F	A	A
Sodium Dichromate	A	AB	AC	A to 70°F	–	A	AB to 100% to 210°F	A	AB to 210°F
Sodium Ferricyanide	A	AB to 275°F	A 5% hot & cold B 10-100% at 70°F	A to 70°F	–	A 100% 70-175°F B 10%	AB to 100% to 210°F	A to 70°F	AB to 210°F
Sodium Fluoride	A (Resin Only)	A to 275°F	C/NR 8% at 140°F A 5% pits on drying	A to 200°F	–	–	AB to 100% to 180°F (Resin only)	A	AB to 210°F (resin only)
Sodium Hydroxide (caustic soda-lye)	A	A 50% to 212°F Becomes brittle at 250°F	A 10-20% to 212°F B 30-50% to 212°F Stress cracks 50-100%►400°F	A 1-100% to 125°F A 50% to 250°F	A to 70°F A 5% to 122°F B 40% to 122°F C 40% at 212°F	B 10-70% to 212°F A 100% at 70°F	AB conc. to 70°F BC 45-50% at 210°F BC 15-25% at 120°F AB 5% at 210°F	A 50% to 240°F A conc. to 70°F	A to 70°F A at 70°F AB to 50% at 200°F
Sodium Hydroxide (molten)►604°F	NR	NR	B/NR	NR	NR	NR	NR	NR	NR
Sodium Hypochlorite (solution)	A	A to 275°F	A to 5% at 70°F BC 20% NR standing 5% A◄1% to 212°F	A 20% to 200°F A 15% to 250°F	C 20% NR conc.	A 16% AB 100%	AB 5% at 125°F BC 5-15% at 150°F	A 20% to 200°F	AB to 20% at 180°F
Sodium Hyposulfite	AB	A to 240°F	AB 100% A 25% boiling	A to 70°F	–	–	AB to 20% to 210°F	A	AB to 20% at 210°F
Sodium Metaphosphate	A	–	A	A to 70°F	A	–	–	A	A
Sodium Metasilicate	A	–	A 10-100% 70-212°F	A to 70°F	A	A 10-100% 70-212°F	–	A	A
Sodium Nitrate	A	A to 275°F	A 10-90% to 212°F B 100% at 70°F B 10-90% at 250°F	A to 200°F	A	B 30-100% A to 30%	AB to 100% to 210°F	A	A
Sodium Nitrate (molten)►586°F	NR	NR	A	NR	NR	–	NR	NR	NR
Sodium Nitrite	A	A to 275°F	AB to 20% AC conc.	A to 200°F	–	–	AB to 100% to 210°F	A	A
Sodium Perborate	A	–	A 100% at 70°F B 10% to 212°F	A to 70°F	AB	B 10% to 212°F	–	A	AB
Sodium Peroxide	A	A to 275°F	A 70-212°F	A to 200°F	A to 50% A/C conc.	–	AB to 80°F	A	A to 50% to 150°F
Sodium Phosphates	A	A to 275°F	AB 10-100% 70-212°F	A to 200°F	A	A 10-100% 70-212°F	AB to 100% to 210°F except sodium hexametaphosphate	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Sodium Silicate (water glass)	A	A to 275°F	A 10-100% 70-212°F NR 100% at 1500°F	A to 200°F	A	B 10-100% 70-212°F	AB to 100% to 210°F	A	A
Sodium Sulfate	A	A to 275°F	A 10% to 212°F B 20-40% to 212°F A 100% to 400°F B 100% at 1600°F	A to 300°F	A	B 10-40% to 212°F A 100% to 175°F	AB to 100% to 210°F AB 10% to 75°F	A	A
Sodium Sulfide	A	A to 275 °F	A 100% 70°F to hot B 10-40% to 212°F NR 50% 70-300°F	A to 300°F	A	B 10-40% to 212°F B 100% at 70°F	B/NR 100% to 210°F	A	A
Sodium Sulfite	A	A to 275°F	A 10% to 212°F A 100% at 70°F B 10-50% at 212°F	A to 200°F	A	B 10-30% to 212°F B 100% 70°F to hot	AB to 100% to 210°F	A	A
Sodium Thiosulfate (hypo)	A	A to 275°F	A 25-100% to 125°F	A to 300°F	A	A to 125°F	AB to 100% to 180°F	A	A
Sodium Tetraborate (borax)	A	–	A to 150°F	A to 200°F	A	–	AB to 100% to 180°F	A	A
Soy Bean Oil	A	–	A to 170°F A fumes to 500°F	A to 200°F	A	–	AB to 100% to 150°F	A	A
Stannic Chloride	A	A to 275°F	A 10% at 70°F NR 10-100% 70°F to boiling	A to 200°F	A	AB to 185°F	AB to 100% to 180°F	A	A
Stannous Chloride	A	A to 275°F	A 10% to 212°F A sat'd at 120°F	A to 200°F	–	B 10-100% to 212°F B 100% to 700°F	AB to 100% to 210°F	A	A
Starch	A	–	A to 340°F	A to 70°F	A	–	AB to 100% to 140°F	A	A
Stearic Acid	A	A to 275°F	A 100% to 400°F	A to 125°F	AB	B to 600°F	AB to 100% to 210°F	A	AB
Steam	A at 500°F	Q at 300°F	A to 700°F	A to 300°F	–	A to 500°F	AB to 220°F	A	A to 250°F
Stoddard Solvent	A	A to 250°F	A	A to 300°F	A	A	AB to 210°F	A	A
Styrene (styrol)	A	–	A	A to 70°F	A	NR	B/NR to 120°F	A	A
Sugar Juice	A	–	A to 100% to 160°F	A	A	–	AB to 100% to 180°F (beet liquor & cane liquor)	A	A
Sulphate Black Liquor	A	A to 275°F	B to 212°F BC to 450°F	A to 200°F	A	A to 212°F	AB to 100% to 200°F	A	A
Sulphate Green Liquor	A	–	B to 212°F	A to 70°F	A	B to 175°F	AB to 100% to 200°F	A	A
Sulfinol	A	A	A	A to 70°F	–	–	–	A	–
Sulphite Liquor (100% solution with 10% SO_2)	A	–	AB to 212°F	A to 70°F	–	AB to 212°F	AB to 100% to 200°F	A to 70°F	AB to 100% to 220°F
Sulfolane	A	–	–	A to 300°F	–	–	–	A to 70°F	–
Sulfur	A	A to 248°F	A to 250°F AB wet pits to 700°F A 90% at 70°F	A to molten	A	B to 700°F	AB to 250°F	A	A
Sulfur Molten ►266°F	A	–	AB to 700°F	A	NR	B to 700°F	AB to 250°F	A	A

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Sulfur Chloride	AB	A to 70°F	B 100% to 212°F NR at 250°F NR 90% 70-212°F	A to 125°F	C	A 90-100% to 212°F	NR at 80°F	A	C
Sulfur Dioxide (wet)	A	A to 212°F	A moist gas 70°F B 20-100% 70-1200°F A 10% to 212°F	A to 300°F	A to 70°F B at 122°F C at 212°F	A 10-80% to 212°F C 90-100% to 700°F	AB to 210°F	A	A to 70°F B at 212°F
Sulfur Dioxide (dry gas)	A	A to 212°F	A to 500°F	A to 300°F	A to 70°F B at 122°F C at 212°F	B to 300°F	AB at 210°F	A	A to 70°F B at 212°F
Sulfur Trioxide	A	C to 70°F NR at 122°F	A dry B 90-100% to 400°F B 100% to 700°F	A to 200°F	A dry	A 10% to 700°F B 90-100% 70-700°F	AB to 210°F (wet or dry)	A	A to 210°F
Sulfuric Acid (air free)	A 50% to 350°F A 98% to 212°F	A 10-98% to 212°F A 60% to 230°F C 60-90% at 248°F	B 10 & 90-100% at 70°F NR 20-70% at 70°F B 100% to 212°F	A 0-100% to 400°F	A to 60% to 70°F A 10% to 212°F NR 98% at 70°F C 75-90% to 70°F	A 10-60% at 70°F NR 70% 70-400°F A 100% to 212°F	AB to 50% to 210°F AB to 65% to 180°F AB to 75% to 100°F NR 93%	A 0-98% to 248°F	A to 75% to 200°F A 10% to 212°F NR 75% to 98%
Sulfuric Acid (aerated)	A 50% to 315°F A 98% to 212°F	A 10-98% to 212°F A 60% to 230°F C 60-90% at 248°F	A 10 & 90-100% at 70°F NR 20-60% at 70°F B 100% to 175°F	A 0-100% to 400°F	A to 60% to 70°F A 10% to 212°F C 75-90% to 70°F NR 75-90% to 70°F	B 2-96% 70-150°F	AB vapors to 210°F	A 0-98% to 248°F	A to 75% to 200°F A 10% to 212°F NR 75% to 98%
Sulfuric Acid Boiling	A to 98% to 212°F	A 60% to 230°F A 78% to 250°F Elong. reduced 75%	NR 5% B/NR 10% C 100% NR 50%	A 0-100% to 400°F	NR	B 5% C 10% NR►10%	NR►25%	A to 98%	NR
Sulfuric Acid Fuming Oleum	A at 90%	C at 70°F NR at 122°F	B to 400°F NR 90% 300-400°F	A to 400°F	NR	B to 212°F C to 500°F NR at 600°F	NR 93%	A to 73°F	NR
Sulfurous Acid	A	A to 212°F	B 10-90% to 175°F NR conc. at 212°F NR spray	A to 212°F	A	B 10-100% 70-212°F	AB to 10% to 120°F B/NR 100% to 140°F	A	A
Tall Oil	A	A to 275°F	B 100% to 500°F NR 100% at 600°F	A to 200°F	—	A 100% to 600°F	AB to 150°F	A	A to 150°F
Tallow	A	—	A	A to 70°F	A	—	—	A	A
Tannic Acid	A	AB to 230°F	A 10-100% 70-212°F	A to 200°F	A	B 100% at 70°F B 10% to 212°F	AB to 100% to 210°F	A	A
Tanning Liquor (Alum Solution)	A	—	A to 130°F	A to 200°F	A	AB to 300°F	—	A	A
Tar & Tar Oil	A	—	A 70°F to hot	A to 70°F	—	—	—	A	A to 150°F
Tartaric Acid	A	AB to 250°F	A/NR conc. 70-120°F B 10-50% to 212°F	A to 125°F	A	B 10-100% 70-212°F	AB to 100% to 210°F	A	A
Tetrachloracetic Acid	AB	A to 70°F B to 122°F C to 158°F NR at 212°F	NR 10-100%	A to 248°F	—	—	—	A	C
Tetrachloroethane	A	A to 248°F	A pure	A to 125°F	A	—	—	A	A
Tetrachlorethylene	A	—	—	A to 125°F	—	—	AB to 100% to 100°F	A	A to 100°F
Tetra Ethyl Lead	A	A to 275°F	A	A to 200°F	AB	—	—	A	AB
Tetrahydrofuran	A	B to 70°F C to 122°F NR at 200°F	A	A to 300°F	A	A	—	A	A
Tetrahydro Naphthalene (Tetralin)	A	—	—	A to 70°F	AB	—	—	A	AB
Tetraphosphoric Acid	A	—	B 100%	—	—	B 100% to 212°F	—	A to 70°F	AB

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL–PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Thionyl Chloride	AB to 80°F	NR at 70°F	NR	A to 125°F	–	–	NR liquid or vapor	A	C
Tin Molten ►449°F	–	NR	C	NR	NR	–	NR AC fumes	NR	NR
Tin Tetrachloride	A to 80°F	A to 275°F	NR	–	–	BC 220-240°F	–	A to 70°F	C
Titanium Tetrachloride	AB to 225°F	AB to 150°F	B 100%	A to 125°F	–	B 100%	–	A	C
Toluene (Toluol)	A	A to 70°F AB at 122°F AC at 212°F	A 100% to 212°F	A to 200°F	B to 70°F C at 122°F NR at 212°F	A 100% to 212°F	A to 100% to 100°F NR at 140°F	A	A to 180°F
Tomato Juice	A	A	A	A to 200°F	–	–	A	A	A
Tri Butyl Citrate	–	–	–	A to 125°F	–	–	–	A	–
Tri Butyl Phosphate	A	A to 212°F	A to 70°F	A to 200°F	AB	–	AB to 140°F	A	AB to 150°F
Transformer Oil	A	–	A	A to 70°F	AB	–	AB to 210°F	A	AB to 210°F
Trichloracetic Acid	AB to 212°F	A to 70°F B to 122°F C to 167°F NR at 200°F	NR	A to 300°F	NR	A to boiling	AB to 50% to 210°F	AB to 384°F	AB to 100°F
Trichlorethane	A	AB to 150°F	A	A to 125°F	A	–	B/NR 100% to 120°F	A	A
Trichlorethylene	A	A to 70°F AB at 122°F AC at 275°F	B 100% to 212°F A 90% to 212°F	A to boiling	A/NR to 70°F	B 90% to 212°F A 100% to 212°F	C/NR to 140°F AB fumes to 150°F	A	–
Trichloromonofluoroethane (Freon 17)	–	–	A	A to 70°F	–	A	–	A to 70°F	–
Trichloropropane	A	–	A to 212°F	A to 70°F	A	A to 212°F	–	A to 70°F	A
Trichlorotrifluoroethane (Freon 113)	–	–	A	A to 200°F	–	A	–	A	–
Tricresylphosphate	A	NR at 70°F	A to 150°F B to 700°F	A to 70°F	A	A	AB to 100% to 120°F	A	A
Triethanolamine	A	AB to 125°F	A	A to 70°F	A	AB to 200°F	AB to 100% to 120°F	A	A
Triethylamine	A	A to 122°F B to 158°F C to 212°F	A	A to 200°F	A	–	AB to 100% to 150°F	A	A
Triethylene Glycol	–	–	–	A to 125°F	NR	–	–	A	NR
Triethyl Phosphate	A	–	A	A to 200°F	–	–	AB to 100% to 200°F	A	A to 200°F
Triphenyl Phosphite	–	–	A 100%	A to 200°F	–	–	–	A	–
Tripropylene Glycol	A	–	–	A to 125°F	NR	–	AB to 100% to 140°F	A	AB to 160°F

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
Trisodium Phosphate	A	A to 275°F	A 20% to 125°F B 100% at 70°F	A to 300°F	A	A 20% to 125°F	B/NR 100% to 210°F	A	A
Tung Oil (china wood oil)	A	—	A to 150°F	A to 70°F	AB	—	AB to 100% to 200°F	A	A
Turpentine	A	A to 275°F	A to 200°F	A to 200°F	AB	AB	AB to 100% to 100°F	A	A
Undecyl Alcohol (undecanol)	A	—	—	A to 125°F	A	—	—	A to 70°F	A
Urea	A	A 50% H_2O to 248°F	A 28% to 360°F AB to 180°F A 45% to 250°F	A to 125°F A 50% to 200°F	A	B	AB to 50% to 150°F AB to 100% to 140°F	A 50%	A
Uric Acid	A	—	B 100%	A to 70°F	—	B 100%	—	A	A
Urine	A	A to 250°F	A	A to 70°F	A	—	AB to 140°F	A	A
Varnish	A	—	A to 600°F	A to 70°F	A	—	—	A	A
Vinegar	A	AB to 225°F	A hot or cold still; flowing aerated; fumes	A to 200°F	A	A	AB to 210°F	A	A
Vinylacetate	A	A to 248°F	A 10% to 290°F A to 100% to 170°F	A to 200°F	—	—	NR 100%	A	A
Vinyl Chloride	A	AB to 70°F	A 20% to 150°F A 90-100% at 70°F A 100% to 125°F B 100% 175-700°F	A to 70°F	—	A 100% to 125°F	—	A	A
Vinylidine Chloride (Resin)	A	AB to 70°F	—	A to 125°F	—	—	AB to 100% to 120°F	A to 70°F	A
Water, Acid Mine	A	AB to 225°F	A pits on drying NR without oxidizing salts	A to 212°F	A	A	AB to 120°F	A	A
Water, Boiler Feed	A	—	A to 220°F	A to 212°F	—	—	—	A	A
Water, Distilled	A	A to 275°F	A	A to 212°F	A	A	AB to 210°F	A	A
Water, Fresh	A	A to 275°F	A to 425°F	A to 250°F	A	A to 200°F	AB to 210°F	A	A
Water, De-Ionized	A	A to 275°F	A	A to 212°F	—	A to 600°F	AB to 180°F	A	A
Water, De-mineralized	A	A to 275°F	A	A to 212°F	A	—	AB to 210°F	A	A
Water, Brackish	A	—	A hot & cold	A to 212°F	—	—	—	A	A
Water, (salt) See also Sea Water	A	A to 275°F	AB can pit	A to 250°F	A	A to 300°F A flowing or still	AB to 180°F	A	A
Wax	A	—	A to 70°F AB to 212°F	A to 70°F	—	—	AB chlorinated wax to 150°F	A to molten	A
Whiskey	A	A	A 70°F to boiling	A to 70°F	AB	—	AB to 80°F	A	AB

(continued)

TABLE 1.23: OXIRANE OLIGOMER OF RESORCINOL—PLASTONICS INTERNATIONAL (continued)

CHEMICAL	PYROITE II 200°F	KYNAR 200°F	STAINLESS STEEL 316 70°F	TEFLON FEP 70°F	EPOXY 70°F	HASTELLOY C 70°F	VINYL ESTER THERMOSET 70°F	TEFLON PFA 200°F	PYROITE I 70°F
White Liquor (Pulp Mill)	A	A to 70°F	A	A to 70°F	A	A	AB to 180°F	A	A
White Spirit	A	A to 70°F	A	A to 70°F	—	A	—	A	A
Wine	A	A	A	A to 70°F	AB	—	AB to 180°F	A	A
Wood Pulp	A	—	A A liquors boiling	A to 70°F	—	—	—	A	A
Xylene (Xylol) (Xylole)	A	A to 212°F	A to 200°F	A to 280°F	A	A to 200°F	AC to 100% to 120°F NR at 140°F	A	A
Zinc Carbonate	A	—	B 100% at 70°F A 20% to 180°F	A to 70°F	—	B 100% at 70°F	—	A	A
Zinc Chloride	A	A to 275°F	A 10% at 70°F NR 20-90% at 70°F B/NR 100% at 70°F	A 100% to 125°F A 25% to 250°F	A	A 100% at 70°F	AB to 70% to 250°F AB to 100% to 210°F	A	A
Zinc Cyanide	A	—	A moist	A to 70°F	—	—	AB to 180°F NR bath at 180°F	A	A
Zinc, Molten	NR	NR	NR	NR	NR	—	NR	NR	NR
Zinc Nitrate	A	A to 275°F	A hot	A to 125°F	A	—	AB to 100% to 210°F	A	A
Zinc Stearate	A	—	—	A to 125°F	—	—	—	A	A
Zinc Sulfate	A	A to 275°F	A sat'd boiling B 10-80% 70°F to 212°F A 100% at 70°F	A to 125°F	A	B 10-90% to 212°F A 100% at 70°F	AB to 100% to 210°F	A	A
Atmosphere, Industrial	A	A	A	A	—	A	A	A	A
Atmosphere, Marine	A	A	A	A	—	A	A	A	A
Atmosphere, Rural	A	A	A	A	A	A	A	A	A
Sunlight	No Effect	Slight bleaching	No Effect	No Effect	No Effect	No Effect	Requires U.V. inhibitor	No Effect	No Effect
Ultraviolet Light	Excellent	Excellent	No Effect	No Effect	Satisfactory with UV Stabilizers	No Effect	Requires U.V. inhibitor	No Effect	Excellent

TABLE 1.24: PHENOLIC RESINS—OCCIDENTAL CHEMICAL

The following chemical resistance data was obtained by exposing several DUREZ materials to common known chemical contaminants for variable periods of time and then calculating the percent change in specimen dimensions and weight. The specimens were either 2" diameter discs by ⅛" thick; or ½" by ½" bars, 5" long. The appearance of the after-exposed specimen was graded according to the following codes:

A – Smooth, glossy	G – Wrinkled
B – Slightly dull	H – Swollen
C – Dull	I – Cracked
D – Fiber shows	J – Warped
E – Pimpled	K – Blistered
F – Mottled	

Positive or unsigned values indicate specimen growth or weight gain; negative values indicate specimen shrinkage or weight loss.

Durez 791 Black CHEMICAL RESISTANCE One-Year Exposure at 23°C.
% Change in 1/8 x 2" Disk ASTM D 543-60T

Chemical	Diameter	Thickness	Weight	Appearance
Acetic Acid (5%)	2.90	6.00	12.00	G
Acetone	-0.23	-0.35	-1.10	G
Ammonium Hydroxide (10%)	2.40	5.00	9.00	G
Aniline	-0.29	-1.32	1.20	A
Carbon Tetrachloride	0.00	-0.22	-0.03	C
Citric Acid (10%)	2.40	4.60	9.70	G
Detergent Solution (0.25%)	2.10	3.90	8.70	G
Dimethyl Formamide	0.18	0.21	0.63	E
Distilled Water	1.80	3.20	8.10	G
Ethyl Acetate	0.09	-0.18	0.54	G
Ethyl Alcohol (95%)	0.09	-0.11	0.49	G
Ethyl Alcohol (50%)	1.20	2.30	5.00	G
Ethylene Dichloride	0.03	-0.25	0.06	C
Heptane	0.36	0.25	1.80	A
Hydrochloric Acid (10%)	I	I	I	I
Hydrogen Peroxide (3%)	2.10	4.60	9.80	G
Nitric Acid (10%)	I	I	I	I
Oleic Acid	0.15	0.45	0.90	C
Phenol Solution (5%)	2.70	5.40	11.00	F
Soap Solution (1%)	2.30	4.50	9.20	G
Sodium Carbonate (2%)	1.90	3.80	8.50	G
Sodium Chloride (10%)	1.60	3.00	7.10	A
Sodium Hydroxide (10%)	I	I	I	I
Sodium Hydroxide (1%)	3.20	7.00	13.00	G
Sodium Hypochlorite (4-6%)	I	I	I	I
Sulfuric Acid (30%)	I	I	I	I
Sulfuric Acid (3%)	2.70	9.90	17.00	G
Toluene	0.14	-0.05	0.51	C
Transformer Oil	0.02	-0.75	0.05	A
Turpentine	0.01	-1.20	0.10	A

Durez 13856 Black CHEMICAL RESISTANCE One-Year Exposure at 23°C.
% Change in 1/8 x 2" Disk ASTM D 543-60T

Chemical	Diameter	Thickness	Weight	Appearance
Acetic Acid (Glacial)	-0.21	-0.72	-0.83	B
Acetic Acid (5%)	1.10	1.60	5.50	B
Acetone	-0.04	0.56	-0.39	E
Ammonium Hydroxide (conc.)	3.90	5.60	12.00	H
Ammonium Hydroxide (10%)	1.80	2.50	8.30	B
Aniline	0.18	1.50	0.98	A
Benzene	0.06	-1.32	0.29	B
Carbon Tetrachloride	-0.02	-0.37	0.14	A
Chromic Acid (40%)	0.65	-0.55	-2.29	F
Citric Acid (10%)	1.00	0.68	5.05	F
Detergent Solution (0.25%)	1.00	0.68	5.29	A
Diethyl Ether	0.12	-0.99	1.17	A
Dimethyl Formamide	-0.16	-0.44	-0.61	G
Distilled Water	0.95	1.10	4.70	A
Ethyl Acetate	0.09	-0.31	0.66	E
Ethyl Alcohol (95%)	0.20	0.26	0.87	C
Ethyl Alcohol (50%)	0.98	1.20	4.40	G
Ethylene Dichloride	0.02	-0.29	0.36	A
Heptane	0.38	0.21	2.10	A
Hydrochloric Acid (conc.)	2.71	9.21	11.11	E
Hydrochloric Acid (10%)	2.70	6.40	8.20	E
Hydrofluoric Acid (40%)	3.00	8.00	14.00	H
Hydrogen Peroxide (28%)	I	I	I	I
Hydrogen Peroxide (3%)	1.10	1.70	5.80	B
Isooctane	0.01	-0.39	0.21	A
Kerosine (#2 fuel oil)	0.04	-0.66	0.30	A
Mineral Oil, White USP	0.05	0.13	0.39	A
Nitric Acid (conc.)	I	I	I	I
Nitric Acid (40%)	I	I	I	I
Nitric Acid (10%)	I	I	I	I
Oleic Acid	0.20	0.04	1.30	A
Phenol Solution (5%)	0.99	0.60	5.40	A
Soap Solution (1%)	1.10	0.49	5.30	A
Sodium Carbonate (20%)	0.82	0.81	4.50	B
Sodium Carbonate (2%)	1.10	1.40	5.90	A
Sodium Chloride (10%)	1.00	1.40	5.50	A
Sodium Hydroxide (60%)	I	I	I	I
Sodium Hydroxide (10%)	I	I	I	I
Sodium Hydroxide (1%)	1.90	2.70	10.30	F
Sodium Hypochlorite (4-6%)	0.06	-7.90	13.00	F
Sulfuric Acid (conc.)	I	I	I	I
Sulfuric Acid (30%)	3.30	5.50	13.00	E
Sulfuric Acid (3%)	0.94	1.50	4.90	F
Toluene	0.16	-0.02	0.61	A
Transformer Oil	0.04	1.00	0.02	A
Turpentine	0.00	-1.00	-0.05	A

(continued)

TABLE 1.24: PHENOLIC RESINS—OCCIDENTAL CHEMICAL (continued)

Chemical Resistance

Exposure to Various Chemicals for 1 Week

Material and Condition	% Change Length	% Change Thickness	% Change Width	% Change Weight
23570				
Boiling Water	+ .12	+1.34	+ .78	+ .86
10% H_2SO_4	+ .04	+1.20	+ .60	+ .88
10% NaOH	+ .13	+3.58	+1.85	+2.24
10% NH_4OH	+ .02	+ .15	+ .13	+ .10
Leaded Gasoline	0	+ .16	+ .10	0
10-30 Motor Oil	0	+ .12	+ .10	0
Transmission Fluid	0	+ .14	+ .11	- .01
Brake Fluid	0	-1.23	- .43	- .03
50% Glycol	+ .01	- .87	- .40	+ .09
5% NaCL	+ .01	- .91	- .46	+ .11
50% Alcohol	+ .01	- .93	- .45	+ .09

Chemical Resistance

Exposure to Various Chemicals for 1 Month

Material and Condition	% Change Length	% Change Thickness	% Change Width	% Change Weight
23570				
Boiling Water	-	-	-	-
10% H_2SO_4	+ .12	+2.73	+1.42	+2.64
10% NaOH	*	*	*	*
10% NH_4OH	+ .03	+ .28	+ .18	+ .23
Leaded Gasoline	0	+ .13	+ .10	0
10-30 Motor Oil	0	+ .07	+ .09	- .01
Transmission Fluid	+ .01	+ .14	+ .11	+ .09
Brake Fluid	0	+ .98	+ .47	+ .07
50% Glycol	+ .02	- .90	- .41	+ .20
5% NaCl	+ .03	- .94	- .44	+ .24
50% Alcohol	+ .07	- .83	- .42	+ .20

\- Not Available
* Deteriorated

(continued)

TABLE 1.24: PHENOLIC RESINS—OCCIDENTAL CHEMICAL (continued)

Chemical Resistance

Exposure to Various Chemicals for 6 Months

Material and Condition	% Change Length	% Change Thickness	% Change Width	% Change Weight
23570				
Boiling Water	-	-	-	-
10% H_2SO_4	+ .34	+5.66	+2.56	+7.11
10% NaOH	*	*	*	*
10% NH_4OH	+ .09	+ .28	+ .24	+ .58
Leaded Gasoline	0	+ .11	- .08	- .02
10-30 Motor Oil	0	+ .06	+ .04	- .04
Transmission Fluid	0	+ .14	+ .11	+ .01
Brake Fluid	- .02	- .98	- .50	- .17
50% Glycol	+ .06	- .83	- .33	+ .47
5% NaCl	+ .08	- .83	- .36	+ .61
50% Alcohol	+ .06	- .82	- .22	+ .47

- Not Available
* Deteriorated

Chemical Resistance

Exposure to Various Chemicals for 1 Week

Material and Condition	% Change Length	% Change Thickness	% Change Width	% Change Weight
29502				
Boiling Water	+ .08	+1.09	+ .64	+ .55
10% H_2SO_4	+ .25	+6.95	+3.06	+4.56
10% NaOH	+ .16	+2.54	+1.27	+2.48
10% NH_4OH	0	- .90	- .46	+ .01
Leaded Gasoline	0	- .77	- .46	0
10-30 Motor Oil	0	- .80	- .43	+ .06
Transmission Fluid	0	- .64	- .44	+ .02
Brake Fluid	0	- .79	- .39	+ .01
50% Glycol	+ .01	- .92	- .41	+ .10
5% NaCl	0	- .80	- .46	+ .06
50% Alcohol	+ .01	- .92	- .40	+ .05

(continued)

TABLE 1.24: PHENOLIC RESINS—OCCIDENTAL CHEMICAL (continued)

Chemical Resistance

Exposure to Various Chemicals for 1 Month

Material and Condition	% Change Length	% Change Thickness	% Change Width	% Change Weight
29502				
Boiling Water	-	-	-	-
10% H_2SO_4	+1.01	+25.81	+11.69	+20.88
10% NaOH	+2.43	+11.02	+ 5.56	+ 9.20
10% NH_4OH	+ .01	- .80	- .41	+ .13
Leaded Gasoline	0	- .91	- .46	+ .16
10-30 Motor Oil	0	- .72	- .42	0
Transmission Fluid	+ .01	- .81	- .48	+ .06
Brake Fluid	0	- .82	- .49	+ .01
50% Glycol	+ .02	- .95	- .39	+ .20
5% NaCl	+ .02	- .88	- .42	+ .14
50% Alcohol	+ .01	- .45	- .92	+ .12

\- Not Available

Chemical Resistance

Exposure to Various Chemicals for 6 Months

Material and Condition	% Change Length	% Change Thickness	% Change Width	% Change Weight
29502				
Boiling Water	-	-	-	-
10% H_2SO_4	*	*	*	*
10% NaOH	*	*	*	*
10% NH_4OH	+ .04	- .78	- .37	+ .32
Leaded Gasoline	+ .01	- .88	- .47	+ .09
10-30 Motor Oil	0	- .73	- .44	0
Transmission Fluid	0	- .64	- .44	+ .02
Brake Fluid	- .01	- .82	- .50	- .05
50% Glycol	+ .05	-1.15	- .36	+ .41
5% NaCl	+ .06	- .83	- .28	+ .38
50% Alcohol	+ .03	- .43	- .87	+ .29

\- Not Available
* Deteriorated

(continued)

Chemical Resistance

10 Days in 250°F Vapor at 16 psis Pressure

Material	% Change Weight	% Change Thickness	% Change Diameter	Appearance Code
156	1.72	.76	.50	B
165	2.17	1.19	.73	B, E, K
13856	2.64	1.24	.85	B
22829	1.98	.92	.66	B
30169	3.27	2.55	1.22	B
30698	1.74	.87	.57	B

Chemical Resistance

10 Days in 250°F Water at 16 psis Pressure

Material	% Change Weight	% Change Thickness	% Change Diameter	Appearance Code
156	2.67	1.55	1.03	B
165	3.00	1.74	1.09	B, E, K
13856	3.56	1.11	.95	B
22829	2.20	.77	.59	B
30169	3.75	2.59	1.28	B
30698	1.97	.80	.52	B

Chemical Resistance

96 Hours in Boiling Water

Material	% Change Weight	% Change Thickness	% Change Diameter	Appearance Code
111	7.24	5.72	1.71	B, F
118	7.68	4.45	1.23	B, K
123	5.14	6.03	1.26	B, K
145	2.36	1.13	.63	B, E
152	4.13	2.33	1.00	A
153	5.00	4.05	1.19	C, E
156	2.09	.92	.48	B, E
161	3.39	1.46	.76	B, F
165	1.62	.60	.33	B
791	6.24	3.61	1.64	B, E
3948	6.42	4.49	1.67	A
3856	3.80	1.70	.91	A
14900	2.82	1.21	.60	B, E
16378A	3.39	1.65	.64	B, E
18420	6.17	3.13	1.60	A
18441	6.79	3.47	1.76	B
21028	6.44	3.35	1.88	B, D
21210	7.52	5.11	1.88	A
22257	7.08	4.82	1.63	B
23570	1.00	.22	.15	B
29237	6.28	5.83	1.19	B, D, F
30270	2.77	1.30	.69	B, K
30614	.89	.32	.21	B
30645	2.14	.59	.34	B
30698	3.00	1.20	.80	A, B, D
30806	3.20	.90	.80	A

(continued)

TABLE 1.24: PHENOLIC RESINS—OCCIDENTAL CHEMICAL (continued)

Chemical Resistance

96 Hours in Boiling Sulphuric Acid (H_2SO_4)

Material	% Change Weight	% Change Thickness	% Change Diameter	Appearance Code
111	18.49	15.58	2.72	C, F, G
118	24.53	14.15	2.59	C, D, H
123	16.46	15.29	2.80	B, H, J
145	7.92	12.76	1.25	C, F
152	15.14	12.39	2.25	C, F
153	11.58	11.14	2.19	C, F
156	11.17	10.36	1.27	C, E, F
161	4.71	3.74	1.02	C, F
165	1.63	1.25	.61	C, F
791	17.66	13.93	7.20	C, D, H
3948	10.20	7.31	2.43	B,F,H,J
13856	7.10	4.55	1.56	B
14900	8.76	8.01	1.13	C, E
16378A	16.75	11.37	.60	D, F
18420	6.05	3.55	1.78	B, J
18441	8.84	4.98	2.27	B, D, J
21028	26.67	16.66	4.89	C, D, H
21210	12.03	10.57	2.39	B,G,H,J
22257	16.76	12.92	2.53	C, H, J
23570	7.41	8.84	.86	C, E, F
29237	22.03	15.80	3.30	C, D, F
30270	5.21	3.73	1.33	B, E, J
30614	4.91	8.08	.94	B, E, I
30645	25.75	27.56	3.59	C,E,G,H,I
30698	3.97	2.73	.93	C, K
30806	7.10	3.53	1.66	B

Chemical Resistance

96 Hours in Boiling Caustic (.5% NAOH)

Material	% Change Weight	% Change Thickness	% Change Diameter	Appearance Code
111	9.41	7.88	.90	C, E
118	12.88	4.32	1.26	B, D
123	7.36	6.54	1.44	B, K
145	4.89	1.17	.77	B, E
152	4.64	2.57	1.19	B, E
153	6.38	5.54	1.47	C, E
156	1.51	1.18	.63	B, E
161	3.96	1.79	1.00	B, F
165	2.14	.81	.49	B
791	7.16	4.39	1.87	B, E
3948	7.29	4.75	2.10	B
13856	3.91	1.80	.94	B, G
14900	2.87	1.38	.62	B, E
16378A	3.69	1.90	.79	B, E
18420	6.64	3.89	1.71	B
18441	7.27	3.84	1.84	B, D
21028	7.68	4.21	2.10	C, D
21210	9.36	6.31	2.27	B
22257	8.16	5.84	1.88	B
23570	1.05	.31	.22	B
29237	5.76	.57	1.22	C, D, E
30270	3.65	2.05	.90	C
30614	.99	.55	.24	B, E
30645	2.23	.59	.33	B
30698	3.12	1.32	.82	B, K
30806	3.70	1.12	.91	B

(continued)

TABLE 1.24: PHENOLIC RESINS—OCCIDENTAL CHEMICAL (continued)

Chemical Resistance

168 Hours (7 Days) in Sodium Hypochlorite (5% NaOCl) at 50°C

Material	% Change Weight	% Change Thickness	% Change Diameter	Appearance Code
118	6.08	1.80	.84	C
123	4.22	1.99	.83	C
165	1.6C	.55	.47	C, D, F
791	3.18	1.65	1.01	C, D
3948	4.05	2.02	1.21	C, D
13856	2.90	1.01	.71	C, D
14900	1.18	.41	.27	C, D
18420	4.26	1.93	.14	C, D
18441	4.89	2.39	1.28	C, D
21028	1.46	.67	.93	C, D
21210	4.58	2.78	1.47	C, D
22257	2.92	1.95	.93	C, D
30270	2.65	1.32	.76	C
30614	1.28	.03	.07	C, D
30645	1.41	.31	.33	C, D
30698	.83	.02	.50	C, D
30806	1.61	.50	.43	C, D, F

Chemical Resistance

96 Hours in Boiling Soap (5% Ivory)

Material	% Change Weight	% Change Thickness	% Change Diameter	Appearance Code
111	8.05	6.16	1.79	C, E
118	11.46	5.48	1.49	C
123	2.96	6.72	1.51	C, K
145	2.26	1.24	.52	C, E
152	4.45	2.65	.99	C
153	5.77	4.58	1.37	C
156	2.11	1.09	.37	C, E
161	3.51	1.73	.88	C
165	1.92	.64	.43	C, F
791	7.43	4.45	1.93	B, D
3948	8.13	5.76	1.99	C, D
13856	3.70	1.70	.80	B, D
14900	2.94	1.37	.62	B, E
16378A	3.47	1.78	.73	B, E
18420	7.40	4.11	1.93	C, J
18441	7.59	4.07	2.01	B, D
21028	7.44	3.90	2.12	C, D
21210	9.34	6.66	2.36	B, D
22257	8.58	6.30	1.95	C, D
23570	1.01	.26	.19	B
29237	7.39	8.02	1.55	C, D, F
30270	3.34	1.61	.88	C
30614	1.00	.39	.24	C
30645	2.34	.49	.33	B
30698	3.21	1.10	.83	B, K
30806	3.50	1.10	.80	B, D

TABLE 1.25: PHENYLENE OXIDE-BASED RESIN—GENERAL ELECTRIC

NORYL resins are especially noted for their outstanding hydrolytic stability. The water absorption rate of all NORYL resins, both at room temperature and at elevated temperatures, are among the lowest of any engineering thermoplastic, which contributes to the retention of properties and dimensional stability in the presence of water, high humidity and even steam environments. In addition, NORYL resins are also virtually unaffected by most aqueous solutions, detergents, acids, and bases.

Chemical Resistance

	NORYL GFN3 Resin				NORYL 731/SE1 Resin					NORYL GFN3 Resin				NORYL 731/SE1 Resin			
	7 Days at 78°F		3 Days at 185°F		7 Days at 78°F		3 Days at 185°F			7 Days at 78°F		3 Days at 185°F		7 Days at 78°F		3 Days at 185°F	
Applied Stress, psi	0	6,000	0	6,000	0	3,600	0	3,600	Applied Stress, psi	0	6,000	0	6,000	0	3,600	0	3,600
Hydrochloric Acid (10%)	N	N	N	N	N	N	N	N	Cascade (10%)	N	N	N	N	N	N	N	N
Hydrochloric Acid (conc.)	N	N	N	N	N	N	N	N	Oleic Acid	N	N	N	A	N	N	N	A
Sulfuric Acid (10%)	N	N	N	N	N	N	N	N	Mazola Corn Oil	N	N	N	A	N	A	N	A
Sulfuric Acid (60%)	N	N	N	N	N	N	N	A	Linseed Oil	N	N	X	X	X	X	X	X
Sulfuric Acid (90%)	N	N	N	N	N	A	N	A	Mineral Oil	N	N	N	N	N	N	N	A
Acetic Acid (10%)	N	N	N	N	N	N	N	N	Vaseline	N	N	N	N	N	N	N	A
Nitric Acid (10%)	N	N	N	N	N	N	X	X	Heptane	N	A	A	A	N	A	X	X
Phosphoric Acid (60%)	N	N	X	X	N	N	X	X	Methanol	N	N	N	A	N	N	N	N
Hydrofluoric Acid (3%)	N	N	X	X	N	N	X	X	Isopropanol	N	N	N	N	N	N	N	N
Ammonium Hydroxide (10%)	N	N	N	N	N	N	N	N	Ethylene Glycol	N	N	N	A	N	N	N	A
Ammonia	N	N	X	X	X	X	X	X	Gulf Security Oil	N	N	N	N	N	N	N	N
Sodium Hydroxide (10%)	N	N	N	N	N	N	N	N	Rykon 2EP	N	N	N	N	N	N	N	N
Sodium Hydroxide (conc.)	N	N	N	N	N	N	N	A	G.E. Silicone G-697	N	N	N	N	N	N	N	N
Ammonium Phosphate (sat.)	N	N	N	N	N	N	N	N	Houghton Safe 620	N	N	N	N	N	N	N	N
Potassium Bicarbonate (sat.)	N	N	N	N	N	N	N	N	Ucon 660/H_2O	N	N	N	N	N	N	N	X
Sodium Bicarbonate (sat.)	N	N	N	N	N	N	N	N	Trim 5050/H_2O	N	N	N	N	N	N	N	N
Sodium Chloride (sat.)	N	N	N	N	N	N	N	N	Kester No. 135	N	N	N	N	X	X	N	N
Clorox	N	N	N	N	N	N	N	N	Kester No. 1544	N	N	N	N	X	X	N	N
Lestoil (2%)	N	N	N	A	X	X	X	X									

N = No Effect A = Attacked X = Not Tested

COMPATIBILITY TESTING PROCEDURE

Introduction

This test is used as a method for predicting the long-term effects of contact materials or environments on the physical properties of Noryl. The test uses specimens which are exposed under strained conditions at various temperatures duplicating as closely as possible the effect of residual and induced stresses in a fabricated part. By measuring the loss of certain physical properties we can estimate the effects of exposure to the environment on a Noryl application.

Test Procedure

1. Place the tensile bars in the strain jigs which duplicate the stress levels to be checked. For a standard test use 0%, 1/2% and 1% for unfilled grades and 0%, 1/4% and 1/2% for glass-filled grades.

2. Test a minimum of 3 tensile bars for each stress level.

3. Apply the contact material to the tensile bars making sure the material is in direct contact with the bars. If the material is a piece of tubing or gasket material, it may be secured by using a copper wire to tie it to the tensile bar. If the material is a liquid, the tensile bars and strain jigs should be totally immersed. If the material is a grease or paste, coat the tensile bars.

4. Place the specimens in suitable containers and place one set in an oven for 3 days at 185°F and the other leave out at room temperature for 7 days.

   Example: If testing a material with NORYL 731 the number of specimens would be:

	0%	1/2%	1%	
3 days @ 185°F	3	3	3	= 9
7 days @ RT	3	3	3	= 9
			Total	18

5. At the duration of test, remove the specimens from the oven and leave at room temperature for a minimum of 30 minutes. Then use the Instron to determine tensile strength and % of elongation.

Reporting Results

The contact material is considered compatible if there is no cracking, embrittlement or less than 10% loss in tensile properties. The material is considered marginal if there is no cracking, crazing or less than 20% loss in tensile properties. An incompatible material is one which cracks, crazes or loses more than 20% of its tensile properties. (The above are compared against a control).

(continued)

TABLE 1.25: PHENYLENE OXIDE-BASED RESIN—GENERAL ELECTRIC (continued)

COMPATIBILITY TESTING RESULTS

Hydrocarbons	Effect on Noryl			
Aliphatic	731	Aggres-siveness*	N-190	Aggres-siveness*
n-Pentane	Craze	S	Craze	S
n-Hexane	Craze	S	Craze	S
Octane	Craze	S	Craze	S
Dodecane	Craze	S	Craze	S
Aromatic				
Toluene	Solvent	M	Solvent	M
Xylene	Swell	V	Swell	V
Alcohols				
Methanol	No Effect	-	Craze	S
Ethanol	No Effect	-	Craze	S
Isopropanol	No Effect	-	Craze	S
n-Butanol	No Effect	-	Craze	S
Pentanol	Craze	S	Craze	S
Isohexanol	No Effect	-	Craze	S
Octanol	No Effect	-	Craze	S
2-Ethyl Hexanol	Craze	S	Craze	S
Trimethyl-3,5, 5-3-hexanol	Craze	S	Craze	S
Chlorinated				
Methylene Chloride	Solvent	V	Solvent	V
Chloroform	Solvent	V	Solvent	V
Trichloroethylene	Solvent	V	Solvent	V
1,1,1-Trichloroethane	Craze	V	Craze	V
1,1,2-Trichloroethane	Solvent	M	Solvent	M
Chlorobenzene	Solvent	M	Solvent	M

	Effect on Noryl			
	731	Aggres-siveness*	N-190	Aggres-siveness*
Amines				
Ethylamine	No Effect	-	No Effect	-
Ethylenediamine	No Effect	-	No Effect	-
Diethylamine	Swell	V	Swell	V
n-Amylamine	Crack	V	Swell	M
Triethylamine	Crack	V	Crack	V
Ketones				
Acetone	Craze	V	Craze	V
Methyl ethyl ketone	Swell	V	Swell	V
Methyl propyl Ketone	Swell	V	Swell	V
Methyl isobutyl ketone	Crack	V	Crack	V
Methyl phenyl ketone	Craze	V	Craze	V
Isophorone	Crack	V	Craze	V
Cyclohexanone	Solvent	M	Swell	V
Ether				
Dibenzyl ether	Swell	M	Swell	M
Acetates				
Methyl acetate	Crack	V	Swell	V
Ethyl acetate	Crack	V	Swell	V
n-Propyl acetate	Swell	V	Swell	V
isopropyl acetate	Crack	V	Swell	M
Anhydrides				
Acetic anhydride	No Effect	-	No Effect	-
Propionic anhydride	Crack	V	Craze	S

* Aggressiveness: S-Slight, M - Moderate, V - Very

TABLE 1.26: POLYALLOMER—EASTMAN CHEMICAL PRODUCTS

The effects of various chemicals on TENITE Polyallomer Formula 5020 were determined by immersing weighed and measured injection-molded samples of the plastic in the chemicals and maintaining them at a temperature of 73°F (23°C) for one year. After one year, each sample of plastic was removed from the jar in which it was tested, wiped dry, and quickly weighed and measured. The appearance of the sample after exposure to the test medium was also recorded.

The shelf-life tests were conducted using 50 ml capacity, 0.010 inch (0.25 mm) wall thickness blow-molded bottles of TENITE Polyallomer 5020 filled with selected household items. The filled bottles were stored at temperatures of 73°F (23°C) and 140°F (60°C) for one year. Changes in bottle weight and appearance were determined at the end of the test period.

Polyallomer is highly resistant to chemical attack and to stress-cracking. However, a few chemicals produce swelling and attack the surface slightly. These chemicals are mainly chlorinated compounds, aromatic hydrocarbons, and the higher aliphatic hydrocarbons, such as gasoline.

Resistance of TENITE® Polyallomer 5020 to Various Chemicals [Exposure: One Year at 73°F (23°C)]

Reagent	Change in		
	Weight, %	Thickness, %	Appearance
Acetic Acid, 5%	0.04	0.28	No Change
Acetic Acid, conc	1.18	0.33	No Change
Acetone	1.94	0.74	No Change
Alconox Detergent (0.25%)	0.01	0.04	No Change
Ammonium Hydroxide, conc.	0.07	0.04	Slightly Discolored
Ammonium Hydroxide 10%	0.10	0.20	Slightly Discolored
Benzene	19.10	5.70	Swollen
Brake Fluid	0.38	0.12	No Change
Carbon Tetrachloride	67.50	11.20	Swollen
Chromic Acid, 40%	-0.08	0.04	Slightly Discolored
Citric Acid, 10%	0.08	0.08	No Change
Coffee	0.03	0.12	No Change
Cottonseed Oil	0.05	-0.08	No Change
Dibutyl Sebacate	1.51	0.29	No Change
Diethyl Ether	14.10	5.50	Swollen
Di 2-Ethyl Hexyl Phthalate	0.20	0.08	No Change
Dimethyl Formamide	0.37	0.20	No Change
Deionized Water	0.01	0.04	No Change
Ethanol, 100%	0.26	0.12	No Change
Ethanol, 50%	0.07	0.21	No Change
Ethyl Acetate	5.20	1.60	No Change
Ethylene Dichloride	10.60	1.90	Swollen
Gasoline, Regular	19.40	7.60	Blistered, Swollen
Gasoline, High Test	17.60	6.80	Swollen
Hexane	16.90	6.70	Swollen
Hydrochloric Acid, conc.	0.11	0.24	No Change
Hydrochloric Acid, 10%	0.01	0.08	No Change
Hydrogen Peroxide, 28%	0.01	0.08	No Change
Hydrogen Peroxide, 3%	-0.01	0.16	No Change
Iodine	0.11	0.08	Stained
Isooctane	15.90	6.30	Blistered, Discolored, Swollen
Kerosene	17.50	5.50	Blistered, Discolored, Swollen
Lysol Disinfectant	0.11	0.12	No Change
Methyl Alcohol	0.12	0.08	No Change
Mineral Oil	0.59	0.12	No Change
Molasses	0.03	0.28	No Change
Mouthwash	0.35	0.16	No Change
Mustard	6.04	0.12	No Change
Nitric Acid, conc.	4.70	0.45	Badly Discolored
Nitric Acid, 40%	0.79	0.16	Slightly Discolored
Nitric Acid, 10%	0.02	0.08	Slightly Discolored
Oleic Acid, 83%	0.51	0.12	No Change
Olive Oil	0.04	0.08	No Change
Orange Drink	0.05	0.04	No Change
Phenol, 5%	0.04	0.08	No Change
Soap Solution, 1%	0.01	0.04	No Change
Sodium Chloride, 10%.	-0.01	0.00	No Change
Sodium Carbonate, 20%	0.04	0.04	No Change
Sodium Carbonate, 2%	0.18	0.24	No Change
Sodium Hydroxide, 10%	-0.03	0.00	No Change
Sodium Hydroxide, 1%	-0.01	0.04	No Change
Sodium Hypochlorite, 3.5%	0.08	0.12	Discolored
Sulfuric Acid, conc.	-0.03	0.04	Discolored
Sulfuric Acid, 30%	-0.005	0.12	No Change
Sulfuric Acid, 3%	-0.008	0.08	No Change
Toluene	19.50	6.20	Blistered, Swollen
Tomato Juice	0.07	0.08	No Change
Transformer Oil	3.50	1.50	No Change
Turpentine	23.70	7.50	Blistered, Swollen

(continued)

TABLE 1.26: POLYALLOMER–EASTMAN CHEMICAL PRODUCTS (continued)

Shelf-Life Data on Blow-Molded Bottles of TENITE® Polyallomer 5020 [Exposure: One Year at 73°F (23°C)]

Reagent	Change in Weight, %	Change in Appearance
Mustard	-0.33	No Change
Molasses	-0.13	No Change
Orange Drink	-1.66	No Change
Mouthwash	-1.14	No Change
Tomato Juice	-1.06	No Change
Coffee	-0.61	No Change
Lysol Disinfectant	-0.14	No Change
Iodine	-1.89	No Change
Ivory Detergent, 1%	-0.12	No Change
Shoe Polish	-0.29	No Change
Margarine	-0.07	No Change
Grape Juice	-1.00	No Change
Cheese Spread	-0.32	No Change
Grape Jelly	-0.42	No Change
Peanut Butter	+0.14	No Change

Shelf-Life Data on Blow-Molded Bottles of TENITE® Polyallomer 5020 [Exposure: One Year at 140°F (60°C)]

Reagent	Change in Weight, %	Change in Appearance
Mustard	-4.2	No Change
Molasses	-3.9	No Change
Orange Drink	-10.8	No Change
Mouthwash	-24.0	No Change
Tomato Juice	-5.8	No Change
Coffee	-9.1	No Change
Lysol Disinfectant	-6.0	Bottle Stained
Iodine	-31.1	Bottle Stained
Ivory Detergent, 1%	-4.8	No Change
Shoe Polish	-4.1	No Change
Margarine	Bottle cracked at seams in 1 day	
Grape Juice	-5.0	No Change
Cheese Spread	-6.7	No Change
Grape Jelly	-6.5	No Change
Peanut Butter	Bottle cracked at seams in four weeks	

TABLE 1.27: POLYCARBONATE–MOBAY CHEMICAL

The combination of mechanical and optical properties offered by MERLON gives the designer a material with many of the characteristics of a transparent metal. It is a thermoplastic which provides good optical properties, exceptional toughness, and a temperature capability up to 250°F.

Because of a combination of optical characteristics, impact strength, and dimensional stability, MERLON polycarbonate sheets are finding application as glazing, especially in those areas where glass breakage is high.

MERLON *is resistant at room temperature to:*

Chemicals

Acetic acid (20%)
Aluminum chloride
Aluminum sulphate
Ammonium chloride
Ammonium nitrate
Ammonium sulphate
Antimony trichloride
Arsenic acid (20%)
Butyl alcohol
Calcium chloride
Calcium nitrate
Chlorinated lime paste
Chlorinated lime solution (2%)
Chrome alum
Chromic acid (20%)
Citric acid (40%)
Copper chloride
Copper sulphate
Cuprous chloride
Cyclohexane
Decahydronaphthalene
Ethyl alcohol (96%)
Formic acid (10%)
Formalin (30%)
Glycerine
Glycol
Hydrochloric acid (10%)
Hydrochloric acid (20%)
Hydrogen peroxide (30%)
Hydrofluoric acid (20%)
Iron chloride
Iron sulphate
Isoamyl alcohol
Lactic acid (20%)
Magnesium chloride
Magnesium sulphate
Manganese sulphate
Mercuric chloride
Nickel sulphate
Nitric acid (10%)
Nitric acid (20%)
Oleic acid
Oxalic acid
Pentane
Petroleum ether
Phosphoric acid, conc.
Propyl alcohol
Potassium aluminum alum
Potassium bichromate
Potassium bromate
Potassium bromide
Potassium chloride
Potassium nitrate
Potassium perchlorate
Potassium permanganate
Potassium persulphate
Potassium sulphate
Propargyl alcohol
Propionic acid (20%)
Silicone oil
Silver nitrate
Sodium bicarbonate
Sodium bisulphate
Sodium bisulphite
Sodium carbonate
Sodium chlorate
Sodium chloride
Sodium hypochlorite
Sodium sulphate
Stannous chloride
Sulphur
Sulphuric acid (10%)
Sulphuric acid (50%)
Tartaric acid (30%)
Trichloroacetic acid (20%)
Zinc chloride
Zinc sulphate

Common Household Materials

Beer
Borax
Cocoa
Castor oil
Cement
Chocolate
Cinnamon
Cod liver oil
Cognac
Coffee
Detergents (nonionic and anionic)
Fish oil
Floor polish
Fruit syrup
Glaziers putty
Grapefruit juice
Grapefruit peel
Gypsum
Ink
Insulating tape
Linseed oil
Linseed oil standard varnish
Liqueur
Milk
Mineral heating oil
Mineral water
Mustard
Olive oil
Onions
Orange juice
Orange peel
Paraffin oil
Pepper
Rapeseed oil
Rum
Salad oil
Salt solution (10%)
Soap (soft and hard)
Table vinegar
Tincture of iodine (5%)
Tomato concentrate
Tomato juice
Turpentine
Vodka
Washing soap
Water
Wine

Industrial Petroleum Products

Axle oil
Brake fluid (room temp.)
Compressor oil
Diesel oil
Gasoline (low aromatic)
Petrol
Refined oil
Spindle oil
Transformer oil
Vacuum pump oil

MERLON has limited resistance to:

Cyclohexanol
Gasoline (high aromatic)
Hydrochloric acid (conc.)
Milk of lime
Nitric acid (conc.)
Sulfuric acid (conc.)

MERLON is not resistant to:

Acetaldehyde
Acetic acid (conc.)
Acetone
Acrylonitrile
Ammonium fluoride
Ammonium sulfide
Benzene
Benzoic acid
Benzyl alcohol
Bromobenzene
Butyric acid
Carbon tetrachloride
Carbon disulfide
Carbolic acid
Caustic potash solution (5%)
Caustic soda solution (5%)
Chlorobenzene
Cyclo hexanone
Cyclohexene
Dimethyl formamide
Ethane tetrachloride
Ethylamine
Ethyl ether
Ethylene chlorohydrin
Formic acid (conc.)
Freon* (refrigerant & propellant)
Nitrobenzene
Nitrocellulose lacquer
Phenol
Phosphorous hydroxy chloride
Phosphorous trichloride
Propionic acid
Sodium sulfide
Styrene
Sulfuryl chloride
Tetrahydronaphthalene
Thiophene
Toluene
Xylene

*Dupont trademark, except Freon 113, which may be used on unstressed MERLON at room temperature.

MERLON is dissolved by:

Chloroform
Cresol
Dioxane
Ethylene dichloride
Methylene chloride
Pyridine

Dimensional Change vs. Per Cent Water Absorption

Water Absorption %	Dimension Change in/in	Conditions
0.0	0.0	
0.15	0.0003	50% R.H.
0.35	0.0008	Room Temp
0.58	0.0013	Boiling Water

MERLON *Samples Aged in Hot Water for 6 Months (212°F)*

Original Dimension (inches)	Dimension after 6 months immersion (inches)
1.3373	1.3382
1.3374	1.3390
0.8735	0.8740

TABLE 1.28: POLYESTER ENGINEERING RESIN—DART INDUSTRIES

XYDAR™ RESINS

CHEMICAL RESISTANCE

TENSILE STRENGTH AND ELONGATION BEFORE AND AFTER EXPOSURE(*)

	XYDAR™ SRT-300			XYDAR™ SRT-500		
	Tensile (psi)	Rating	Elong. (%)	Tensile (psi)	Rating	Elong. (%)
Original Value	16810		4.9	17730		4.8
60% RH (5 wks. @ Rm. Temp.)	16900	A	3.0	17000	A	3.1
Water (200 Hrs. @ 110°C)	13770	B	4.9	13380	C	4.2
Water (30 days @ 82°C)	15900	A	3.3	17100	A	3.4
Acetic Acid (1 week @ reflux)	17290	A	3.9	15420	B	3.2
Ethyl Acetate (1 week @ reflux)	16290	A	3.7	18160	A	4.0
Bleach (1 month @ 50°C)	16640	A	3.9	16920	A	3.1
Brake Fluid (1 month @ 50°C)	16390	A	3.8	17540	A	3.8
10% NaOH (1 month @ 50°C)	16010	A	3.4	16490	A	3.3
Transmission Fluid (1 month @ 50°C)	17320	A	3.6	17220	A	4.0
Motor Oil (1 month @ 50°C)	17090	A	4.7	17580	A	4.6
Skydrol (2 weeks @ 71°C)	17940	A	3.9	17280	A	3.7
Antifreeze (1 month @ 50°C)	17990	A	4.2	17700	A	2.8
20% H_2SO_4 (1 month @ 50°C)	17230	A	3.9	17600	A	3.8
37% H_2SO_4 (1 week @ 50°C)	15600	A	3.2	11080	D	3.6
100% H_2SO_4 (1 week @ 50°C)	----Disintegrated----					
20% HCl (1 month at 50°C)	16520	A	3.6	17410	A	3.5
70% HNO_3 (11 days @ Rm. Temp.)	16400	A	2.8	-	-	-
Gasoline (Leaded) (1 month @ 50°C)	16840	A	4.3	16840	A	4.9
MEK (1 week @ reflux)	16200	A	3.2	18150	A	5.4
Isopropyl Alcohol (1 week @ reflux)	17680	A	4.4	19420	A	6.0
JP-4 (1 month @ 50°C)	16860	A	5.1	17030	A	4.8
Detergent (1 month @ 50°C)	17800	A	5.1	16840	A	4.9
Trichloroethylene (1 week @ 50°C)	19000	A	4.0	19900	A	4.1

(*) % Decrease in tensile strength after exposure - A = 0 to 10%; B = 11 to 20%; C = 21 to 30%; D = >30%.

TABLE 1.29: POLYESTER LAMINATES—HAYSITE REINFORCED PLASTICS

HCR-191 is a chemical resistant polyester laminate produced by the match metal molding of fiberglass mat, inert fillers and HETRON® 197 resin. HCR-191 laminate when compared to other corrosive resistant materials offers excellent weight to strength ratio (specific gravity of HCR-191–1.9 . . . stainless steel–8.0) and ease of handling and fabrication.

HCR-196 is a chemical resistant polyester laminate produced by the match metal molding of fiberglass mat, inert fillers and DERAKANE® 470 resin. The DERAKANE® 470 is a vinyl ester resin.

HCR-197 is a chemical resistant polyester laminate produced by the match metal molding of fiberglass mat, inert fillers and ATLAC 382 resin. The ATLAC 382 system is bisphenol A fumarate resin.

CHEMICAL RESISTANCE DATA OF HETRON® 197

Materials	Concentration %	Temp. F.	Test Results*
Acetic Acid	25	210	S
Acetic Acid	10	65-95	S
Acetic Acid, Glacial	100	100	S
Acetic Acid, Vapor & Condensate	25	180	S
Acetophenone	100	75	S
Aluminum Trichloride	40	210	S
Aluminum Fluoride	100	75	S
2-Aminoethanol	100	85	S
Ammonia Aqulous	28	80	S
Ammonium Chloride	45	200	S
Ammonium Fluoride	40	150	S
Ammonium Hydroxide	20	150	S
Ammonium Nitrate	45	200	S
Ammonium Persulfate	25-100	150	S
Ammonium Phosphate, Monobasic	65	225	S
Ammonium Salt of Primary Alcohol Glycol Ether Sulfate	100	100	S
Ammonium Sulfate	60	250	S
Ammonium Thiosulfate	60	100	S
Amyl Acetate	100	75	S
Amyl Alcohol	100	200	S
Aniline	100	125	S
Antimony Pentachloride	100	75	S
Antimony, Trichloride	50	200	S
Antimony, Trichloride	100	75	S
Barium Carbonate	100	250	S
Barium Chloride	100	250	S
Benzene	100	75	S
Benzene Disulfonic Acid	100	194	S
Benzene, Sulfonic Acid	25	200	S
Benzoic Acid	100	250	S
Bromine, Dry Gas	100	75	S
Butyl Acetate	100	75	S
Butyl Carbitol	100	85	S
Butyl Phthalate	100	100	S
Butyric Acid	20	200	S
Calcium Chlorate	All	250	S
Calcium Chloride	All	250	S
Calcium Sulfate	100	250	S
Caprylic Acid	100	140	S
Carbon Dioxide	100	250	S
Carbon Tetrachloride	100	120-122	S
Chlorine Gas, Dry	100	140	S
Chlorine Gas,Wet	100	220	S
Chlorofluocarbon	100	158	S
Chromic Acid	32	140	S
Chromous Sulfate	Sat.	150	S
Copper Chloride	All	250	S
Copper Cyanide	All	250	S
Copper Nitrate	Sat.	140	S
Dibutyl Phthalate	100	100	S
Diesel Fuel	100	75	S
Diethanol Amine	100	75	S
Diethyl Sulfate	100	100	S
Diethylene Gycol	100	100	S
Diethylene Gycol N-butyl Ether	100	85	S
Diisobutyl Phthalate	100	80	S
Dodecene, trace HCl	100	120	S
Ethyl Acetoacetate	Sat.	80	S
Ethyl Alcohol	0-95	150	S
Ethyl Chloride	100	75	S
Ethylene Chlorohydrin	100	200	S
Ferric Chloride	100	250	S
Ferric Nitrate	100	250	S
Ferrous Sulfate	100	250	S
Formaldehyde	37-44	150	S
Gasoline	100	194	S
Glycerine	0-75	250	S
Heptane, Vapor & Condensate	100	120	S
Hydrochloric Acid	0-20	230	S
Hydrogen Chloride Gas	100	392	S
Lead Acetate	All	250	S
Magnesium Carbonate	100	250	S
Mercury	100	250	S
Nitric Acid	35% Sol. Vapor	200	S
Perchloric Acid	0-72	85	S
Stannic Chloride	100	75	S
Stearic Acid	100	250	S
Sulfuric Acid	0-50	200	S
Tetrapotassium Pyrophosphate	60	125	S
1,1,1-Trichloroethane	100	80	S
Triethanolamine	100	80	S
Trimethyl Carbinol	100	100	S
Triphenyl Phosphite	100	122	S
Trisodium Phosphate	0-50	75	S
Urotropine	28	80	S
Xylene	100	100	S
Zinc Chloride	70	300-310	S
Zinc Hydrosulfite	Sat.	160	S
Zinc Sulfate	All	250	S

*Note: S — Satisfactory

(continued)

TABLE 1.29: POLYESTER LAMINATES–HAYSITE REINFORCED PLASTICS (continued)

Chemical Resistance of Dow DERAKANE 470 Resin

MAXIMUM SERVICE TEMPERATURE VS CHEMICAL ENVIRONMENT

CHEMICAL ENVIRONMENT	CONCENTRATION %	MAXIMUM °F/°C	CHEMICAL ENVIRONMENT	CONCENTRATION %	MAXIMUM °F/°C
Acetic Acid	25	210/99	Diethanol Amine	30	120/49
Acetic Acid	50	180/82	Diethylene Glycol	100	210/99
Acetic Anhydride	100	100/38	Diisobutyl Phthalate	100	150/65
Acetone	10	180/82	Ethanol	95	100/38
Acid Cleaner - 31% hydrochloric acid	—	190/88	Ethyl Alcohol	All	100/38
Acrylic Acid	25	100/38	Ethyl Benzene: Benzene	2/3:1/3	120/49
Allyl Chloride	All	80/27	Ethylene Chlorohydrin	100	100/38
Alkyl Benzene Sulfonic Acid	92	120/49	Ethyl Sulfate	100	100/38
Aluminum Chloride	All	250/121	Ferric Chloride Hydrochloric Acid	29:18.5	180/82
Aluminum Chlorohydroxide	50	210/99	Formic Acid	All	100/38
Aluminum Nitrate	10	180/82	Gasoline	100	180/82
Aluminum Sulfate	All	250/121	Heptane	100	210/99
Ammonium Chloride	All	210/99	Hydrobromic Acid	62	100/38
Ammonium Phosphate, dibasic	65	210/99	Hydrochloric Acid	37	180/82
Ammonium Thiocyanate	50	100/38	Isopropyl Myristate	—	230/110
Ammonium Thiosulfate	60	100/38	Jet Fuel (JP-4)	—	180/82
Barium Sulfate	All	250/121	Lead Acetate	All	230/110
Benzaldehyde	100	70/21	Maleic Acid	100	250/121
Benzene	100	100/38	Morpholine	—	80/27
Benzene, Ethyl Benzene	1/3:2/3	100/38	Naphtha	100	210/99
Bisulfite in Scrubber	Gases	350/177	Nitric Acid	40	80/27
Black Liquor recovery, furnace gases	—	350/177	Oxalic Acid	All	210/99
Bleach Liquor (Pulp Mill)	100	200/93	Phenol Sulfonic Acid	65	80/27
Boric Acid	All	210/99	Platinum Plating Solution	—	180/82
Brine	All	210/99	Propionic Acid	100	100/38
Butryic Acid	100	120/49	Sodium Chromate	50	210/99
Caprylic Acid	All	210/99	Sodium Hydroxide (1)	10	180/82
Carbon Tetrachloride	100	180/82	Sodium Lauryl Sulfate	All	160/71
Chlorine, dry gas	100	250/121	Styrene 80 F Bath	100	120/49
Chlorine, wet gas	100	250/121	Sulfur, Molten	—	300/149
Chloroacetic Acid	50	150/65	Sulfuric Acid	75	100/38
Chromic Acid	20	150/65	Thioglycolic Acid	All	100/38
Copper Matte Dipping Bath, 30% $FeCl_3$; 19% Hydrochloric	—	200/93	Transformer Oils	—	300/149
			Zinc Chloride	70	310/154
			Zinc Sulfate	All	250/121

CHEMICAL RESISTANCE OF ATLAC 382

The data below represent the current knowledge of corrosive environmental conditions which Atlac 382 bisphenol A fumarate resin will withstand when properly used in reinforced plastic laminates:

CHEMICAL	CONCENTRATION %	MAXIMUM °F	CHEMICAL	CONCENTRATION %	MAXIMUM °F
Acetic Acid	10	220	Magnesium Sulfate	All	220
Acetic Acid	25	220	Metal Plating Solution	100	180
Acetic Acid	50	140	Methyl Alcohol	All	140
Ammonium Hydroxide	20	140	Napthalene	100	220
Ammonium Chloride	All	220	Nitric Acid	5	200
Ammonium Sulfate	20	220	Nitric Acid	20	80
Amyl Alcohol	All	220	Perchloric Acid	10	160
Butyl Alcohol	All	180	Phosphoric Acid	50	220
Calcium Chloride	All	220	Potassium Carbonate	10	140
Calcium Sulfate	All	220	Potassium Carbonate	25	100
Chlorine Dioxide	5	220	Potassium Hydroxide	10	160
Chlorine Dry	—	220	Sodium Bicarbonate	10	180
Chlorine Wet	—	220	Sodium Carbonate	10	140
Chloroacetic Acid	25	220	Sodium Carbonate	25	80
Chloroacetic Acid	50	140	Sodium Chloride	All	220
Chromic Acid	5	200	Sodium Hydroxide	5	220
Ethyl Alcohol	All	180	Sodium Hydroxide	10	180
Ethylene Glycol	All	220	Sodium Hydroxide	25	80
Ferric Sulfate	All	220	Sodium Hypochlorite	15	180
Ferrous Nitrate	All	220	Sulfonated Detergents	100	160
Fluosilicic Acid	10	80	Sulfur Dioxide, Dry	—	220
Gylcerin	100	220	Sulfur Dioxide, Wet	—	220
Hydrochloric Acid	10	220	Sulfuric Acid	25	220
Hydrochloric Acid	20	160	Sulfuric Acid	50	220
Hydrochloric Acid	37	160	Sulfuric Acid	70	160
Hydrogen Peroxide	30	160	Trichloroacetic Acid	50	220
Hypochlorous Acid	20	220	Zinc Chloride	All	220
Lactic Acid	All	220			

TABLE 1.30: POLYETHER BLOCK AMIDES—RILSAN

PEBAX is ATOCHEM's registered trade name for a family of polymers known as polyether block amides (PEBA). The structure of all PEBAX products comprises linear and regular chains of rigid polyamide segments and flexible polyether segments. In addition to their copolymeric structure, the various grades of PEBAX show other original characteristics: very wide range of flexibility; absence of any plasticizer; excellent impact resistance, even at low temperatures; little variation in flexibility between -40°C and +80°C; low density; very high elastic memory; excellent mechanical properties; and good chemical resistance.

Chemical Resistance of PEBAX Polymers

① Change in stress at break in %
② Change in elongation at break in %
③ Change in volume in %

Chemicals	Test Time Temperatures	5533 SN 00			4033 SN 00			3533 SN 00		
		①	②	③	①	②	③	①	②	③
Sulphuric Acid, 10%	7 days/23 °C	- 15	- 20	+ 1,2	+ 7	+ 1	+ 1,2	- 6	- 3	+ 1
Sodium Hydroxide, 10%	"	- 11	- 20	+ 1,2	- 5	+ 1	+ 1	- 3	- 3	+ 1
Zinc Chloride, 50%	"	—	—	+ 1,5	—	—	+ 3,4	—	—	+ 4,5
Water	"	—	—	+ 1	—	—	+ 1	—	—	+ 1
Boiling Water	7 days/100 °C	- 32	- 32	+ 1,2	- 24	- 28	+ 1,3	- 26	- 3,5	+ 2
Lockheed H 55	7 days/121 °C	- 45	- 42	+ 26	- 64	- 49	+ 58	Dissolves	Dissolves	Dissolves
Skydrol	"	- 98	- 98	+ 66	Dissolves	Dissolves	Dissolves	Dissolves	Dissolves	Dissolves
ASTM N° 1 Oil	3 days/100 °C	—	—	+ 4,7	—	—	+ 6,9	—	—	+ 14,8
	7 days/121 °C	0	0	+ 1,8	- 14	- 14	+ 5	- 43	- 44	+ 18
ASTM N° 3 Oil	3 days/100 °C	—	—	+ 16,5	—	—	+ 36	—	—	+ 91
	7 days/121 °C	- 8	0	+ 13	- 47	- 41	+ 29	- 80	- 32	+ 78
SKIP Detergent 30 g/l	7 days/95 °C	0	- 12,5	+ 2,4	- 12,5	- 21,5	+ 2	- 12,5	- 2	+ 2
Potassium 34° Baume	7 days/79 °C	0	0	+ 1,5	- 20	- 14	+ 1,2	- 24	- 0	+ 1

Chemicals	Test Time Temperatures	2533 SN 00			6312 MN 00			5512 MN 00		
		①	②	③	①	②	③	①	②	③
Sulphuric Acid, 10%	7 days/23 °C	- 20	+ 20	+ 1	- 85	- 90	+ 8	- 95	- 98	+ 6
Sodium Hydroxide, 10%	"	+ 6	+ 15	+ 1	- 70	- 85	+ 8	- 75	- 95	+ 7
Zinc Chloride, 50%	"	—	—	+ 5,5	—	—	+ 10,5	—	—	+ 9,5
Water	"	—	—	+ 1	—	—	+ 8,5	—	—	+ 8,5
Boiling Water	7 days/100 °C	- 28	- 2	+ 2	- 6	- 49	+ 2	- 44	- 57	+ 4
Lockheed H 55	7 days/121 °C	Dissolves	Dissolves	Dissolves	- 15	- 26	+ 11	—	—	+ 28
Skydrol	"	Dissolves	Dissolves	Dissolves	- 85	- 96	+ 13,5	—	—	+ 46
ASTM N° 1 Oil	3 days/100 °C	—	—	+ 17,7	—	—	+ 1,3	—	—	—
	7 days/121 °C	- 55	- 50	+ 40	- 12	- 10	+ 2,5	- 27	- 18	+ 4,5
ASTM N° 3 Oil	3 days/100 °C	—	—	+ 135	—	—	+ 2,4	—	—	—
	7 days/121 °C	- 92	- 49	+ 51	- 25	- 42	+ 1,8	- 27	- 18	+ 4,5
SKIP Detergent 30 g/l	7 days/95 °C	- 25,5	- 4	+ 3	- 7,5	- 40	+ 6,3	- 56	- 57	+ 8,3
Potassium 34° Baume	7 days/79 °C	- 49	0	+ 2,5	—	Complete breakdown				

Chemicals	Tests Time Temperatures	5533 SN 00	4033 SN 00	3533 SN 00	2533 SN 00	6312 MN 00	5512 MN 00
		③	③	③	③	③	③
Ethanol	7 days/23 °C	+ 7	+ 27	+ 45	+ 60	+ 22	+ 33
Propanol		+ 21	+ 30	+ 54	+ 54	+ 20	+ 32
Butanol		+ 31	+ 51	+ 128	+ 405	+ 25	+ 37
Isooctane	7 days/23 °C	+ 8,5	+ 9	+ 22	+ 28	0	0
100 octane petrol	"	+ 18	+ 44	+ 110	+ 110	+ 3,5	+ 14
M 15 fuel	2 days/50 °C	+ 32	+ 64	—	—	—	—
Kerosene	7 days/23 °C	+ 16	+ 27	+ 48	+ 48	+ 5	+ 7,4
Paraffin	"	+ 5	+ 15	+ 26	+ 26	+ 3,5	+ 2,6

(continued)

TABLE 1.30: POLYETHER BLOCK AMIDES–RILSAN (continued)

Chemicals	Tests Time Temperature	5533 SN 00	4033 SN 00	3533 SN 00	2533 SN 00	6312 MN 00	5512 MN 00
		③	③	③	③	③	③
ASTM Fuel B	7 days/23 °C	+ 8	+ 8				
	2 days/50 °C	+ 21	+ 41				
ASTM Fuel C	2 days/50 °C	+ 27	+ 41				
Benzene	7 days/23 °C	+ 33	+ 60	+ 182	+ 210	+ 12	+ 22
Acetone		+ 4,2	+ 4,2	+ 4,5	+ 8	+ 8	+ 4,5
Ethylene glycol		+ 4,5	+ 4,5	+ 4,5	+ 4,5	+ 4,5	+ 8
Methylethyl ketone		+ 9	+ 9	+ 22	+ 77	+ 9	+ 9
Methylene chloride	7 days/23 °C	+ 7,6	+ 156	> 300	> 300	+ 38	+ 43
Trichlorethylene		+ 4,5	+ 9	> 300	> 300	+ 3	+ 13
Perchlorethylene		+ 13	+ 13	> 300	> 300	+ 4,5	+ 13
Freon 11	7 days/23 °C	+ 22	+ 40	+ 95	+ 104	+ 4,5	+ 16
Freon R 22	7 days/45 °C	+ 32	+ 35	+ 79	+ 94	+ 37	+ 31
Freon R 502	7 days/45 °C	+ 26	+ 35	+ 60	+ 65	+ 10	+ 31

TABLE 1.31: POLYETHYLENE–EASTMAN CHEMICAL PRODUCTS

Two-inch diameter by ⅛-inch thick disks injection molded from a 0.918 density TENITE Polyethylene formulation were immersed in the chemicals listed in the tabulation and stored under a constant temperature of 73°F for one year. The disks were weighed and measured at the beginning of the test period and again at the end. The percent change in weight and thickness was calculated for each chemical at the end of the test. The change in appearance was also noted.

Chemical resistance of polyethylene is density related–improving with increasing density. Therefore, the lowest density formulation of the TENITE Polyethylene family was tested to represent the greatest change that would be expected from contact with the various chemicals.

The Effect of Various Chemicals on TENITE® Polyethylene (Exposure: One year)

Chemical	% Change In Weight	% Change In Thickness	Appearance
*Acetone	1.2	0.2	No change
Acetic Acid 5%	0.8	0.0	No change
Ammonium Hydroxide 10%	0.0	0.0	No change
**Butyl Acetate	4.1	0.8	No change
Calcium Chloride 2-½%	0.0	0.1	No change
**Carbon Disulfide	36.8	7.7	Swollen
*Carbon Tetrachloride	37.9	4.3	Swollen
*Chloroform	25.1	2.6	Swollen and warped
*Citric Acid 10%	0.0	0.0	No change
**Ethanol 50%	0.1	0.1	No change
*Ethanol 95%	0.0	0.0	No change
**Ethyl Acetate	2.8	0.6	No change
*Ethylene Dichloride	6.9	0.9	Swollen
*Ethylene Glycol	0.0	0.0	No change
**Ethylene Glycol Monoethyl Ether	0.3	0.0	No change
**Formaldehyde 35%	0.1	0.0	No change
**Gasoline (Regular)	13.5	3.2	Swollen, Pink
**Gasoline (Aviation)	15.1	3.0	Swollen
*Glycerine	0.0	0.0	No change
*Green Soap Solution	0.0	0.3	No change
*Heptane	10.0	2.5	Swollen

Chemical	% Change In Weight	% Change In Thickness	Appearance
Hydrochloric Acid 10%	–0.2	0.2	No change
Hydrogen Peroxide 30%	0.0	0.0	No change
Methanol 5%	0.0	–0.1	No change
*Methanol 100%	0.0	0.1	No change
**Motor Oil	0.5	0.8	No change
Nitric Acid (Conc.)	4.8	1.4	Yellowed
**Oleic Acid	2.4	0.5	No change
**Olive Oil	0.3	0.0	No change
**Phenol 5%	0.2	0.0	No change
Sodium Chloride 10%	0.0	0.0	No change
Sodium Carbonate 2%	0.0	0.0	No change
Sodium Hydroxide 10%	0.1	0.0	No change
Sodium Hydroxide 1%	0.0	0.0	No change
Sodium Hypochlorite Solution 5%	0.0	–0.1	No change
Sulfuric Acid 30%	0.0	0.0	No change
Sulfuric Acid 3%	0.0	–0.1	No change
**Toluene	15.1	2.9	Swollen
*Turpentine	14.5	3.3	Swollen
Water	0.0	0.0	No change
**Wesson Oil	0.2	0.0	No change
**Xylene	15.4	3.1	Swollen

**Listed as a stress-cracking agent.*
***Believed likely to be a stress-cracking agent, but not tested for this characteristic.*

TABLE 1.32: POLYETHYLENE–HIMONT

1900 UHMW Polymer is an ultrahigh molecular weight, high density polyethylene resin having a molecular weight range between 3 and 6 million. The extraordinary wear properties of parts manufactured from 1900 UHMW Polymer result in superior replacement parts or long-performance components on original equipment. Used either way, they offer outstanding resistance to impact, abrasion, and chemicals, plus high energy absorption and self-lubricating properties.

Test pieces, 0.040 x 1 x 2 inches, immersed in reagent under conditions given: Appearance and weight change reported on removal from reagent and wiping dry.

	At 22°C (72°F)			At 60°C (140°F)		
Chemicals	Time, Days	Weight Change, %	Appearance	Time, Days	Weight Change, %	Appearance
Inorganic						
Chlorosulfonic acid	30	–	Decomposed	10	–	Decomposed
Chromic acid (1 N)	30	+0.34	Slight yellow	10	–0.16	Slight yellow
Hydrochloric acid, 37%	30	+0.24	Light tan	10	+0.40	Tan
Hydrogen peroxide, 30%	30	–0.01	No change	10	+0.04	No change
Iodine (in alcohol)	30	+1.78	Dark red	–	–	–
Nitric acid, 50%	30	+0.78	Brittle, attacked	10	+4.44	Brittle, attacked
Phosphoric acid, 85%	30	+0.07	No change	10	+0.03	No change
Sodium hydroxide, 30%	5	–0.50	No change	–	–	–
Sodium hypochlorite	30	+0.04	No change	10	+0.21	No change
Sulfuric acid, fuming	Decomposed in one day			–	–	–
Sulfuric acid, 100%	30	+0.26	Slight change	10	+1.00	Black, attacked
Sulfuric acid, 50%	30	–0.06	No change	10	–1.14	Slight change
Water, synthetic seawater	30	+0.13	No change	10	+0.22	No change
Organic						
Acetic acid	30	+0.87	Slight brown	8	+0.83	Slight brown
Acetone	30	+0.24	No change	4	+0.45	No change
Benzene	30	+6.30	Slight change	4	+8.11	Slight change
Carbon bisulfide	30	+16.2	Swelled, attacked	–	–	–
Carbon tetrachloride	30	+18.8	Swelled, attacked	4	+22.4	Swelled, attacked
Cyclohexanol	30	–0.37	No change	8	+1.81	Slight change
Dibutyl phthalate	30	–0.36	Slight change	8	+0.95	Slight change
Ethanol	30	+0.03	No change	4	–0.01	Slight change
Ethyl acetate	30	+1.34	Slight change	4	+1.86	Slight change
Ethyl ether	30	+3.9	Slight change	–	–	–
Ethylene dichloride	30	+12.2	Swelled, attacked	–	–	–
Gasoline	30	+4.81	Slight change	4	+6.61	Slight change
Oil, lard	–	–	–	7	+0.22	No change
Oil, linseed	30	–0.70	No change	8	–0.23	No change
Oil, olive	30	–0.50	No change	8	–0.12	No change
Oil, pine	30	+7.2	Slight swelling	8	+6.98	Slight swelling
Oil, spindle JY-1	30	+3.8	No change	8	+7.08	Swelled
Oil, transformer	30	+2.4	Slight change	8	+6.35	Slight swelling
Petroleum ether	30	+5.74	No change	–	–	–
Toluene	30	+7.0	Slight swelling	8	+10.9	Slight swelling
Trichloroethylene	30	+15.0	Swelling, brown	8	+26.3	Swelled
Xylene	30	+7.1	Slight swelling	8	+15.5	Swelled

TABLE 1.33: POLYETHYLENE-LINED ETHYLENE-VINYL ACETATE TUBING—THERMOPLASTIC SCIENTIFICS INC.

BEV-A-LINE, translucent, flexible tubing for purity systems, combines two tubings in one: an ethylene vinyl acetate shell and a polyethylene liner. Liner and shell are merged by a patented extrusion process.

The shell excels in durability with superior aging characteristics. Tubing burst strength surpasses that of PVC. BEV-A-LINE IV retains flexibility at temperatures from -60° to 160°F and BEV-A-LINE V HT withstands temperatures from -60° to 200°F.

The liner is ideal for use where purity must be maintained and good resistance to alcohols, acids, caustics and solvents is required. This tubing will resist stress-cracking. Its inert and neutral contact surface provides a stable environment in which the pH of the content is essentially maintained. The interior is exceptionally resistant to stains and it resists absorption of liquids, stays translucent and cleans easily.

Chemical and Environmental Properties of BEV-A-LINE IV and V HT Liner and Shell at Room Temperature (73°F)

Chemical or Solvent	Concentration	BEV-A-LINE IV Outer Shell*	B-IV Liner	B-V Liner
Acetaldehyde	100%	U	O	S
Acetic Acid (Glacial)	Conc	S	O	S
Acetone	100%	U	U	S
Aluminum Chloride	Dilute	S	S	S
Aluminum Hydroxide	Conc	S	S	S
Aluminum Sulfate	Conc	S	S	S
Ammonium Carbonate	Conc	S	S	S
Ammonium Chloride	Sat'd	S	S	S
Ammonium Nitrate	Sat'd	S	S	S
Ammonium Persulfate	Sat'd	S	S	S
Ammonium Sulfate	Sat'd	S	S	S
Ammonium Thiocyanate	Sat'd	S	S	S
Amyl Acetate	100%	U	U	S
Amyl Chloride	100%	U	U	S
Aniline	100%	O	S	S
Antimony Chloride	Sat'd	S	S	S
Arsenic Acid	100%	S	S	S
Barium Carbonate	Sat'd	S	S	S
Barium Chloride	Sat'd	S	S	S
Barium Hydroxide	Sat'd	S	S	S
Barium Sulfate	Sat'd	S	S	S
Benzene	100%	U	U	S
Benzoic Acid	Sat'd	O	S	S
Borax	Sat'd	S	S	S
Boric Acid	Conc	S	S	S
Boric Acid	Dilute	S	S	S
Butanediol	100%	S	S	S
Butanediol	60%	S	S	S
Butanediol	10%	S	S	S
Calcium Carbonate	Sat'd	S	S	S
Calcium Chloride	Sat'd	S	S	S
Calcium Hydroxide	Sat'd	S	S	S
Calcium Hypochlorite	Bleach sol'n	S	S	S
Calcium Nitrate	Sat'd	S	S	S
Calcium Sulfate	Sat'd	S	S	S
Castor Oil	100%	U	S	S
Chromic Acid	50%	U	S	S
Citric Acid	Sat'd	S	S	S
Copper Chloride	Sat'd	S	S	S
Copper Nitrate	Sat'd	S	S	S
Copper Sulfate	Dilute	S	S	S
Cottonseed Oil	100%	U	S	S
Cresol	100%	U	U	S
Cyclohexane	100%	U	U	S
Cyclohexanol	100%	S	S	S
Dextrin	Sat'd	S	S	S
Dextrose	Sat'd	S	S	S
Disodium Phosphate	Sat'd	S	S	S
Diethylene Glycol	100%	S	S	S
Dioctyl Phthalate	100%	O	O	S
Ethyl Acetate	100%	U	O	S
Ethyl Alcohol	100%	S	S	S
Ethyl Alcohol	35%	S	S	S
Ethyl Butyrate	100%	U	O	S
Ethyl Ether	100%	U	U	S
Ferric Chloride	Sat'd	O	S	S
Ferric Nitrate	Sat'd	O	S	S
Ferric Sulfate	Sat'd	S	S	S
Ferrous Chloride	Sat'd	S	S	S
Formaldehyde	40%	S	S	S

Chemical or Solvent	Concentration	BEV-A-LINE IV Outer Shell*	B-IV Liner	B-V Liner
Fructose	Sat'd	S	S	S
Gallic Acid	Sat'd	S	S	S
Glycerine	100%	S	S	S
Glycolic Acid	30%	S	S	S
Heptane	100%	U	U	O
Hydrobromic Acid	50%	U	S	S
Hydrochloric Acid	Conc	O	S	S
Hydrofluorosilicic	31.1%	S	S	S
Hydrogen Peroxide	30%	S	S	S
Lactic Acid	90%	S	S	S
Latex	100%	S	S	S
Lead Acetate	Sat'd	S	S	S
Magnesium Carbonate	Sat'd	S	S	S
Magnesium Chloride	Sat'd	S	S	S
Magnesium Hydroxide	Sat'd	S	S	S
Magnesium Nitrate	Sat'd	S	S	S
Magnesium Sulfate	Sat'd	S	S	S
Maleic Acid	Sat'd	S	S	S
Mercuric Chloride	Sat'd	S	S	S
Methylene Chloride	100%	U	U	O
Mineral Oil	100%	O	O	S
Naphtha	100%	O	S	S
Nickel Chloride	Sat'd	S	S	S
Nickel Nitrate	Conc.	S	S	S
Nickel Sulfate	Sat'd	S	S	S
Nicotinic Acid	100%	S	S	S
Nitric Acid	30-50%	O	S	S
Oleic Acid	Conc	U	O	S
Oxalic Acid	Sat'd	S	S	S
Phosphoric Acid	85%	S	S	S
Picric Acid	1%	O	S	S
Potassium Bicarbonate	Sat'd	S	S	S
Potassium Borate	1%	S	S	S
Potassium Bromate	10%	S	S	S
Potassium Bromide	Sat'd	S	S	S
Potassium Carbonate	Conc.	S	S	S
Potassium Chloride	Sat'd	S	S	S
Potassium Dichromate	40%	S	S	S
Potassium Ferricyanide	Sat'd	S	S	S
Potassium Hydroxide	20%	S	S	S
Potassium Nitrate	Sat'd	S	S	S
Potassium Perchlorate	Sat'd	S	S	S
Potassium Permanganate	20%	U	S	S
Potassium Sulfate	Conc.	S	S	S
Potassium Sulfite	Conc.	S	S	S
Propylene Glycol	100%	S	S	S
Silicic Acid	Sat'd	S	S	S
Sodium Bicarbonate	Sat'd	S	S	S
Sodium Borate	Conc.	S	S	S
Sodium Carbonate	Conc.	S	S	S
Sodium Chloride	Sat'd	S	S	S
Sodium Hydroxide	50%	S	S	S
Sodium Sulfate	Conc.	S	S	S
Sulfuric Acid	70%	U	S	S
Sulfuric Acid	98%	U	O	S
Tetrahydrofuran	100%	U	U	S
Toluene	100%	U	U	S
Tetrachloroethylene	100%	U	U	O
Trichloroethylene	100%	U	U	O
Xylene	100%	U	U	S
Zinc Sulfate	Sat'd	S	S	S

S = satisfactory (no attack) O = slight attack U = unsatisfactory 70°F = 21°C

*For chemical resistance characteristics of Bev-A-Line V HT outer shell, contact Thermoplastic Scientifics, Inc.

TABLE 1.34: POLYETHYLENE RESINS—U.S.I. CHEMICALS

PETROTHENE resins are available across the entire range of polyethylene densities 0.91 to 0.96. The variations in density appear very small, but the effect of even a very small change in density on certain essential properties is very marked. There are many applications for which resins of higher density and many others for which those of lower density may be preferable. The three density ranges of polyethylene are:

Low density	0.910-0.925 g/cc
Medium density	0.926-0.940 g/cc
High density (linear)	0.941-0.965 g/cc

Chemical Resistance of Low and Medium Density Polyethylene to Various Reagents

Reagent	Concentration	Temp. 70° F	Temp. 140° F
Acetaldehyde	100%	O	U
Acetic Acid*	1-10%	S	S
Acetic Acid*	10-60%	S	O
Acetic Acid*	80-100%	O	U
Acetic Anhydride		U	U
Acetone		U	U
Acrylic Emulsions*		S	S
Allyl Alcohol		U	U
Allyl Chloride		U	U
Aluminum Chloride	Dilute	S	S
Aluminum Chloride	Conc.	S	S
Aluminum Fluoride	Conc.	S	S
Aluminum Sulfate	Conc.	S	S
Alums (all types)	Conc.	S	S
Ammonia, 100%	Dry Gas	S	S
Ammonium Carbonate		S	S
Ammonium Chloride	Sat'd.	S	S
Ammonium Fluoride	20%	S	S
Ammonium Hydroxide	0,880 s.g.	S	S
Ammonium Metaphosphate	Sat'd.	S	S
Ammonium Nitrate	Sat'd.	S	S
Ammonium Persulfate	Sat'd.	S	S
Ammonium Sulfate	Sat'd.	S	S
Ammonium Sulfide	Sat'd.	S	S
Ammonium Thiocyanate	Sat'd.	S	S
Amyl Acetate	100%	U	U
Amyl Alcohol*	100%	S	S
Amyl Chloride	100%	U	U
Aniline*	100%	S	U
Aniline Hydrochloride	Sat'd.	U	
Antimony Chloride		S	S
Aqua Regia		U	U
Arsenic Acid	100%	S	S
Barium Carbonate	Sat'd.	S	S
Barium Chloride	Sat'd.	S	S
Barium Hydroxide		S	S
Barium Sulfate	Sat'd.	S	S
Barium Sulfide	Sat'd.	S	S
Beer		S	S
Benzene		U	U
Benzene Sulfonic Acid*		S	S
Benzoic Acid	All Conc.	S	S
Bismuth Carbonate	Sat'd.	S	S
Black Liquor		S	S
Bleach Lye	10%	S	S
Borax	Cold Sat'd.	S	S
Boric Acid	Dilute	S	S
Boric Acid	Conc.	S	S
Bromic Acid	10%	S	S
Bromine Liquid	100%	U	U
Bromine Water		U	U
Butanediol*	10%	S	S
Butanediol*	60%	S	S
Butanediol*	100%	S	S
Butyl Alcohol	100%	S	S
Butyric Acid	Conc.	U	U
Calcium Bisulfide		S	S
Calcium Carbonate	Sat'd.	S	S
Calcium Chlorate	Sat'd.	S	S
Calcium Chloride	Sat'd.	S	S
Calcium Hydroxide		S	S
Calcium Hypochlorite	Bleach Sol'n.	S	S
Calcium Nitrate	50%	S	S
Calcium Sulfate		S	S-
Camphor Oil		U	U
Carbon Dioxide	100% dry	S	S
Carbon Dioxide	100% wet	S	S
Carbon Dioxide	Cold Sat'd.	S	S
Carbon Disulfide		U	U
Carbon Monoxide		S	S
Carbon Tetrachloride		U	U
Carbonic Acid		S	S
Castor Oil*	Conc.	S	S
Chloracetic Acid	100%	U	U
Chlorine Dry Gas	100%	O	U
Chlorine Moist Gas		O	U
Chlorine Liquid		U	U
Chlorine Water	2% Sat'd. Sol.	S	S
Chlorobenzene		U	U
Chloroform		U	U
Chlorosulfonic Acid	100%	U	U
Chrome Alum	Sat'd.	S	S
Chromic Acid	20%	S	S
Chromic Acid	up to 50%	S	S
Chromic Acid & Sulfuric Acid*		S	O
Cider*		S	S
Citric Acid*	Sat'd.	S	S
Coconut Oil Alcohols*		S	S
Cola Concentrates*		S	S
Copper Chloride	Sat'd.	S	S
Copper Cyanide	Sat'd.	S	S
Copper Fluoride	2%	S	S
Copper Nitrate	Sat'd.	S	S
Copper Sulfate	Dilute	S	S
Copper Sulfate	Sat'd.	S	S
Cottonseed Oil*		S	S
Cresol	100%	U	U
Cresylic Acid	50%	S	S
Cuprous Chloride	Sat'd.	S	S
Cyclohexanol*		S	S
Cyclohexanone		U	U
Detergents, Synthetic*		S	S
Developers, Photographic		S	S
Dextrin	Sat'd.	S	S
Dextrose	Sat'd.	S	S
Dibutylphthalate		O	O
Disodium Phosphate		S	S
Diazo Salts		S	S
Diethylene Glycol*		S	S
Diglycolic Acid*		S	S
Dimethylamine		U	U
Dioctyl Phthalate		O	U
Emulsions, Photographic*		S	S
Ethyl Acetate	100%	O	U
Ethyl Alcohol*	100%	S	S
Ethyl Alcohol*	35%	S	S
Ethyl Butyrate		O	U
Ethyl Chloride		U	U
Ethyl Ether		U	U
Ethylene Chloride		U	U
Ethylene Chlorohydrin		U	U
Ethylene Dichloride		U	U
Ethylene Glycol*		S	S
Ferric Chloride	Sat'd.	S	S
Ferric Nitrate	Sat'd.	S	S
Ferrous Chloride	Sat'd.	S	S
Ferrous Sulfate		S	S
Fish Solubles*		S	S
Fluoboric Acid		S	S
Fluorine		S	U
Fluosilicic Acid	32%	S	S
Fluosilicic Acid	Conc.	S	O
Formaldehyde*	40%	S	S
Formic Acid*	0-20%	S	S
Formic Acid*	20-50%	S	S
Formic Acid*	100%	S	S
Fructose	Sat'd.	S	S
Fruit Pulp		S	S
Fuel Oil		O	U
Furfural	100%	U	U
Furfuryl Alcohol		U	U
Gallic Acid*	Sat'd.	S	S
Gasoline		U	U
Gin		U	U
Glucose		S	S
Glycerine*		S	S
Glycol*		S	S
Glycolic Acid*	30%	S	S
Grape Sugar	Sat'd. Aq.	S	S
Heptane		U	U
Hexanol, Tert.*		S	S
Hydrobromic Acid	50%	S	S
Hydrocyanic Acid	Sat'd.	S	S
Hydrochloric Acid	10%	S	S
Hydrochloric Acid	30%	S	S
Hydrochloric Acid	35%	S	S
Hydrochloric Acid	Conc.	S	S
Hydrofluoric Acid	40%	S	S
Hydrofluoric Acid	60%	S	S
Hydrofluoric Acid	75%	S	O
Hydrogen	100%	S	S
Hydrogen Bromide	10%	S	S
Hydrogen Chloride Gas	Dry	S	S
Hydrogen Peroxide	30%	S	O
Hydrogen Peroxide	90%	S	U
Hydrogen Phosphide	100%	S	S
Hydrogen Sulfide		S	S
Hydroquinone		S	S
Hypochlorous Acid	Conc.	S	S
Inks*		S	S
Iodine (in KI Sol'n.)	Conc.	O	U

(continued)

TABLE 1.34: POLYETHYLENE RESINS—U.S.I. CHEMICALS (continued)

Reagent	Concentration	Temp. 70° F	Temp. 140° F
Lactic Acid*	10%	S	S
Lactic Acid*	90%	S	S
Latex*		S	S
Lead Acetate	Sat'd.	S	S
Lead Tetra-Ethyl	100%	S	
Linseed Oil		O	U
Lube Oil		U	U
Magnesium Carbonate	Sat'd.	S	S
Magnesium Chloride	Sat'd.	S	S
Magnesium Hydroxide	Sat'd.	S	S
Magnesium Nitrate	Sat'd.	S	S
Magnesium Sulfate	Sat'd.	S	S
Maleic Acid	Sat'd.	S	S
Mercuric Chloride	Sat'd.	S	S
Mercuric Cyanide	Sat'd.	S	S
Mercurous Nitrate	Sat'd.	S	S
Mercury		S	S
Methyl Alcohol*	100%	S	S
Methyl Bromide		O	U
Methyl Chloride		O	U
Methyl Ethyl Ketone	100%	U	U
Methylene Chloride	100%	U	U
Methylsulfuric Acid*		S	S
Milk		S	S
Mineral Oils		O	U
Molasses	Comm.	S	S
Naphtha		S	U
Naphthalene		U	U
Nickel Chloride	Sat'd.	S	S
Nickel Nitrate	Conc.	S	S
Nickel Sulfate	Sat'd.	S	S
Nicotine*	Dilute	S	S
Nicotinic Acid*		S	S
Nitric Acid	0-30%	S	S
Nitric Acid	30-50%	S	O
Nitric Acid	70%	S	O
Nitric Acid	95-98%	U	U
Nitrobenzene	100%	U	U
Octyl Cresol		O	U
Oils and Fats		O	U
Oleic Acid	Conc.	O	U
Oleum	Conc.	U	U
Orange Extract		S	S
Oxalic Acid*	Dilute	S	S
Oxalic Acid*	Sat'd.	S	S
Oxygen	100%	S	
Ozone	100%	O	U
Perchloric Acid	10%	S	S
Petroleum Ether		U	U
Phenol	90%	U	U
Phosphoric Acid	up to 30%	S	S
Phosphoric Acid	30-90%	S	S
Phosphoric Acid	90 %	S	U
Phosphorus (Yellow)	100%	S	
Phosphorus Pentoxide	100%	S	S
Phosphorus Trichloride	100%	S	
Photographic Solutions		S	S

Reagent	Concentration	Temp. 70° F	Temp. 140° F
Pickling Baths			
Hydrochloric Acid*		S	S
Sulfuric Acid*		S	S
Sulfuric–Nitric*		S	
Picric Acid*	1%	S	
Plating Solutions			
Brass*		S	S
Cadmium*		S	S
Chromium*		U	U
Copper*		S	S
Gold*		S	S
Indium*		S	S
Lead*		S	S
Nickel*		S	S
Rhodium*		S	S
Silver*		S	S
Tin*		S	S
Zinc*		S	S
Potassium Bicarbonate	Sat'd.	S	S
Potassium Borate	1%	S	S
Potassium Bromate	10%	S	S
Potassium Bromide	Sat'd.	S	S
Potassium Carbonate		S	S
Potassium Chlorate	Sat'd.	S	S
Potassium Chloride	Sat'd.	S	S
Potassium Chromate	40%	S	S
Potassium Cyanide	Sat'd.	S	S
Potassium Dichromate	40%	S	S
Potassium Ferri/ Ferro Cyanide	Sat'd.	S	S
Potassium Fluoride		S	S
Potassium Hydroxide	20%	S	S
Potassium Hydroxide	Conc.	S	S
Potassium Nitrate	Sat'd.	S	S
Potassium Perborate	Sat'd.	S	S
Potassium Perchlorate	10%	S	S
Potassium Permanganate	20%	S	S
Potassium Persulfate	Sat'd.	S	S
Potassium Sulfate	Conc.	S	S
Potassium Sulfide	Conc.	S	S
Potassium Sulfite	Conc.	S	S
Propargyl Alcohol*		S	S
Propyl Alcohol*		S	S
Propylene Dichloride	100%	U	U
Propylene Glycol*		S	S
Rayon Coagulating Bath*		S	S
Sea Water		S	S
Selenic Acid		S	S
Shortening*		S	S
Silicic Acid		S	S
Silver Nitrate Sol'n.		S	S
Soap Solution*	Any Conc'n.	S	S
Sodium Acetate	Sat'd.	S	S
Sodium Benzoate	35%	S	S
Sodium Bicarbonate	Sat'd.	S	S

Reagent	Concentration	Temp. 70° F	Temp. 140° F
Sodium Bisulfate	Sat'd.	S	S
Sodium Bisulfite	Sat'd.	S	S
Sodium Borate		S	S
Sodium Bromide	Dil. Sol'n.	S	S
Sodium Carbonate	Conc.	S	S
Sodium Chlorate	Sat'd.	S	S
Sodium Chloride	Sat'd.	S	S
Sodium Cyanide		S	S
Sodium Dichromate	Sat'd.	S	S
Sodium Ferricyanide	Sat'd.	S	S
Sodium Ferrocyanide	Sat'd.	S	S
Sodium Fluoride	Sat'd.	S	S
Sodium Hydroxide	Conc.	S	S
Sodium Hypochlorite		S	S
Sodium Nitrate		S	S
Sodium Sulfate		S	S
Sodium Sulfide	25%	S	S
Sodium Sulfide	Sat'd. Sol'n.	S	S
Sodium Sulfite	Sat'd.	S	S
Stannic Chloride	Sat'd.	S	S
Stannous Chloride	Sat'd. Sol'n.	S	S
Starch Solution*	Sat'd.	S	S
Stearic Acid*	100%	S	S
Sulfur	Colloidal	S	
Sulfur Dioxide	Dry, 100%	S	S
Sulfur Dioxide	Wet, 100%	S	
Sulfur Trioxide		S	S
Sulfuric Acid	0-50%	S	S
Sulfuric Acid	70%	S	O
Sulfuric Acid	80%	S	U
Sulfuric Acid	96%	O	U
Sulfuric Acid	98% (Conc.)	O	U
Sulfuric Acid, Fuming		U	U
Sulfurous Acid		S	S
Tallow		S	O
Tannic Acid*	10%	S	S
Tanning Extracts*	Comm.	S	S
Tartaric Acid	10%	S	S
Tartaric Acid	Sat'd.	U	U
Tetrahydrofurane		U	U
Titanium Tetrachloride	Sat'd.	U	U
Toluene		U	U
Transformer Oil		O	U
Trichloroethylene		U	U
Triethanolamine	100%	S	U
Trisodium Phosphate	Sat'd.	S	S
Turpentine		S	U
Urea*	up to 30%	S	S
Urine		S	S
Vinegar	Comm.	S	S
Vanilla Extract*		S	S
Wetting Agents*		S	S
Whiskey*		S	
Wines		S	S
Xylene		U	U
Yeast		S	S
Zinc Chloride	Sat'd.	S	S
Zinc Sulfate	Sat'd.	S	S

70°F = 21°C, 140°F = 60°C

Key: S—satisfactory O—some attack U—unsatisfactory

*The values are obtained from tests made under static conditions and using non-stressed specimens. Reagents marked with an asterisk (*) may, under certain conditions, cause environmental stress cracking if the polyethylene products are improperly designed or not made of the best suitable resins.

TABLE 1.35: POLYETHYLENE TANK MATERIAL—NALGE

The XL-200 D.O.T.-exempted mini-bulk tank is a reusable, lightweight 200 gal tank system for hazardous liquids. Rotationally molded of cross-linked high-density polyethylene (XLPE), the XL-200 has superior resistance to impact and stress-cracking and is compatible with a wide range of chemicals (see chemical resistance summary). It's strong over a wide temperature range, from -20° to +160°F (-29° to +71°C).

Chemical Resistance Summary*

Class of Substances at 20°C	
Acids, dilute or weak	Excellent
Acids**, strong and concentrated	Excellent
Alcohols, Aliphatic	Excellent
Aldehydes	Good
Bases	Excellent
Esters	Good
Hydrocarbons, Aliphatic	Good
Hydrocarbons, Aromatic	Good
Hydrocarbons, Halogenated	Fair
Ketones	Good
Oxidizing Agents, strong	Fair

**This Chemical Resistance Summary is intended as a general guide only.*

***Except for oxidizing acids; for oxidizing acids, see "Oxidizing Agents, strong."*

TABLE 1.36: POLYETHYLENE TEREPHTHALATE-BASED COPOLYESTER—EASTMAN CHEMICAL PRODUCTS

KODAR PETG Copolyester 6763 is a clear, amorphous polymer based on poly(ethylene terephthalate) and has a number average molecular weight ($\overline{M}n$) of about 26,000. To obtain the data shown below, sections of unstressed injection-molded tensile bars 1/8 inch (3.2 mm) thick were weighed and measured and immersed in the chemical or reagent shown and stored at 73°F (23°C) for a period of one year. At the end of the test period, each sample of plastic was removed from the jar in which it was tested, wiped dry, and quickly weighed and measured again and the changes in weight and thickness were calculated. The appearance of the sample after exposure to the test medium was also recorded. Ordinarily, a plastic would not be suggested for continuous immersion in a reagent that causes an increase of 5% or more in weight or thickness. This does not imply that a change in weight or thickness of less than 5% necessarily indicates suitability for immersion.

The results of these tests showed that KODAR PETG Copolyester 6763 is resistant to a variety of chemicals, high-molecular-weight esters, aliphatic hydrocarbons, and dilute solutions of acids and salts. PETG 6763 was significantly affected by concentrated acetic acid, acetone, benzene, toluene, carbon tetrachloride, dimethyl formamide, and phenol and was completely deteriorated by concentrated nitric and sulfuric acids and by ethylene dichloride.

(continued)

TABLE 1.36: POLYETHYLENE TEREPHTHALATE-BASED COPOLYESTER—EASTMAN CHEMICAL PRODUCTS (continued)

Reagent	% Change* in		Appearance of Plastic After Exposure
	Weight	Thickness	
Acetic Acid, 5%	0.5	0.2	Very slight yellowing
Acetic Acid, conc.	19.2	18.5	Discolored and swollen
Acetone	15.6	23.4	Discolored (brown), swollen, rubber-like
Ammonium Hydroxide, conc.	−29.1	−20.3	Turned white – outside crumbling off
Ammonium Hydroxide, 10%	3.7	4.1	Discolored (pink) – surface has blisters
Benzene	34.4	42.6	Discolored and rubber-like
Bis (2-Ethylhexyl) Phthalate	0.1	0.2	Very slight yellowing
Brake Fluid	5.9	6.3	Surface attacked – flaking off – turned yellow
Carbon Tetrachloride	27.3	17.8	Discolored and swollen
Chromic Acid, 40%	0.1	0.2	Slightly discolored
Citric Acid, 10%	0.5	0.2	Slight yellowing
Cottonseed Oil	0.03	0.1	Very slight yellowing
Detergent, *Alconox* (0.25%)	0.6	0.2	Slight yellowing
Deionized Water	0.4	0.3	Slight yellowing
Dibutyl Sebacate	0.9	1.0	Slight yellowing
Dimethyl Formamide	21.9	38.6	Badly discolored and distorted
Ethanol, 100%	0.5	0.7	Very slight yellowing
Ethanol, 50%	0.6	0.5	Slight yellowing
Ethyl Acetate	20.2	24.5	Badly discolored and swollen – rubber-like
Ethylene Dichloride	–	–	Completely deteriorated in one week
Gasoline, High Test	1.3	0.9	Cloudy
Gasoline, Regular	0.8	0.8	Slight yellowing
Hexane	0.1	0.2	Slight yellowing
Hydrochloric Acid, conc.	1.1	0.9	Badly discolored – blisters under surface
Hydrochloric Acid, 10%	0.2	0.3	Slight yellowing
Hydrogen Peroxide, 28%	0.6	0.4	Slight yellowing
Hydrogen Peroxide, 3%	0.4	0.3	Slight yellowing
Isooctane	0.3	0.2	Very slight yellowing
Kerosene	0.3	0.2	Very slight yellowing
Methyl Alcohol	0.5	0.7	Very slight yellowing, crazing
Mineral Oil	0.2	0.1	Very slight yellowing
Nitric Acid, conc.	–	–	Completely deteriorated after one week
Nitric Acid, 40%	1.4	0.8	Turned white
Nitric Acid, 10%	0.5	0.3	Slight yellowing
Oleic Acid, 83%	0.1	0.2	Very slight yellowing
Olive Oil	0.2	0.2	Very slight yellowing
Phenol, 5%	13.2	14.3	Turned black
Soap Solution, 1%	0.5	0.2	Slight yellowing
Sodium Chloride, 10%	0.3	0.1	Slight yellowing
Sodium Carbonate, 20%	0.4	0.2	Slight yellowing
Sodium Carbonate, 2%	0.5	0.4	Slight yellowing
Sodium Hydroxide, 10%	8.0	6.4	Slight yellowing
Sodium Hydroxide, 1%	0.8	0.2	Slight yellowing
Sodium Hypochlorite, 3.5%	0.8	0.6	Slight yellowing
Sulfuric Acid, conc.	–	–	Completely deteriorated in one week
Sulfuric Acid, 30%	0.3	0.2	Slight yellowing
Sulfuric Acid, 3%	0.5	0.2	Slight yellowing
Transformer Oil	0.4	0.2	Very slight yellowing
Toluene	25.9	31.0	Turned white – rubber-like
Turpentine	0.3	0.2	Slight yellowing

**Changes shown were increases unless the figure is preceded by a negative sign.*

TABLE 1.37: POLYMETHYLPENTENE–WESTLAKE PLASTICS

The high resistance of TPX (polymethylpentene) to chemical attack, combined with its excellent transparency and high temperature performance, makes it particularly suitable for a wide range of applications. TPX polymers are highly resistant to inorganic environments, are not attacked by aqueous solutions of inorganic salts nor by most mineral acids or alkalis even in a concentrated form. They are, however, affected by oxidizing reagents. TPX polymers show good resistance to many organic chemicals although, as with other polyolefins, absorption does occur in certain cases leading to a loss of rigidity and a decrease in yield stress. Tests on injection molded samples at 20°C (68°F) and 60°C (140°F) over a period of 3 months are listed and give an indication of the behavior in practice.

	20°C	60°C
Acetic acid (glacial)	B	B
Acetic acid (dilute)	A	A
Acetone	B	B
Aluminum chloride	A	A
Aluminum fluoride	A	A
Aluminum sulfate	A	A
Ammonia	A	A
Ammonium carbonate	A	A
Ammonium chloride	A	A
Ammonium fluoride (20%)	A	A
Ammonium hydroxide (10%)	A	A
Ammonium nitrate	A	A
Ammonium sulfate	A	A
Ammonium sulfide	A	A
Ammonium thiocyanate	A	A
Amyl acetate	B	C
Amyl alcohol	B	C
Amyl chloride	C	C
Anisole	B	C
Barium carbonate	A	A
Barium chloride	A	A
Barium hydroxide	A	A
Barium sulfate	A	A
Barium sulfide	A	A
Beer	A	A
Benzaldehyde	A	B
Benzene	C	C
Benzoic acid	A	A
Benzyl alcohol	A	A
Brake fluid	A	A
Bromine liquid	D	D
Bromine water	D	D
Butyl acetate	C	C
Calcium carbonate	A	A
Calcium chlorate	A	A
Calcium chloride	A	A
Calcium hydroxide	A	A
Calcium hypochlorite	A	A
Calcium nitrate	A	A
Calcium phosphate	A	A
Calcium sulfate	A	A
Calcium sulfite	A	A
Carbon dioxide	A	A
Carbon tetrachloride	C	C
Carbonic acid	A	A
Chlorine water	D	D
Chlorobenzene	C	C
Chloroform	C	D
Chromic acid	A	A

	20°C	60°C
Citric acid	A	A
Copper chloride	A	A
Copper cyanide	A	A
Copper fluoride	A	A
Copper nitrate	A	A
Copper sulfate	A	A
Corn oil	A	A
Cuprous chloride	A	A
Cyclohexanol	A	B
Cyclohexanone	B	C
Decalin	C	C
Diesel Oil	B	D
Dimethyl formamide	A	A
Dioctyl phthalate	A	A
Ether	C	C
Ethyl acetate	B	C
Ethyl alcohol	A	B
Ethyl oleate	B	C
Ethylene glycol	A	A
Ferric chloride	A	A
Ferric nitrate	A	A
Ferric sulfate	A	A
Ferrous chloride	A	A
Ferrous sulfate	A	A
Fluosilic acid	A	A
Formaldehyde	A	A
Formic acid (100%)	A	A
Fruit juices	A	A
Gear box oil	A	B
Gin	A	A
Glycol	A	A
Hexane	C	C
Hydrochloric acid (50%)	A	B
Hydrochloric acid (30%)	A	A
Hydrochloric acid (20%)	A	A
Hydrochloric acid (10%)	A	A
Hydrofluoric acid (60%)	A	A
Hydrogen peroxide (70%)	A	B
Hydrogen peroxide (35%)	A	B
Hydrogen peroxide (10%)	A	A
Isopropyl alcohol (100%)	A	B
Iodine in ethanol solution	A	A
Lead acetate (100%)	A	A
Lemon oil (concentrated)	C	C
Linseed oil	A	A
Lubricating oil	B	C
Magnesium carbonate	A	A

(continued)

TABLE 1.37: POLYMETHYLPENTENE–WESTLAKE PLASTICS (continued)

	20°C	60°C
Magnesium chloride	A	A
Magnesium hydroxide	A	A
Magnesium nitrate	A	A
Magnesium sulfate	A	A
Magnesium sulfite	A	A
Mercuric chloride	A	A
Mercuric cyanide	A	A
Mercurous nitrate	A	A
Mercury	A	A
Methyl alcohol	A	B
Methyl ethyl ketone	B	B
Methylene chloride	A	–
Milk	A	A
Mineral oil	A	B
Motor oil	A	B
Nickel nitrate	A	A
Nickel sulfate	A	A
Nitric acid (fuming)	D	D
Nitric acid (70%)	A	B
Nitric acid (50%)	A	A
Nitric acid (10%)	A	A
Nitrobenzene	A	B
Oleum	D	D
Olive oil	A	A
Oxalic acid (50%)	A	B
Paraffin ozone	A	A
Paraffin wax	A	A
Paraldehyde	B	C
Petrol	B	C
Petroleum ether	C	C
Phenol	A	A
Phosphoric acid (50%)	A	A
Photographic developer	A	A
Potassium bicarbonate	A	A
Potassium bromide	A	A
Potassium carbonate	A	A
Potassium chlorate	A	A
Potassium chloride	A	A
Potassium chromate	A	A
Potassium cyanide	A	A
Potassium dichromate	A	A
Potassium ferricyanide	A	A
Potassium ferricyanide	A	A
Potassium fluoride	A	A
Potassium hydroxide	A	A
Potassium nitrate	A	A
Potassium perborate	A	A
Potassium perchlorate	A	A
Potassium permanganate	A	A
Potassium sulfate	A	A
Potassium sulfide	A	A
Potassium sulfite	A	A
Pyridine	B	B
Resorcinol (saturated)	A	A
Rum	A	A
Silicone oil	A	A
Soap solution (concentrated)	A	A
Sodium acetate	A	A
Sodium bicarbonate	A	A
Sodium bisulfite	A	A
Sodium borate	A	A
Sodium carbonate	A	A
Sodium chlorate	A	A
Sodium chloride	A	A
Sodium chlorite (20%)	A	A
Sodium cyanide	A	A
Sodium dichromate	A	A
Sodium ferricyanide	A	A
Sodium ferrocyanide	A	A
Sodium fluoride	A	A
Sodium hydroxide (50%)	A	A
Sodium hypochlorite	A	A
Sodium nitrate	A	A
Sodium nitrite	A	A
Sodium silicate	A	A
Sodium sulfate	A	A
Sodium sulfide (25%)	A	A
Sodium sulfite	A	A
Stannic chloride	A	A
Stannic sulfate	A	A
Stannous chloride	A	A
Sulphamic acid	A	A
Sulfuric acid (98%)	A	B
Sulfuric acid (60%)	A	A
Sulfuric acid (30%)	A	A
Sulfuric acid (10%)	A	A
Tannic acid	A	A
Tartaric acid	A	A
Tetrahydrofuran	C	C
Toluene	C	C
Transformer oil	A	C
Trichloroacetic acid (10%)	A	A
Trichloroethylene	C	C
Turpentine	C	C
Vaseline	A	A
Vinegar	A	A
Vodka	A	A
Water	A	A
Whisky	A	A
White paraffin	A	B
White spirit	C	C
Wines	A	A
Xylene	C	C
Zinc chloride	A	A
Zinc oxide	A	A
Zinc sulfate	A	A

A = Negligible effect
B = Limited absorption or attack
C = Extensive absorption
D = Extensive attack

TABLE 1.38: POLYPHENYLENE SULFIDES—PHILLIPS CHEMICAL

RYTON polyphenylene sulfide resins and compounds are engineering thermoplastics developed by Phillips Petroleum Company. Available in both molding and coating grades, these materials feature excellent dimensional stability, inherent flame retardancy, thermal stability, chemical resistance, desirable electrical properties and ease of processing.

RYTON resin compounds are resistant to a very broad range of chemical materials and at elevated temperatures are considered second only to PTFE in overall resistance to corrosive and hostile chemical environments. Environments to which RYTON compounds do not have adequate resistance include oxidizing environments such as 50% nitric acid, 30% sulfuric acid, sodium hypochlorite, bromine water, etc., all at 200°F (93°C) or above.

ENVIRONMENTS COMPATIBLE WITH RYTON COMPOUNDS

Room Temperature	200°F (93°C)
Hydrocarbons	Hydrocarbons
Esters	Esters
Ketones	Ketones
Alcohols	Alcohols
Chlorinated Hydrocarbons	Chlorinated Hydrocarbons
Bases	Bases
Amines	Dilute Acids
Acids	

TABLE 1.39: POLYPROPYLENE—EASTMAN CHEMICAL PRODUCTS

Resistance of TENITE Polypropylene 4231 to Various Chemicals*

Chemical	% Change in		Appearance
	Weight	Thickness	
Acetone	2.2	1.0	No change
Acetic Acid 5%	0.1	0.1	Slightly bleached
Ammonium Hydroxide 10%	0.0	–0.1	Slightly bleached
Butyl Acetate	6.3	1.8	Slightly bleached
Calcium Chloride 2½%	0.1	–0.4	Slightly yellow

(continued)

TABLE 1.39: POLYPROPYLENE–EASTMAN CHEMICAL PRODUCTS (continued)

Chemical	% Change in		Appearance
	Weight	Thickness	
Carbon Disulfide	18.3	3.9	Swollen and slightly bleached
Carbon Tetrachloride	43.0	7.3	Swollen and slightly bleached
Chloroform	26.7	4.8	Severly swollen and slightly bleached
Citric Acid 10%	0.0	0.3	No change
Copper Sulfate 10%	0.0	0.2	No change
Ethanol 50%	0.2	0.1	No change
Ethanol 95%	0.2	0.5	No change
Ethyl Acetate	5.0	1.6	Slightly swollen
Ethylene Glycol	0.1	0.3	No change
Ethylene Glycol Monoethyl Ether	0.4	0.2	Slightly Yellow
Ethylene Dichloride	9.2	2.0	Swollen and slightly bleached
Ferric Chloride 10%	0.1	–0.1	No change
Formaldehyde 35%	0.2	–0.1	Slightly yellow
Gasoline (Regular)	13.7	4.5	Swollen and very slightly bleached
Gasoline (Aviation)	12.2	4.5	Swollen and bleached
Glycerine	0.0	0.2	No change
Green Soap Solution	0.1	0.2	No change
Heptane	11.1	4.4	Swollen and bleached
Hydrochloric Acid 10%	0.0	0.3	No change
Hydrogen Peroxide 30%	0.0	0.2	Yellow
Methanol 5%	0.0	0.3	No change
Methanol 100%	0.4	0.5	Slightly bleached
Motor Oil	0.2	0.0	No change
Nitric Acid (Conc.)	1.0	0.3	Yellow
Oleic Acid	0.2	0.3	No change
Olive Oil	0.0	0.5	No change
Phenol 5%	0.1	0.1	No change
Phosphoric Acid (Conc.)	0.0	–0.2	No change
Potassium Dichromate 10%	0.0	0.3	No change
Sodium Chloride 10%	0.0	–0.2	No change
Sodium Carbonate 2%	0.0	–0.2	Very yellow
Sodium Hydroxide 10%	0.0	0.1	No change
Sodium Hydroxide 1%	0.0	0.6	No change
Sodium Hypochlorite	0.0	–0.3	No change
Sulfuric Acid 30%	0.0	–0.2	No change
Sulfuric Acid 3%	0.0	0.0	No change
Sulfuric Acid (Conc.)	0.0	0.2	Stained
Toluene	12.8	3.6	Swollen and slightly bleached
Triethyl Phosphate	0.1	0.2	No change
Turpentine	14.2	5.0	Swollen and bleached
Water	0.0	0.2	No change
Vegetable Oil	0.0	–0.2	No change
Xylene	12.7	3.7	Swollen and slightly bleached

*Injection-molded disks 2 inches in diameter and ⅛-inch thick were immersed in the chemicals and stored under a constant temperature of 73°F for one year. Polypropylene is highly resistant to chemical attack and to stress-cracking. However, a few chemicals produce swelling and attack the surface slightly. These chemicals are mainly chlorinated compounds, aromatic hydrocarbons, and the higher aliphatic hydrocarbons, such as gasoline.

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Acetaldehyde	68	180	M	39.6
	122	180	M	——
Acetate solvents, pure	73		M	
Acetic Acid (5%)	73	365	S	
	140	30	S	
Acetic Acid (10%)	70	100	S	
	140	100	M	
Acetic Acid (20%)	73		S	
Acetic Acid (50%)	72	30	S	
	176	30	M	
Acetic Acid (Glacial) (100%)	68	180	S	1.06
	122	180	S	6.4
	140	100	M	——
Acetone (DMK)	68	30	S	4.2
	68	100	M	
	122	180	M	
	140	100	M	
Acetophenone	73		S	
Acetylene	73		S	
Acriflavine (2% aq. sol'n)	68		S	
	176		S	
Acrylic emulsions	68		S	
	140		S	
Allyl chloride	68		M	
	140		U	
Almond Oil	73	117	S	0.0
Aluminum chloride	68		S	
	140		S	
	212		S	
Aluminum fluoride	68		S	
	140		S	
Aluminum Sulfate	73		S	
Alums	73		S	
Ammonia (15% sol.)	72	30	S	
Ammonia (25%)	73	180	S	9.5
	140	180	S	17.4
Ammonia (30%)	73	365	S	
Ammonia, concen.	73	100	S	
Ammonia (gas-liquid)	73		S	
Ammonium Acetate	73		S	
Ammonium Bicarbonate	68		S	
	140		S	
Ammonium Carbonate	73		S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Ammonium Chloride	73		S	
Ammonium fluoride	68		S	
	140		S	
	212		S	
Ammonium Hydroxide (10% aqueous sol.)	73	365	S	
Ammonium metaphosphate	68		S	
	140		S	
	212		S	
Ammonium Nitrate	73		S	
Ammonium persulphate	68		S	
	140		S	
	212		S	
Ammonium Phosphate	73		S	
Ammonium Sulfate	73		S	
Ammonium Thiocyanate	68		S	
	140		S	
	212		S	
Amyl Acetate	73		S	
Amyl Alcohol	68		S	
	140		S	
	212		S	
Amyl Chloride	68		M	
	140		M	
Aniline	68	180	S	0.165
	122	180	M	2.77
	140	30	S	
Anisole	68		S	
	140		M	
	212		U	
Anti-freeze	68	180	S	0.0
	122	180	S	0.45
Antimony Chloride, sat'd	68		S	
	140		S	
	212		M	
Apple Juice	73	43	S	1.78
Aqua regia	68		S	
	140		M	
	212		U	
Aromatic Hydrocarbons	73		U	
Asphalt	73		U	
Barium Carbonate	68		S	
	140		S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Barium Carbonate	212		S	
Barium Chloride	68		S	
	140		S	
	212		S	
Barium Hydroxide	68		S	
	140		S	
	212		S	
Barium Salts	73		S	
Barium Sulfate	68		S	
	140		S	
	212		S	
Barium Sulfide	68		S	
	140		S	
	212		S	
Beer	72	30	S	
Beet Juice	73		S	
Benzaldehyde	73		M	
Benzene/Benzol	68	180	U	100% loss
Benzene Sulfonic Acid	68		M	
	140		M	
Benzoic Acid	73		S	
Benzoyl Chloride	73		S	
Benzyl Alcohol	68	180	S	0.22
	122	180	S	1.0
Bismuth Carbonate	68		S	
	140		S	
	212		S	
Bluing	73		S	
Borax	73		S	
Boric Acid,	73		S	
Brandy	73		S	
Brine Solution	73	365	M	
Bromine Gas (weak)	68		M	
	140		U	
Bromine Liquid	68		M	
	140		M	
Bromine water, sat'd	73		M	
Butane	73		M	
Butanol	73		S	
Butter	73		S	
Butyl Acetate	73	365	S	
Butyl Phthalate	72	90	S	
	176	30	S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS–SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE Temp., °F	EXPOSURE Time, days	CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
Calcium Bisulfite	73		S	
Calcium Carbonate	68		S	
	140		S	
	212		S	
Calcium Chlorate	68		S	
	140		S	
	212		S	
Calcium Chloride (2.5% aqueous solution)	73	365	S	
Calcium Chloride (50% Solution)	72	30	S	
	176	30	S	
Calcium Hydroxide	68		S	
	140		S	
	212		S	
Calcium Hypochlorite	73		S	
Calcium Nitrate (50% sol'n.)	68		S	
	140		S	
	212		S	
Calcium Phosphate	68		S	
Calcium Salts	73		S	
Calcium Sulfate	68		S	
	140		S	
	212		S	
Calcium Sulfite	68		S	
	140		S	
	212		S	
Camphor Oil	73	86	U	3.64
Cane Sugar Liquors	73		S	
Carbon Bisulfide	73	365	U	
Carbon Dioxide, dry	73		S	
Carbon Dioxide, wet	73		S	
Carbon Dioxide Solution	68		S	
	140		S	
Carbon Disulfide	73	365	S	
Carbon Monoxide	68		S	
	140		S	
Carbon Tetrachloride	73	365	U	
	140	100	U	
Carbonic Acid	68		S	
	140		S	
Carrot Oil	73		S	
Castor Oil	73	143	S	0.0

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Castor Oil	140	91	S	0.0
Caustic Soda, conc.	73	100	S	
Caustic Soda, dil.	73	100	S	
Cellosolve®	73	365	S	
Cetyl Alcohol	68		S	
Char-co-sol	73	30	S	0.62
	140	30	S	76.0
Chlorobenzene	68	180	U	100% loss
Chlorine Gas	68		U	
	140		U	
Chlorine Liquid	68		U	
	140		U	
Chlorine Water	68		S	
	140		M	
Chlorine (wet)	73		S	
Chlorine (dry)	73		U	
Chlorinated Hydrocarbons	73		M	
Chloroform	73	365	U	
Chlorosulfonic Acid	73		U	
Chlorox	73	365	S	
Chrome Alum	68		S	
	140		S	
	212		S	
Chocolate Syrup	73		S	
Chromic Acid (10%)	73	365	S	
Chromic Acid (30%)	73		S	
Chromic Acid (40%)	73	30	S	
	140	30	S	
Chromic Acid, 2 N	73		S	
Cider	68		S	
	140		S	
Citric Acid (10%)	68	180	S	0.48
	122	180	S	2.3
	140	30	S	
Citric Acid, 2 N	73	365	S	
Citrondropar (Lemon)	68	109	S	6.43
	122	109	S	22.77
Clove Oil	73	302	M	0.0
	140	159	M	5.35
Coconut Oil	73	162	S	0.0
Cod Liver Oil	73	96	S	0.0
Coffee	73		S	
Coke Oven Gas	73		S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS–SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Copper Salts	73		S	
Copper Sulfate	73		S	
Core Oils	73		S	
Corn Oil	73	158	S	0.0
	140	167	S	0.0
Cottonseed Oil	73	191	S	0.0
	140	113	S	0.0
Creosote	73		S	
Cresal	73		U	
Cresol	68		S	
Cupric Chloride	68		S	
	140		S	
Cupric Cyanide	68		S	
	140		S	
Curpic Fluoride	68		S	
	140		S	
Cupric Nitrate	68		S	
	140		S	
Cupric Sulfate	68		S	
	140		S	
Cuprous Chloride	68		S	
	140		S	
Cyclohexane	68	180	M	194.0
	122	180	M	100% loss
Cyclohexanol	68	180	S	0.13
	122	180	S	1.63
Cyclohexanone	68	180	M	0.22
	122	180	M	13.4
DDT Spray	68		S	
Decalin	73		U	
Detergent Solution	73	30	S	
(Heavy Duty)	140	30	S	
Developers	68		S	
(Photographic)	140		S	
Dextrine	68		S	
	140		S	
Dextrose	68		S	
	140		S	
Diacetone Alcohol	68	180	S	0.21
	122	180	S	3.94
Diazo Salts	68		S	
	140		S	
Dibutyl Phthalate	73		M	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Dichloroethylene	73		S	
Diethanolamine	68		S	
	140		S	
Diethyl Carbonate	68		S	
	140		M	
Diethylene Glycol	68		S	
	140		S	
Di-iso-octyl Phthalate	68		S	
	140		S	
Dimethyl Ether	68		M	
	140		M	
Dimethyl Formamide	73	30	S	
	140	30	S	
Dimethylamine	68	180	S	1.1
	122	180	M	10.6
Dioctyl Phthalate	70	100	M	
(DOP)	140		M	
Dioxane	73		M	
Disodium Phosphate	68		S	
	140		S	
Distilled Water	73	78	S	0.55
	140	160	S	5.03
Dobanic Acid	68		S	
	140		S	
Donax "B"	68	180	S	0.0
	122	180	S	0.40
Dye (Rit)	73		S	
Epichlorohydrin	68	180	S	1.42
	122	180	S	17.9
Ethanol (50% Aqueous Solution)	73	365	S	
Ethanol (95%)	73	365	S	
Ethanolamine	68		S	
	140		S	
Ethers	73		S	
Ethyl Acetate	73	365	M	7.0
	122	180	M	100% loss
	140	100	M	
Ethyl Acrylate	68		M	
	140		M	
Ethyl Alcohol	73	365	S	
	140	100	S	
Ethyl Alcohol (50%)	68	30	S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Ethyl Alcohol (50%)	140	30	S	
Ethyl Alcohol (95%)	73	100	S	
	140	30	S	
Ethyl Chloride	68		M	
	140		M	
Ethylene Chloride	68		M	
	140		M	
Ethyl Ether	68	180	M	
Ethylene Di-chloride	70	30	M	
Ethylene Glycol	73	365	S	
Ethylene Oxide	50		M	
Ethyl Oleate	68		S	
	140		M	
	212		M	
Fatty Acids, C^6	68		S	
	140		S	
Ferric Chloride	73		S	
Ferric Nitrate	68		S	
	140		S	
Ferrous Chloride	73		S	
Ferrous Sulfate	73		S	
Fish	73		S	
"Flit" Insecticide	68		S	
Fluosilicic Acid	68		S	
	140		S	
Fly Spray (Ortho)	73		S	
Formaldehyde, (35% Solution)	72	90	S	
Formaline, (40% Solution)	73		S	
Formic Acid (85%)	72	30	S	
Formic Acid (Anhydrous)	73	365	S	
Freon®	73		M	
Fructose	68		S	
	140		S	
Fruit Juice	68		S	
	140		S	
Fruit Pulp	68		S	
	140		S	
Fuming Nitric Acid	73		U	
Furfural	68		M	
	140		M	
Furfurol	73		S	0.31
Gas Oil	68	180	S	0.31
	122	180	S	24.7

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Gasoline	73	100	M	100% loss
	73	365	M	100% loss
	140	100	M	100% loss
Gasoline (Aviation)	73	365	M	
Gasoline (Sour)	73		M	
Gearbox Oil	68		S	
	140		M	
Gelatin	73		S	
Glucose	73		S	
Glue	73		S	
Glycerine	68		S	
	140		S	
Glycolic Acid (30%)	68		S	
	140		S	
Glycerol	68	180	S	−0.14
	122	180	S	−0.86
Grape Sugar	68		S	
	140		S	
Grease	68		S	
Green Soap Solution	73	365	S	
Heavy Duty Detergent	73	30	S	
(OMO) Solution (5%)	73	100	S	
Heptane	73	180	M	100% loss
Hexane	73	365	M	
Household Detergent	70	100	S	
	140	100	S	
Household Ammonia Solution	73		S	
Household Soap	73		S	
Hydrobromic Acid	68		S	
	140		S	
Hydrochloric Acid (Conc.) (38%)	73	100	S	
Hydrochloric Acid (10% aqueous solution)	73	365	S	
	140	100	S	
Hydrochloric Acid (30%)	73	365	S	
Hydrochloric Acid (35%)	68	180	S	
	73	100	S	.35
	140	100	M	
Hydrochloric Acid (36%)	72	90	S	
	176	10	S	
Hydrochloric Acid (50%)	73		S	
Hydrochloric Acid, 2N	73	365	S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL **(continued)**

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Hydrocyanic Acid	73		S	
Hydrolfluoric Acid, Dil.	73		S	
Hydrofluoric Acid (38%)	73	30	S	
Hydrofluoric Acid (40%)	140	30	S	
Hydrofluoric Acid (50%)	73		S	
Hydrofluoric Acid, Techn.	72	90	S	
Hydrogen Bromide (10%)	68		S	
	140		S	
Hydrogen Chloride Gas, dry	68		S	
	140		S	
Hydrogen fluoride	73		S	
Hydrogen	73		S	
Hydrogen Peroxide (3% Solution)	73	100	S	
	73	365	S	
Hydrogen Peroxide (28% Solution)	73	30	S	
	140	30	U	
Hydrogen Sulfide, dry	73		S	
Hydrogen Sulfide (wet + aqueous solution)	73		S	
Hydroquinone	68		S	
	140		S	
Igepal	73	365	S	
Ink, Washable	73		S	
Iodine Solution	73		S	
Iodine (in alcohol)	73	365	S	
Iosan	140	30	S	5.10
Ipana Plus	73	30	S	
Isopropyl Alcohol	68	180	S	0.25
	122	180	S	3.74
Isopropyl Ether	68	180	M	48.0
	122	80	M	100% loss
Isooctane	73	30	M	
	140	30	M	
Kardemommudropar (Cardamon)	68	109	S	0.110
	122	86	S	2.89
Karo Syrup	73		S	
Kerosine	68	180	S	4.27
	122	180	M	59.0
	140	100	M	
Kerosine (No. 2 fuel oil)	73	30	M	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M = Marginal U = Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Kerosine (No. 2 fuel oil)	140	30	U	
Kleenezy	140	30	S	4.62
Kleenosan	140	30	S	5.38
Kleer-View Windshield	73	69	S	0.85
Washer Solvent	140	68	S	4.53
Kresol	68	180	S	0.23
	122	180	S	1.56
Lacquer and Lacquer Solvents	73		M	
Lactic Acid	73		S	
Lactic Acid (20%)	73	365	S	
Lanolin	68		S	
	140		S	
Lead Acetate	73		S	
Lemon Oil	73	65	M	23.5
	140	14	M	
Ligroine	68	180	M	258.0
	122	180	M	100% loss
Lime Sulfur	73		S	
Linseed Oil	73	365	S	
Linseed Oil (blue)	73	30	M	
	73	100	M	
Lubricating Oil	140	100	M	
Lye	73	303	S	
Machine Oil	73		S	
Magenta Dye (2% Soln.)	68		S	
	140		S	
Magnesium Chloride	73		S	
Magnesium Carbonate	68		S	
	140		S	
	212		S	
Magnesium hydroxide	73		S	
	140		S	
	212		S	
Magnesium Sulfate	73		S	
	140		S	
	212		S	
Magnesium Sulfide	68		S	
	140		S	
	212		S	
Malic Acid	73		S	
Manganese Salts	73		S	
Mayonnaise	73		S	
Meat Sauce	68	180	S	0.29

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Meat Sauce	122	180	S	1.3
Mennen's "Skin Bracer"	73	23	S	0.68
	140	23	S	6.8
Mercuric Cyanide	68		S	
	140		S	
Mercurochrome	73		S	
Mercuric Chloride	73		S	
Mercurous Nitrate	68		S	
	140		S	
Mercury	73		S	
Methyl Alcohol (100%)	73	365	S	
	140	30	S	
Methyl Bromide	68		M	
	140		U	
Methyl Ethyl Ketone	68	180	M	3.5
	122	180	M	84.0
Methyl Isobutyl Carbinol	68	180	S	0.21
	122	180	S	2.7
Methyl Isobutyl Ketone	70	100	S	
	140	100	U	
Methylene Chloride	73		M	
Milk	73	30	S	
Mineral Oil (White)	73	30	M	
	140	30	M	
Molasses	73		S	
Mondludropar (Almond)	68	109	S	0.16
	122	86	S	1.29
Monochloracetic Acid	68		S	
	140		S	
Moth Spray (Black Flag)	73		S	
Motor Oil (Shell X-100)	68	180	S	0.031
	122	180	S	0.26
	140	100	S	
Mustard Paste	73		S	
n-Heptane	140	100	M	
Naphtha	68		M	
Naphthalene	68		M	
	140		M	
	212		M	
Natural Gas	73		S	
Neatsfoot Oil	73	103	S	0.0
	140	110	S	0.06
Nickel Chloride	73		S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Nickel Nitrate	68		S	
	140		S	
	212		S	
Nickel Salts	73		S	
Nickel Sulfate	73		S	
Nitric Acid, Conc.	73	365	S	0.42
	122	180	S	–
	140	30	U	
Nitric Acid, Dil (10%)	70	100	S	
	140	100	M	
Nitric Acid, (30%)	73	100	M	
Nitric Acid (40%)	73	365	M	
	140	30	U	
Nitric Acid, Conc. (50%)	70	100	M	
	140	100	U	
Nitric Acid (75%)	68	180	M	0.42
Nitric Acid, Fuming	73	365	U	
Nitrobenzene	68	180	S	0.40
	122	180	S	8.4
	140	100	U	
Nitrogen Oxides	73		S	
Nitrous Acids	73		S	
Nutmeg Oil	73	82	U	1.25
OPC 60 Solution (21%)	73	100	S	
Oils, Vegetables	73		S	
Oleic Acid	68	180	S	0.076
	122	180	S	0.27
	140	30	U	
Oleum	68		U	
	140		U	
	212		U	
Olive Oil	73	365	S	
	140	152	S	0.0
Oxalic Acid	68	180	S	0.28
	122	180	S	2.3
Oxalic Acid (50%)	73	365	S	
Oxygen Gas	73		S	
Palmitic Acid	73		S	
Paraffin Wax	68		S	
	140		S	
Paraldehyde	68		M	
	140		M	
Peanut Oil	73	133	S	0.0

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Peanut Oil	140	73	S	0.07
Peppermint Oil	73	196	S	0.14
	120	95	M	39.3
Perchloric Acid	73		S	
Petroleum Oils, Sour	73		M	
Petroleum Oils, Refined	73		S	
Phenol	73	100	S	
	140	100	S	
Phenol Solution (5%)	73	365	S	
	140	30	S	
Phosphoric Acid (25%)	73		S	
Phosphoric Acid (25-50%)	73		S	
Phosphoric Acid (85%)	70	100	S	
	140	100	S	
Phosphorous Oxychloride	68		M	
Picric Acid	73		M	
Plating Solutions:	68		S	
Brass, Cadmium, Chromium, Copper, Lead, Gold, Indium, Nickle, Rhodium, Silver, Tin, Zinc.	140		S	
Potassium Bichromate/ Sulphuric Acid/Water (5/100/5)	70	100	M	
	140	100	M	
Potassium Bicarbonate	68		S	
	140		S	
Potassium Borate	68		S	
	140		S	
Potassium Bromate	68		S	
	140		S	
Potassium Bromide	68		S	
	140		S	
Potassium Carbonate	73		S	
Potassium Chlorate	73		S	
Potassium Chloride	73		S	
Potassium Chromate	68		S	
	140		S	
Potassium Cyanide	68		S	
	140		S	
	212		S	
Potassium Ferricyanide	68		S	
	140		S	
Potassium Ferri/Ferrocyanide	68		S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS–SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Potassium Ferri/Ferrocyanide	140		S	
	212		S	
Potassium Fluoride	68		S	
	140		S	
	212		S	
Potassium Hydroxide	68	180	S	0.0
	122	180	S	0.48
Potassium Hydroxide (50%)	73	365	S	
Potassium Iodide	73		S	
Potassium Nitrate	68		S	
	140		S	
	212		S	
Potassium Perborate	68		S	
	140		S	
Potassium Perchlorate (10%)	68		S	
	140		S	
Potassium Persulphate	68		S	
	140		S	
Potassium Permanganate Solution	70	100	M	
	140	100	M	
Potassium Sulfate	73		S	
Potassium Sulfide	68		S	
	140		S	
	212		S	
Potassium Sulfite	68		S	
	140		S	
	212		S	
Propane	73		M	
Propionic Acid	68		S	
	140		M	
Propylene Dichloride	68		M	
	140		M	
Pyridine	73		S	
Rice Barn Oil	73	106	S	0.0
	140	111	S	0.0
Rosin (light)	73		S	
Safflower Oil	73	161	S	0.0
	140	63	S	0.0
Sauerkraut	73		S	
Shell X-100	68	180	S	0.031
	122	180	S	0.26
Shellac	73		S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M = Marginal U = Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Shoe Polish (liquid)	73		S	
Sea Water	68		S	
	140		S	
	212		S	
Silica Gel	68		S	
	140		S	
	212		S	
Silicone Oil	73	365	S	
Silver Nitrate	73		S	
Soap Solution (1%)	73	30	S	
	140	30	S	
Soap Solution (5%)	70	100	S	
	140	100	S	
Soapless Detergent	73		S	
Sodium Acetate	68		S	
	140		S	
	212		S	
Sodium Benzoate (35%)	68		S	
	140		S	
	212		S	
Sodium Bicarbonate	73		S	
Sodium Bisulfate	73		S	
Sodium Bisulfite	73		S	
Sodium Borate	73		S	
Sodium Bromide	68		S	
	140		S	
Sodium Bromide Oil Sol'n	68		S	
	140		S	
Sodium Carbonate	73	365	S	
Sodium Carbonate,	72	30	S	
Satur. Solution	176	30	S	
Sodium Carbonate (2% Sol'n)	73	30	S	
	140	30	S	
Sodium Carbonate (2.5 aqueous solution)	73	365	S	
Sodium Carbonate	73	30	S	
(20% Solution)	140	30	S	
Sodium Chlorate	73		S	
Sodium Chloride,	72	90	S	
Solution	176	30	S	
Sodium Chloride (10% Solution)	73	365	S	
	140	30	S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Sodium Chlorite (2%)	68		S	
	140		S	
Sodium Chlorite (20%)	68		S	
	140		M	
Sodium Chlorite (30%)	68		S	
	140		M	
Sodium Chromate	68		S	
	140		S	
Sodium Cyanide	73		S	
Sodium Dichromate	68		S	
	140		S	
	212		S	
Sodium Ferricyanide	68		S	
	140		S	
	212		S	
Sodium Ferrocyanide	68		S	
	140		S	
	212		S	
Sodium Hydroxide	73	365	S	
(1% Solution)	140	30	S	
Sodium Hydroxide	72	90	S	
(30% Solution)	176	30	S	
Sodium Hydroxide,	70	365	S	
(50%)	140	100	S	
Sodium Hydroxide	73	30	S	
(60% Solution)	140	30	S	
Sodium Hypochlorite	68	180	S	0.58
	122	180	S	1.92
Sodium Hypochlorite (5%)	73	30	S	
	140	30	M	
Sodium Hypochlorite (10% Sol'n)	73	30	M	
	73	100	M	
Sodium Hypochlorite Sol'n Conc.	70	100	M	
	140	100	M	
Sodium Metaphosphate	73		S	
Sodium Nitrate	73		S	
Sodium Palmitate	73	30	S	
(5% Solution)	73	100	S	
Sodium Perborate	73		S	
Sodium Phosphate, Alkaline	73		S	
Sodium Phosphate, Acid	73		S	
Sodium Phosphate, Neutral	73		S	
Sodium Silicate	73		S	

(continued)

TABLE 1.40: POLYPROPYLENE RESINS–SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Sodium Silicate	140		S	
	212		S	
Sodium Sulfate	73		S	
Sodium Sulfide	73		S	
Sodium Sulfite	73		S	
Sodium Thiosulfate (hypo)	73		S	
Soybean Oil	73	110	S	0.0
	140	117	S	0.0
Spindle Oil	70	100	S	
	140	100	M	
Stannic Chloride	68		S	
	140		S	
	212		S	
Stannous Chloride	68		S	
	140		S	
Starch	68		S	
	140		S	
	212		S	
Stearic Acid	73		S	
Succinic Acid	73		S	
Sugars and Syrups	68		S	
	140		S	
	212		S	
Sulfate Liquors	73		S	
Sulfur	73		S	
Sulfamic Acid	68		S	
	176		S	
Sulphur Dichloride	68		S	
Sulfur Chloride	73		S	
Sulfur Dioxide (dry)	73		S	
Sulfur Dioxide (wet)	73		S	
Sulfuric Acid (3%)	73	365	S	
	140	30	S	
Sulfuric Acid, Dil. (10%)	70	100	S	
	140	100	S	
Sulfuric Acid (30%)	73	30	S	
	140	30	S	
Sulfuric Acid (50%)	72	90	S	
	176	10	S	
Sulfuric Acid (96%)	72	90	S	
	176	10	S	
Sulfuric Acid (97%)	73	365	S	
Sulfuric Acid, conc. (98%)	68	180	S	−1.01

(continued)

TABLE 1.40: POLYPROPYLENE RESINS—SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Sulfuric Acid, conc. (98%)	122	180	S	−1.44
	140	100	M	
Sulfurous Acid	73		S	
Super Shell	68	180	M	100% loss
	122	180	M	100% loss
Tallow	68		S	
	140		S	
Tannic Acid	73		S	
Tar	73		S	
Tartaric Acid	73		S	
Tea	73		S	
"Teepol" 514 Solution (27%)	73	100	S	
Tetrahydrofurane	73		S	
Tetralin	73		M	
Thiopen	73		S	
Toluene	73	365	M	
	140	100	M	
Tomato	73		S	
2T Oil	68	180	S	0.0
	122	180	S	4.1
Transformer Oil	73	30	M	
	140	30	U	
Transformer Oil, DTE/3D	72	90	M	
	176	30	M	
Trichloracetic Acid, 2N	73		S	
Trichloroethylene	73		U	
Triethanolamine	68		S	
	140		S	
Tri-sodium Phosphate	73		S	
Turpentine	73	365	M	
	140	30	U	
Two-stroke Oil	70	100	S	
	140	100	M	
Urea	73		S	
Vanillindropar (Vanilla)	68	109	S	
	122	86	S	1.99
Varnish	73		S	
Vaseline	68	180	S	0.0
	122	180	S	0.073
Vaseline Oil	72	90	S	
	176	30	S	
Vinegar	68	180	S	0.64
	122	180	S	2.81

(continued)

TABLE 1.40: POLYPROPYLENE RESINS–SHELL CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	PERMEABILITY (gm./24 hr./ 100 sq. in/mil)
	Temp., °F	Time, days		
Water	73	365	S	
	140	14	S	
Water (brine)	73		S	
Water (fresh)	73		S	
Water (potable)	176	30	S	
Wax Crayon	73		S	
Wedac	140	30	S	2.46
Wesson Oil	72	30	S	0.10
Wheat Germ Oil	73	160	S	0.01
	140	58	S	0.0
Whiskey	73		S	
White Paraffin	68		S	
	176		S	
White Spirit (low aromatic content)	73	100	U	
White Spirit (high aromatic content)	73	100	U	
Wines	73	30	S	
Xylene	68	180	M	100% loss
	73	365	M	100% loss
	122	180	M	100% loss
	140	100	M	100% loss
Yeast	68		S	
	140		S	
Zinc Chloride	73		S	
Zinc Oxide	68		S	
	140		S	
Zinc Sulfate	73		S	

TABLE 1.41: POLYSTYRENE RESINS–HUNTSMAN CHEMICAL

These thermoplastic resins are crystalline, rigid and of brilliant clarity. They are formulated to suit a wide variety of applications. All the polystyrene resins are processed by extrusion, thermoforming, blow molding or injection but only the rubber-modified impact polystyrene or ABS can be thermoformed.

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	SOLVENT (X Indicates that the reagent acted as a solvent)
	Temp., °F	Time, days		
Acetic Acid 5%	77	365	S	
Acetic Acid 10%	77	365	M	
Acetic Acid 100%	77	365	U	
Acetone			U	
Acetophenone			U	
Adrenalin Hydrochloride			S	
Adrenalin in oil			M	
Allyl Alcohol			U	
Aluminum Chloride (Sat.)	122	365	S	
Aluminum Sulphate (Sat.)	122	365	S	
Ammonia			S	
Ammonium Hydroxide	122	365	S	
Amyl Alcohol			U	
Amyl Acetate-n			U	X
Amyl Phthalate			U	
Amseed Oil			U	
Aspirin (pwd)			S	
Atropine Sulphate			S	
Barium Carbonate (pwd)	122	365	S	
Beef			S	
Benzaldehyde			U	
Benzedrine			S	
Benzene			U	X
Benzoic Acid	122	365	S	
Benzyl Acetate			U	
Borax (Sat.)	122	365	S	
Boric Acid	122	365	S	
Bromine Liquid			U	
Butter			U	
Butyl Acetate iso			U	X
Butyl Acetate n			U	X
Butyl Alcohol iso	77	365	S	
Butyl Alcohol n			S	
Butyl Phthalate			U	
Caffeine (Sat.)			S	
Calcium Hypochloride 15%			M	
Calcium Hypochlorite			U	
Camphor			M	
Carbon Tetrachloride			U	X
Carbolic Acid 50%			M	
Carbolic Acid 100%			U	
Cassia Oil			U	
Castor Oil			S	

(continued)

TABLE 1.41: POLYSTYRENE RESINS—HUNTSMAN CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	SOLVENT (X Indicates that the reagent acted as a solvent)
	Temp., °F	Time, days		
Cedarwood Oil			U	
Cellosolve			U	
Cellulose Acetate	122	365	U	
Cetyl Alcohol	77	365	S	
Cherries Processed			S	
Chlorobenzene			U	X
Chloroform			U	X
Chlorine			U	
Chromic Acid 20%			S	
Citric Acid 10%	77	365	S	
Citric Acid 20%			M	
Cocoa Butter			M	
Cod Liver Oil			M	
Coconut Oil			M	
Coffee Solution	122	365	S	
Copper Sulphate	77	10	M	
Corn Oil			M	
Cottonseed Oil			M	
Cyclohexanol	77	365	S	
Cyclohexanone			U	X
Decalin			U	X
Detergents			M	
Diacetone			M	
Dibutyl Sebacate			U	
Dichlorobenzene-o			U	X
Dichlorobenzene-p			U	
Diethylene Glycol	122	365	S	
Diethylketone			U	X
Dimethyl Phthalate			U	
Ethyl Acetate 98%			U	X
Ethyl Alcohol 95%	77	365	M	
Ethyl Benzene			U	X
Ethyl Benzoate			U	
Ethyl Chloride (Gas & Liq.)			U	
Ethyl Ether			U	
Ethyl Lactate			U	
Ethylene Dichloride			U	X
Ethylene Glycol			S	
Ethylene Oxide			U	
Ferrous Chloride	122	365	S	
Formaldehyde			U	
Formic Acid 90%			M	
Furfuryl Alcohol			U	
Gasoline			U	

(continued)

TABLE 1.41: POLYSTYRENE RESINS—HUNTSMAN CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M = Marginal U = Unsatis.	SOLVENT (X Indicates that the reagent acted as a solvent)
	Temp., °F	Time, days		
Glucose 30%			S	
Glycerine	77	240	S	
Heptyl Alcohol-n			S	
Hexane			U	
Hexyl Alcohol-n			S	
Horseradish			M	
Honey			S	
Hydrochloric Acid 10%	77	365	S	
Hydrochloric Acid 38%			M	
Hydrofluoric Acid 10%			U	
Hydrogen Peroxide 30%			S	
Hydroquinone			M	
Iodine Tincture			M	
Iso-propyl Alcohol	77	365	M	
Kerosene			U	
Lactic Acid 10%			U	
Lanolin	77	365	S	
Lard			U	
Lauryl Alcohol			S	
Lead Arsenate			M	
Lead Nitrate	122	365	S	
Lemon Juice			U	
Lime Water			S	
Lipstick			M	
Magnesium Carbonate	122	365	S	
Maleic Acid 10%	77	365	S	
Mercuric Chloride 5%	122	365	S	
Mesityl Oxide			U	X
Methyl Acetate			U	
Methyl Alcohol			M	
Methyl Chloride			U	
Methyl Ethyl Ketone			U	X
Methyl Isobutyl Ketone			U	X
Methyl Propyl Ketone			U	X
Methyl Salicylate (Oil of Wintergreen)			U	
Methylene Chloride			U	
Milk	77	14	S	
Mineral Oil			S	
Mono-Chloro Benzene			U	X
Motor Oil			M	
Mustard			M	
Nitric Acid 20%			U	
Nitroglycerine			S	

(continued)

TABLE 1.41: POLYSTYRENE RESINS—HUNTSMAN CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	SOLVENT (X Indicates that the reagent acted as a solvent)
	Temp., °F	Time, days		
Nonyl Alcohol			S	
Octyl Alcohol			S	
Oils-Essential			U	
Oleic Acid 100%	7	365	M	
Orange Juice Fresh			M	
Orange Juice Conc.			S	
Oxalic Acid 10%	122	365	S	
Ozone (in absence of light)			S	
Palm Oil			M	
Palmitic Acid	77	365	M	
Peanut Oil			U	
Pectin (Sat.)			S	
Petroleum Jelly	122	365	S	
Phenol 5%			M	
Phosphoric Acid 50%	122	365	S	
Phosphorous (white)			M	
Potasium Hydroxide 30%	77	365	S	
Potasium Hydroxide 35%	77	365	M	
Potasium Bromide 3%	77	365	M	
Potasium Ferricyanide	122	365	S	
Potasium Iodide (Sat.)	122	365	S	
Potasium Permanganate	122	365	M	
Propyl Alcohol (iso)	77	365	M	
Propylene Dichloride			U	X
Propylene Glycol	122	365	S	
Pyrogallic Acid	77	395	M	
Resorcinal Crystals			S	
Rubber			S	
Salicylic Acid (Sat.)	122	365	S	
Silver Nitrate (Sat.)	122	365	S	
Sodium Acetate (Sat.)	122	365	S	
Sodium Benzoate	122	365	S	
Sodium Bicarbonate	122	365	S	
Sodium Bisulphite (Sat.)	122	365	M	
Sodium Borate			S	
Sodium Bromide	122	365	S	
Sodium Carbonate (Sat.)	122	365	M	
Sodium Chloride (Sat.)	122	365	M	
Sodium Dichromate 10%			M	
Sodium Fluoride 5%			M	
Sodium Hydroxide 40%	77	30	S	
Sodium Hypochlorite 15%			S	
Sodium Tetraborate (Borax)	122	365	S	

(continued)

TABLE 1.41: POLYSTYRENE RESINS—HUNTSMAN CHEMICAL (continued)

REAGENT (Solids in saturated solution unless indicated otherwise)	EXPOSURE		CHEMICAL EXPOSURE PERFORMANCE S = Satis. M= Marginal U= Unsatis.	SOLVENT (X Indicates that the reagent acted as a solvent)
	Temp., °F	Time, days		
Stannic Chloride			S	
Stearic Acid (pwd)	122	365	S	
Sucrose 30%			S	
Sulphur			S	
Sulphuric Acid 50%			S	
Sulphuric Acid 96%			U	
Tannic Acid 2%			U	
Tartaric Acid	122	365	S	
Tea (Sol.)			S	
Tetrahydrofurfuryl Alcohol			U	
Tetralin			U	X
Thionyl Chloride			U	
Titanium Tetrachloride			U	
Toluene			U	X
Trichloroethylene			U	X
Trisodium Phosphate (Sat.)	122	365	S	
Triethylene Glycol			S	
Triethylene Tetramine			M	
Turpentine			U	X
Water			S	
Water Carbonated			S	
Witch Hazel Distilled			S	
Worcestershire Sauce			S	
Zinc Carbonate	122	365	S	
Zinc Chloride 50%	122	365	S	
Zinc Stearate	122	365	S	
Xylene			U	X

TABLE 1.42: POLYSULFONE–UNION CARBIDE

UDEL Polysulfone is a high performance thermoplastic known for its high temperature resistance [300°F (149°C) UL listing for continuous use], hydrolytic stability, and excellent close tolerance moldability. Polysulfone also possesses good resistance to a wide variety of aggressive environmental conditions. In the most general terms, polysulfone is highly resistant to aqueous mineral acids, alkali, and salt solutions. Resistance to detergents and hydrocarbon oils is good, even at elevated temperatures under moderate levels of stress. In polar organic solvents such as ketones, chlorinated hydrocarbons, and aromatic hydrocarbons, polysulfone will swell, dissolve, or stress-crack.

Chemical Resistance Chart

Key to ratings:

- R Recommended
- LR Limited Recommendation (many applications possible depending on stress level).
- NR Not Recommended
- * No data

Inorganic Chemicals	(22°C.) 73°F.	(60°C.) 140°F.	(85°C.) 185°F.	(99°C.) 210°F.	(121°C.) 250°F.	(149°C.) 300°F.
Acids						
Chromic Acid, 12%	NR	NR	NR	NR	NR	NR
Chromic Acid, 60%	NR	NR	NR	NR	NR	NR
Hydrobromic Acid, 20%	R	R	R	R	R	R
Hydrochloric Acid, 10%	R	R	R	*	*	*
Hydrochloric Acid, 15%	R	R	R	*	*	*
Hydrochloric Acid, 20%	R	R	R	*	*	*
Hydrochloric Acid, 37%	R	R	LR	NR	NR	NR
Hydrofluoric Acid, 50%	LR	*	*	*	*	*
Nitric Acid, 10%	*	LR	*	NR	NR	NR
Nitric Acid, 20%	R	LR	NR	NR	NR	NR
Nitric Acid, 40%	R	LR	*	*	*	*
Nitric Acid, 71%	NR	*	*	*	*	*
Phosphoric Acid, 20%	R	R	R	R	R	R
Phosphoric Acid, 50%	R	R	R	R	R	R
Phosphoric Acid, 85%	R	R	R	R	R	NR
Phosphoric Acid, 100%	R	*	*	*	*	*
Sulfuric Acid, 40%	R	R	R	R	R	R
Sulfuric Acid, 65%	R	R	R	R	R	R
Sulfuric Acid, 75%	R	R	R	R	R	NR
Sulfuric Acid, 85%	R	R	R	R	NR	NR
Sulfuric Acid, 95%	NR	NR	NR	NR	NR	NR
Bases						
Ammonia, 15%	R	*	*	*	*	*
Ammonia, 29%	R	*	*	*	*	*
Potassium Hydroxide, 20%	R	R	*	*	*	*
Potassium Hydroxide, 35%	R	R	*	*	*	*
Sodium Hydroxide, 5%	R	R	R	R	R	*
Sodium Hydroxide, 10%	R	R	R	R	R	NR
Sodium Hydroxide, 25%	R	R	R	R	R	NR
Sodium Hydroxide, 50%	R	R	R	R	R	NR
Other						
Ammonium Persulfate, 24%	R	R	*	*	*	*
Ammonium Persulfate, 40%	R	R	*	*	*	*
Antimony Trichloride, Sat.	*	*	*	*	*	NR
Black Liquor	*	*	*	R	*	NR
Calcium Chloride, Sat.	R	R	R	R	R	R
Calcium Hypochlorite	R	R	R	R	R	R
†Chlorine, 100% Wet	*	*	NR	*	*	*
Cupric Chloride, Sat.	R	R	R	R	R	R
Ferrous Sulfate, Sat.	R	R	R	R	R	R
Green Liquor	R	R	R	R	R	R
Hydrogen Peroxide, 100%	R	*	*	*	*	*
Oxygen	R	R	R	R	*	*
Ozone	R	*	*	*	*	*
Potassium Nitrate, Sat.	R	R	R	R	R	R
Sodium Carbonate, 1.7%	*	*	*	LR	*	*
Sodium Hypochlorite, 5¼%	R	R	R	R	R	R
Sodium Hypochlorite, 17%	R	R	R	R	R	R
Sodium Silicate, 1.7%	*	*	*	LR	*	*
Water	R	R	R	R	*	*
Zinc Chloride, Sat.	R	R	R	R	R	R

Organic Chemicals	(22°C.) 73°F.	(60°C.) 140°F.	(85°C.) 185°F.	(99°C.) 210°F.	(149°C.) 300°F.
Acetic Acid, 10%	R	R	R	R	*
Acetic Acid, 20%	R	R	R	R	NR
Acetic Acid, 50%	R	R	R	R	NR
Acetic Acid, Glacial	LR	*	*	*	NR
Acetic Anhydride	NR	NR	NR	NR	NR
Acetone, 5%	R	*	*	*	*
Acetone, 100%	NR	NR	NR	NR	NR
Acetonitrile, 100%	NR	NR	NR	NR	NR
Benzene, 100%	NR	NR	NR	NR	NR
Butanol, 100%	LR	*	*	*	*
Butyl Acetate, 100%	NR	NR	NR	NR	NR
Butyl CELLOSOLVE Solvent, 100%	R	*	*	*	*
Butylated Hydroxy Anisole, 100%	LR	*	*	*	*
Butylated Hydroxy Toluene, 100%	R	*	*	*	*
Calcium Propionate	R	*	*	*	*
CARBITOL Solvent, 100%	R	*	*	*	*
Carbon Tetrachloride, 100%	R	*	*	*	*
CELLOSOLVE Solvent, 100%	R	*	*	*	*
Chlorobenzene, 100%	NR	NR	NR	NR	NR
Chloroform, 100%	NR	NR	NR	NR	NR
Citric Acid, 40%	R	*	*	*	*
Cottonseed Oil, 100%	R	*	*	*	*
Crude Oil, Texas, 100%	R	*	*	*	*
Cyclohexane, 100%	R	*	*	*	*
Cyclohexanone, 100%	NR	NR	NR	NR	NR
Diethyl ether, 100%	NR	NR	NR	NR	NR
Diisopropyl ether, 100%	NR	NR	NR	NR	NR
Dioctyl Phthalate, 100%	R	*	*	*	*
Ethanol, 100%	R	*	*	*	*
Ethanolamine, 100%	R	*	*	*	*
Ethyl Acetate, 100%	NR	NR	NR	NR	NR
2-Ethyl Butyric Acid, 100%	R	*	*	*	*
Ethylene Diamine, 92%	LR	*	*	*	*
Ethylene Glycol, 100%	R	*	*	*	*
Formaldehyde, 100%	R	*	*	*	NR
"Freon" 11, 100%	LR	*	*	*	*
"Freon" 22, 100%	LR	*	*	*	*
"Freon" BF, 100%	LR	*	*	*	*
"Freon" TMC, 100%	NR	NR	NR	NR	NR
Furfural	NR	NR	NR	NR	NR
Gasoline, 100%	LR	*	*	*	*
Glucose	R	*	*	*	*
Glycerine, 100%	R	*	*	*	*
n-Heptane, 100%	R	*	*	*	*
n-Hexane, 100%	R	*	*	*	*

(continued)

TABLE 1.42: POLYSULFONE–UNION CARBIDE (continued)

Organic Chemicals (continued)	(22°C.) 73°F.	(60°C.) 140°F.	(85°C.) 185°F.	(99°C.) 210°F.	(149°C.) 300°F.
Isooctane, 100%	R	*	*	*	*
Isopropanol, 100%	LR	*	*	*	*
Kerosene, 100%	LR	*	*	*	*
Lactic Acid, 60%	R	R	R	R	R
Lauric Acid	*	*	*	*	NR
Linseed Oil, 100%	R	*	*	*	*
Malonic Acid, 100%	R	*	*	*	*
MEK, 100%	NR	NR	NR	NR	NR
Methanol, 100%	R	*	*	*	*
Methylene Chloride, 100%	NR	NR	NR	NR	NR
Morpholine	NR	NR	NR	NR	NR
Oleic Acid, 100%	R	*	*	*	*
Oxalic Acid, 20%	R	*	*	*	*
Pyridine	NR	NR	NR	NR	NR
Sorbic Acid, 100%	R	*	*	*	*
1,1,2,2-Tetrachloroethane, 100%	NR	NR	NR	NR	NR
Tetrachloroethylene, 100%	NR	NR	NR	NR	NR
Toluene, 100%	NR	NR	NR	NR	NR
1,1,1-Trichloroethane	LR	*	*	*	*
Trichloroethylene, 100%	NR	NR	NR	NR	NR
Tributyl Phosphate	NR	NR	NR	NR	NR
Turpentine, 100%	LR	*	*	*	*
"Varsol," 100%	R	*	*	*	*
VM&P Naphtha, 100%	R	*	*	*	*
Xylene, 100%	NR	NR	NR	NR	NR
Pipe Seal Compounds					
"Loc-Tite" AV 100%	NR	NR	NR	NR	NR
"Loc-Tite" B, 100%	NR	NR	NR	NR	NR
"Loc-Tite" E, 100%	NR	NR	NR	NR	NR
"Masters" Metallic, 100%	R	*	*	*	*
"Permatex" #2, 100%	R	*	*	*	*
"Teflon" TF-15, 100%	R	*	*	*	*
Miscellaneous Commercial Products					
"Clobber"					
Acidic Drain Cleaner, 100%	LR	*	*	*	*
"Copperbrite" Copper Cleaner, 100%	R	*	*	*	*
"Duckseal Sealant," 100%	LR	*	*	*	*
Oils:					
ASTM Oil #1, 100%	R	R	R	R	*
ASTM Oil #2, 100%	R	R	R	R	*
ASTM Oil #3, 100%	R	LR	LR	LR	*
ASTM Oil #10, 100%	R	R	R	R	*
Silicones:					
"Silastic" 140, 100%	R	*	*	*	*
RTV 88 (GE), 100%	LR	*	*	*	*
RTV-106 (GE)	R	R	R	*	*
RTV-109 (GE)	R	R	R	*	*
"Zephiran" Disinfectant, 100%	R	*	*	*	*

This refers specifically to 100% chlorine (wet). It is recognized that widespread industry practice is to refer to many environments, other than 100% chlorine, as "chlorine" exposure. In many of these environments, polysulfone can provide excellent corrosion protection.

TABLE 1.43: POLYVINYL CHLORIDE DUCTS—DAYCO

PLIADUCT is a continuous, all plastic extruded strip, so shaped that when coiled, the edges interlock to form a rigid duct. It is flexible. Hand bend it to any position. It will remain in that position until bent again. Lightweight and durable, PLIADUCT has no wire or metal reinforcement. It will not corrode or oxidize. PLIADUCT is self-extinguishing. Service temperature range is -10° to 150°F.

Chemical Resistance Chart*

CHEMICAL	TEMPERATURE 72°F	140°F
Acetaldehyde	NR	NR
Acetic Acid, to 80%	R	R
Acetic Acid, over 80%	R	NR
Acetic Acid, glacial	R	NR
Acetic Anhydride	NR	NR
Acetone	NR	NR
Acetylene	R	R
Adipic Acid	R	R
Allyl Alcohol, 96%	R	NR
Allyl Chloride	NR	NR
Alum	R	R
Aluminum Salts	R	R
Ammonia (gas-dry)	R	R
Ammonia (liquid)	NR	NR
Ammonium Fluoride, 25%	R	NR
Ammonium Hydroxide	R	R
Ammonium Salts (other)	R	R
Amyl Acetate	NR	NR
Amyl Alcohol	R	NR
Amyl Chloride	NR	NR
Aniline and Salts	NR	NR
Anthraquinonesulfonic Acid	R	R
Antimony Trichloride	R	R
Aqua Regia	R	R
Aromatic Hydrocarbons	NR	NR
Arsenic Acid, 80%	R	R
Arylsulfonic Acid	R	R
Barium Salts	R	R
Beer	R	R
Beet Sugar Liquors	R	R
Benzaldehyde, 10%	R	R
Benzaldehyde, above 10%	NR	NR
Benzene	NR	NR
Benzoic Acid	R	R
Bismuth Carbonate	R	R
Black Liquor	R	R
Bleach (12% Cl)	R	R
Borax	R	R
Boric Acid	R	R
Breeder Pellets (fish derivative)	R	R
Bromic Acid	R	R
Bromine, Liquid	NR	NR
Bromine, Vapor (25%)	R	R
Bromine Water	R	R
Butadiene	R	R
Butane	R	
Butanol, Primary	R	R
Butanol, Secondary	R	NR
Butyl Acetate	R	NR
Butyl Alcohol	R	R
Butyl Phenol	R	NR

CHEMICAL	TEMPERATURE 72°F	140°F
Butyne Diol	R	NR
Butyric Acid	R	NR
Cadmium Salts	R	R
Calcium Salts	R	R
Carbon Bisulfide	NR	NR
Carbon Dioxide	R	R
Carbon Monoxide	R	R
Carbon Tetrachloride	R	NR
Carbonic Acid	R	R
Castor Oil	R	R
Caustic Potash	R	R
Cellosolve	R	NR
Caustic Soda	R	R
Chloracetic Acid	R	R
Chloral Hydrate	R	R
Chloric Acid, 20%	R	R
Chloride (water)	R	R
Chlorine (dry)	NR	NR
Chlorine, Gas (dry)	NR	NR
Chlorine, Gas (wet)	NR	NR
Chlorine-Water	R	R
Chlorobenzene	NR	NR
Chloroform	NR	NR
Chlorosulfonic Acid	R	
Chrome Alum	R	R
Chromic Acid, 10%	R	NR
Chromic Acid, 50%	NR	NR
Citric Acid	R	R
Copper Salts	R	R
Corn Syrup	R	R
Cottonseed Oil	R	R
Cresol	R	NR
Cresylic Acid, 50%	R	R
Crotonaldehyde	NR	NR
Crude Oil	R	R
Cyclohexanol	NR	NR
Cyclohexanone	NR	NR
Detergents	R	R
Dextrin	R	R
Dextrose	R	R
Diazo Salts	R	R
Diglycolic Acid	R	R
Dimethylamine	R	R
Dioctylphthalate	NR	NR
Disodium Phosphate	R	R
Distilled Water	R	R
Esters	NR	NR
Ethers	NR	NR
Ethyl Acetate	NR	NR
Ethyl Acrylate	NR	NR
Ethyl Alcohol	R	R
Ethyl Chloride	NR	NR
Ethyl Ether	NR	NR

CHEMICAL	TEMPERATURE 72°F	140°F
Ethylene Bromide	NR	NR
Ethylene Chlorohydrin	NR	NR
Ethylene Dichloride	NR	NR
Ethylene Glycol	R	R
Ethylene Oxide	NR	NR
Fatty Acids	R	R
Ferric Salts	R	R
Fish Solubles	R	R
Fluboric Acid	R	R
Fluorine, Gas (wet)	R	R
Fluorine, Gas (dry)	R	NR
Fluorosilicic Acid, 25%	R	R
Formaldehyde	R	R
Formic Acid	R	NR
Fructose	R	R
Fruit Juices and Pulp	R	R
Furfural	NR	NR
Gallic Acid	R	R
Gasoline	R	R
Gasoline, High Octane	R	R
Gasoline, Jet Fuel, JP-4	R	R
Gasoline, Jet Fuel, JP-5	R	R
Glucose	R	R
Glycerine	R	R
Glycol	R	R
Glycolic Acid	R	R
Grapesugar	R	R
Heptane	R	R
Hezane	R	
Hexanol, Tertiary	R	R
Hydrobromic Acid, 20%	R	R
Hydrochloric Acid, to 35%	R	R
Hydrochloric Acid, over 35%	NR	NR
Hydrocyanic Acid	R	R
Hydrofluoric Acid, to 50%	R	NR
Hydrofluoric Acid, over 50%	NR	NR
Hydrogen	R	R
Hydrogen Peroxide, to 90%	R	R
Hydrogen Phosphide	R	R
Hydrogen Sulfide	R	R
Hydroquinone	R	R
Hydroxylamine Sulfate	R	R
Hypochlorene Acid	R	R
Hypochlorous Acid	R	R
Iron Salts	R	R
Iodine	NR	NR
Kerosene	R	R
Ketones	NR	NR
Kraft Liquors	R	R
Lactic Acid, 25%	R	R
Lard Oil	R	R
Lauric Acid	R	R
Lauryl Chloride	R	

(continued)

TABLE 1.43: POLYVINYL CHLORIDE DUCTS—DAYCO (continued)

CHEMICAL	TEMPERATURE 72°F	140°F
Lead Salts	R	R
Linoleic Acid	R	R
Linoleic Oil	R	R
Linseed Oil	R	R
Liquers	R	R
Lithium Bromide	R	R
Lubricating Oil, ASTM #1, #2, #3	R	R
Machine Oil	R	R
Magnesium Salts	R	R
Maleic Acid	R	R
Malic Acid	R	R
Manufactured Gas	R	R
Mercury Salts	R	R
Mercury	R	R
Methyl Alcohol	R	R
Methyl Chloride	NR	NR
Methylene Chloride	NR	NR
Methyl Ethyl Ketone	NR	NR
Methyl Iso-butyl Ketone	NR	NR
Methyl Sulfate	R	NR
Methyl Sulfuric Acid	R	R
Milk	R	R
Mineral Oils	R	
Mixed Acids	R	R
Molasses	R	R
Muriatic Acid	R	R
Naphtha	R	R
Naphthalene	NR	NR
Natural Gas	R	R
Nickel Salts	R	R
Nicotine	R	R
Nicotine Acid	R	R
Nitric Acid, Anhydrous	NR	NR
Nitric Acid, to 68%	R	R
Nitric Acid, over 68%	NR	NR
Nitrobenzene	NR	NR
Nitrous Oxide	R	R
Ocenol	R	R
Oils and Fats	R	R
Oil, Sour Crude	R	R
Oleic Acid	R	R
Oleum	NR	NR
Oxalic Acid	R	R
Oxygen	R	R
Ozone	R	R
Palmitic Acid, to 70%	R	R
Palmitic Acid, over 70%	R	NR
Paraffin	R	R
Perchloric Acid, to 10%	R	R
Perchloric Acid, to 70%	R	NR
Perchloric Acid, over 70%	NR	NR
Petroleum Liquefier	R	R
Phenol	R	NR
Phenylhydrazine	NR	NR
Phenylhydrazine Hydrochloride	R	NR
Phosgene, Liquid	NR	NR
Phosgene, Gas	R	
Phosphoric Acid, to 85%	R	R
Phosphorus (yellow)	R	
Phosphorus Pentoxide	R	
Phosphorus Trichloride	NR	NR
Photographic Solutions:		
DK#3	R	R
Dektal Developer	R	R
Kodak Fixer	R	R
Kodak Short Stop	R	R
Picric Acid	NR	NR
Potassium Alum	R	R
Potassium Bicarbonate	R	R
Potassium Bichromate	R	R
Potassium Borate	R	R
Potassium Bromate	R	R
Potassium Bromide	R	R
Potassium Salts	R	R
Potassium Hydroxide	R	R
Potassium Permanganate, 10%	R	R
Potassium Permanganate, 25%	R	NR above 125°F
Propane	R	R
Propane Gas	R	R
Propargyl Alcohol	R	R
Propyl Alcohol	R	R
Propylene Dichloride	NR	NR
Plating Solutions:		
Brass	R	R
Cadmium	R	R
Copper	R	R
Gold	R	R
Indium	R	R
Lead	R	R
Nickel	R	R
Rhodium	R	R
Silver	R	R
Tin	R	R
Zinc	R	R
Rayon Coagulating Bath	R	R
Rochelle Salts	R	R
Sea Water	R	R
Selenic Acid	R	
Sewerage	R	R
Silicic Acid	R	R
Silver Salts	R	R
Soaps	R	R
Sodium Acetate Salts	R	R
Sodium Hydroxide	R	R
Sour Crude Oil (West Texas)	R	R
Stannic Salts	R	R
Stannous Salts	R	R
Starch	R	R
Stearic Acid	R	R
Stoddards Solvent	NR	NR
Sulfur	R	R
Sulfur Dioxide, dry	R	R
Sulfur Dioxide, wet	R	NR
Sulfur Trioxide	R	R
Sulfuric Acid, to 80%	R	R
Sulfuric Acid, over 80%	NR	NR
Sulfurous Acid	R	R
Tall Oil	R	R
Tannic Acid	R	R
Tartaric Acid	R	R
Tetraethyl Lead	R	
Tetrahydrofurane	NR	NR
Thionyl Chloride	NR	NR
Tirpineol	R	
Titanium Tetrachloride	NR	NR
Tanning Liquors	R	R
Toluol or Toluene	NR	NR
Tri Butyl Phosphate	NR	NR
Trichloroethylene	NR	NR
Triethanolamine	R	NR
Trimethyl Propane	R	R
Trisodium Phosphate	R	R
Turpentine	R	R
Urea	R	R
Urine	R	R
Vinegar	R	R
Vinyl Acetate	NR	NR
Water Acid Mine	R	R
Water Deionized	R	R
Water Demineralized	R	R
Water Distilled—water fresh	R	R
Water Salt	R	R
Whiskey	R	R
White Liquor	R	R
Wines	R	R
Xylene or Xylol	NR	NR
Zinc Salts	R	R

* KEY: R—Recommended
NR—Not Recommended
BLANK SPACES indicate lack of specific recommendations

TABLE 1.44: POLYVINYL CHLORIDE JACKETS AND COVERS—CEEL-CO

Typical Resistance Features of CEEL-TITE 300 Series PVC-UVR and 500 Series PVC

	°F	
	70	140
Acetic Acid, 20%	S	S
*Acetone	U	U
*Alcohol, Ethyl	U	U
Aluminum Chloride	S	S
Aluminum Sulfate	S	S
Ammonia Gas	S	S
Ammonium Chloride	S	S
Ammonium Hydroxide	S	S
Ammonium Sulfate	S	S
*Amyl Chloride	U	U
*Aniline	U	U
Barium Hydroxide	S	S
Barium Sulfate	S	S
Barium Sulfide	S	S
Beet Sugar Liquors	S	S
*Benzene	U	U
Benzoic Acid	S	S
Black Liquor	S	S
Bleach 12.5% active Cl_2	S	S
Boric Acid	S	S
Bromic Acid	S	S
Calcium Carbonate	S	S
Calcium Chloride	S	S
Calcium Hydroxide	S	S
*Carbon Bisulfide	U	U
Carbon Monoxide	S	S
*Carbon Tetrachloride	S	U
Carbonic Acid	S	S
Caustic Soda	S	S
Caustic Potash	S	S
Chlorine Water	S	S
*Chlorine	U	U
*Chlorobenzene	U	U
Chromic Acid, 10%	S	S
*Chromic Acid 30%	S	U
Citric Acid	S	S
*Coke Oven Gas	U	U
Copper Cyanide	S	S
Copper Sulfate	S	S
*Creosol	S	U
*Cyclohexanol	U	U
*Cyclohexanone	U	U
*Dimethylamine	S	U
*Dioctylphthalate	U	U
Disodium Phosphate	S	S
*Ethers	U	U
Ethylene Glycol	S	S
Fatty Acids	S	S
Ferric Chloride	S	S
Ferrous Sulfate	S	S
Fluorine (gat-wet)	S	S
Fluosilicic Acid	S	S
Formaldehyde	S	S
*Formic Acid	S	U
Fruit Juices + Pulp	S	S
*Furfural	U	U
*Gasoline (refined)	S	U
Glycerine	S	S
Hydrochloric Acid	S	S
Hydrocyanic Acid	S	S
*Hydrofluoric Acid 50%	S	U
Hydrogen Sulfide (dry)	S	S
Hydroquinone	S	S
Hypochlorous Acid	S	S
Iodine Tincture	S	S
Kerosene	S	S
Magnesium Chloride	S	S
Maleic Acid	S	S
Methyl Alcohol	S	S
*Methyl Ethyl Ketone	U	U
*Methyl Chloride	U	U
Mixed Acids	S	S
Nickel Chloride	S	S
Nickel Sulfate	S	S

	°F	
	70	140
*Nitric Acid Anhydrous	U	U
Nitric Acid, 10%	S	S
Nitric Acid, 68%	S	S
Nitrous Oxide	S	S
Oils and Fats	S	S
Oleic Acid	S	S
*Oleum	U	U
Oxalic Acid	S	S
Palmitic Acid, 10%	S	S
Perchloric Acid, 10%	S	S
*Petroleum Oils (sour)	S	U
*Phenol	S	U
Phosgene Gas	S	S
Phosphoric Acid, 25%	S	S
Phosphoric Acid, 50%	S	S
*Phosphorous Trichloride	U	U
Phthalic Anhydride	S	S
Plating Solutions	S	S
Potassium Chloride	S	S
Potassium Cyanide	S	S
Potassium Dichromate	S	S
Potassium Hydroxide	S	S
Potassium Permanganate, 10%	S	S
Propyl Alcohol	S	S
*Propylene Dichloride	U	U
Sea Water	S	S
Silver Cyanide	S	S
Silver Plating Solution	S	S
Silver Nitrate	S	S
Sodium Bisulfite	S	S
Sodium Chloride	S	S
Sodium Cyanide	S	S
Sodium Ferrocyanide	S	S
Sodium Hydroxide	S	S
Sodium Hypochlorite, 125%	S	S
Sodium Sulfate	S	S
Sodium Sulfite	S	S
Sodium Thiosulfate	S	S
Sour Crude Oil	S	S
Stannic Chloride	S	S
Stearic Acid	S	S
Stannous Chloride	S	S
Sulfur	S	S
Sulfur Dioxide (dry)	S	S
*Sulfur Dioxide (wet)	S	U
Sulfuric Acid, 10%	S	S
Sulfuric Acid, 70%	S	S
Sulfurous Acid	S	S
Tannic Acid	S	S
Tartaric Acid	S	S
*Tetrahydrofuran	U	U
*Toluene	U	U
*Trichloroethylene	U	U
Triethanolamine	S	S
Trisodium Phosphate	S	S
Turpentine	S	S
Urea	S	S
Vinegar	S	S
Water (acid mine water)	S	S
Whiskey and White liquor	S	S
Xylene	S	S
Zinc Chloride	S	S
Zinc Sulfate	S	S

S-Satisfactory
U-Unsatisfactory

Test Method ASTM — D — 1784

*Satisfactory for use under atmospheric conditions

TABLE 1.45: POLYVINYL CHLORIDE LINERS—FABRICO

CHEMICAL RESISTANCE CHART

"R-Recommended"
"RT-Room Temp."

INORGANIC ACIDS

Chemical Reagent	Conc. % ⑥	Material recommended at max. constant temp. BORN	651	2699 ③
Aqua Regia			R-RT	
Boric Acid		R-130	R-130	
Bromic Acid	10	R-110	R-110	
Carbonic Acid		R-130	R-130	
Chromic Acid	30		R-140	
Chromium, Trioxide			R-140	
Fluosilicic Acid		R-120	R-130	R-120
Hydrobromic Acid		R-110	R-130	
Hydrochloric Acid ①	30	R-RT	R-RT	
Hydrochloric Acid ①	20	R-100	R-130	
Hydrofluoric Acid	20		R-110	R-RT
Nitric Acid	40			
Nitric Acid	30		R-100	
Phosphoric Acid	75	R-100	R-110	R-110
Sulfuric Acid	10		R-150	R-100
Sulfuric Acid	40		R-RT	R-RT
Sulfurous Acid			R-RT	R-RT
Mixed Acids for Stainless Steel pickling 20% HNO_3 7%HF			R-140	

INORGANIC ALKALIES

Chemical Reagent	Conc. % ⑥	Material recommended at max. constant temp. BORN	651	2699 ③
Ammonium Hydroxide	30	R-RT	R-RT	R-RT
Ammonium Hydroxide	20	R-100	R-100	R-100
Sodium Hydroxide	25		R-RT	

INORGANIC SALTS & COMPOUNDS

Chemical Reagent	Conc. % ⑥	Material recommended at max. constant temp. BORN	651	2699 ③
Aluminum Chloride		R-130	R-150	R-RT
Aluminum Fluoride		R-120	R-140	R-RT
Aluminum Sulfate	50	R-130	R-150	R-RT
Ammonium Carbonate		R-130	R-150	R-RT
Ammonium Chloride		R-130	R-150	R-RT
Ammonium Fluoride	20	R-130	R-130	R-RT
Ammonium Nitrate		R-130	R-150	R-RT
Ammonium Sulfide		R-130	R-150	R-RT
Antimony Chloride		R-130	R-150	R-RT
Barium Carbonate		R-130	R-150	R-RT
Barium Sulfate		R-130	R-150	R-RT
Bismuth Carbonate		R-130	R-150	R-RT
Calcium Bisulfate		R-130	R-150	R-RT
Calcium Carbonate		R-130	R-150	R-RT
Calcium Chloride		R-130	R-150	R-RT
Calcium Hypochlorite		R-130	R-150	R-RT
Calcium Nitrate		R-130	R-150	R-RT
Calcium Sulfate		R-130	R-150	R-RT

INORGANIC SALTS & COMPOUNDS (Cont'd.)

Chemical Reagent	Conc. % ⑥	Material recommended at max. constant temp. BORN	651	2699 ③
Chrome Alum		R-130	R-150	R-RT
Copper Chloride		R-130	R-150	R-RT
Copper Nitrate		R-130	R-150	R-RT
Copper Sulfate		R-130	R-150	R-RT
Cuprous Chloride		R-130	R-150	R-RT
Disodium Phosphate		R-130	R-150	R-RT
Ferric Chloride		R-110	R-130	R-RT
Ferric Nitrate		R-110	R-130	R-RT
Ferrous Chloride		R-110	R-130	R-RT
Ferrous Sulfate		R-110	R-130	R-RT
Hydrogen Peroxide ②	3	R-110	R-110	R-RT
Hydrogen Peroxide ②	10	R-RT	R-RT	R-RT
Hydrogen Sulfide		R-110	R-130	R-RT
Magnesium Carbonate		R-120	R-140	R-RT
Magnesium Chloride		R-120	R-140	R-RT
Magnesium Nitrate		R-120	R-140	R-RT
Magnesium Sulfate		R-120	R-140	R-RT
Mercuric Chloride		R-110	R-130	R-RT
Mercurous Nitrate		R-110	R-130	R-RT
Mercury		R-130	R-150	R-RT
Phosphorus (Yellow)		R-100	R-110	R-RT
Phosphorus Pentoxide		R-100	R-110	R-RT
Potassium Bicarbonate		R-130	R-150	R-RT
Potassium Carbonate		R-130	R-150	R-RT
Potassium Chloride		R-130	R-150	R-RT
Potassium Chromate		R-130	R-150	R-RT
Potassium Cyanide		R-110	R-130	R-RT
Potassium Nitrate		R-130	R-150	R-RT
Potassium Perchlorate		R-110	R-130	R-RT
Potassium Permanganate		R-130	R-150	R-RT
Potassium Sulfate		R-130	R-150	R-RT
Silver Nitrate		R-130	R-130	R-RT
Sodium Bicarbonate		R-130	R-150	R-RT
Sodium Bisulfite		R-120	R-140	R-RT
Sodium Borate		R-130	R-150	R-RT
Sodium Carbonate		R-130	R-150	R-RT
Sodium Chlorate		R-130	R-150	R-RT
Sodium Chloride		R-130	R-150	R-RT
Sodium Dichromate		R-130	R-150	R-RT
Sodium Ferrocyanide		R-130	R-150	R-RT
Sodium Fluoride		R-130	R-150	R-RT
Sodium Hypochlorite		R-130	R-150	R-RT
Sodium Nitrate		R-130	R-150	R-RT
Sodium Sulfate		R-130	R-150	R-RT
Sodium Sulfite		R-130	R-150	R-RT
Trisodium Phosphate		R-130	R-150	R-RT
Zinc Chloride		R-130	R-150	R-RT
Zinc Sulfate		R-130	R-150	R-RT

(continued)

TABLE 1.45: POLYVINYL CHLORIDE LINERS—FABRICO (continued)

PLATING SOLUTIONS

Chemical Reagent	Conc. % ⑤	Material recommended at max. constant temp. BORN	651	2699③
Brass, Cadmium		R-140	R-150	USE FOR PLATING WASTES IN EFFLUENT PONDS
Chromium, Copper			R-140	
Gold, Indium, Lead			R-150	
Nickel, Rhodium, Silver		R-140	R-150	
Tin, Zinc			R-150	
Note: 3/32" & 1/8" PVC Type 651 are the materials of choice for plating and rinse tanks. The combination of temperature, solution strength and mechanical abuse dictates this.				
Electroless Solutions		8 mil PVC Type 2989 (disposable)		

ORGANIC COMPOUNDS

Chemical Reagent	Conc. % ⑤	Material recommended at max. constant temp. BORN	651	BOEE
Acetaldehyde	100	NR	NR	
Acetic Acid	80	NR	NR	
Acetic Acid	10	R-130	R-130	R-130
Acetic Anhydride		NR	NR	
Acetone		NR	NR	
Alkyl Alcohol		NR	NR	
Alkyl Chloride		NR	NR	
Amyl Alcohol		NR	NR	
Amyl Acetate		NR	NR	
Amyl Chloride		NR	NR	
Aniline		NR	NR	
Benzene		NR	NR	
Benzoic Acid		R-100	R-110	
Butyl Alcohol		NR	NR	
Butyl Phenol		NR	NR	
Butyric Acid		NR	NR	
Carbon Disulfide		NR	NR	
Carbon Tetrachloride		NR	NR	
Chloracetic Acid		NR	NR	
Chlorobenzene		NR	NR	
Chloroform		NR	NR	
Chlorosulfonic Acid		NR	NR	
Citric Acid		R-110	R-130	
Cyclohexanol		NR	NR	
Cyclohexanone		NR	NR	
Dextrin		R-130	R-150	
Dibutylphthalate		NR	NR	
Diethyl Ketone		NR	NR	
Dimethylamine		NR	NR	
Ethyl Acetate		NR	NR	
Ethyl Alcohol④	100	NR	NR	
Ethyl Bromide		NR	NR	
Ethyl Chloride		NR	NR	
Ethyl Ether		NR	NR	
Formaldehyde	40	R-RT	R-RT	
Formic Acid		NR	NR	

ORGANIC COMPOUNDS (Cont'd.)

Chemical Reagent	Conc. % ⑤	Material recommended at max. constant temp. BORN	651	BOEE
Furfural		NR	NR	
Gallic Acid		NR	NR	
Glucose		R-120	R-150	
Glycerine		R-120	R-150	
Hydroquinone		NR	NR	
Isopropyl Alcohol④	100	NR	NR	
Lactic Acid		NR	NR	
Lead Acetate		R-100	R-100	
Malic Acid		R-100	R-100	
Methyl Alcohol④	100	NR	NR	
Methyl Ethyl Ketone		NR	NR	
Naphthalene		NR	NR	
Nitrobenzene		NR	NR	
Oleic Acid		R-RT	R-RT	
Oxalic Acid		R-100	R-110	
Phenol Acid		NR	NR	
Phenylhydrazine		NR	NR	
Polyvinyl Acetate				R-RT
Sodium Acetate		R-100	R-110	
Stearic Acid		R-100	R-110	
Tannic Acid		R-100	R-130	
Tetrahydrofuran		NR	NR	
Triethanolamine		NR	NR	
Urea		R-100	R-130	

Crude oil, fuel oils and other aliphatic hydrocarbons are suitable for use with PVC Type 3134, an oil resistant vinyl.

MISCELLANEOUS COMPOUNDS

Chemical Reagent	Conc. % ⑤	Material recommended at max. constant temp. BORN	651	BOEE	2699③
Distilled Water		R-150	R-150	R-150	
Fertilizer Solutions		R-RT	R-RT		R-RT
Fruit Juices				R-150	
Grape Sugar				R-110	
Mustard				R-150	
Oakite No. 31			R-100		
Photographic Solutions		R-RT	R-RT		
Peanut Oil		NR	NR		
Sea Water		R-130	R-150		R-150
Sugar Solution				R-140	
Vinegar				R-150	
Water (Potable)				R-150	
Wine (non-fortified)				R-RT	
Yeast				R-150	
Wet strength resins:					
Kymene 557			R-95		
Kymene 709		NR	R-70	NR	
Parez Resins		R-95	R-95		

The above ratings are based on the consideration of chemical resistance only. Potable water will not attack flexible vinyls, but to store it safely from the standpoint of toxicity, a specially formulated vinyl must be used. This would also apply to any material that is intended for human consumption. In this latter category, the possibility of the migration of very small amounts of plasticizer having an effect on the taste of the stored liquid should be considered.

①Hydrochloric Acid must not be contaminated with organic chlorides (500 ppm max. concentration)

②Applies only to inhibited hydrogen peroxide. Uninhibited 10% H_2O_2 will not deteriorate lining, but lining will contaminate solution.

③2699 material is specially formulated for pit & pond lining applications and is generally serviceable after installation between −20 deg. and +150 deg. F. It has a bacteriostat which resists attack by soil microorganisms. Some of the recommended uses for particular compounds are shown above, however specific applications should be checked with the factory, particularly those containing mixtures of the compounds mentioned above.

④Concentrations of 10% or less are suitable with all vinyls listed at right for non-food use.

⑤All concentrations left blank are 100% or saturated solution.

TABLE 1.46: POLYVINYL CHLORIDE PIPE AND FITTINGS—THERMOPLASTIC PROCESSES

Chemical Resistance of EXCELON R-4000 Pipe and Fittings

RECOMMENDED
(tested @ 72°F, 140°F)

ACETIC ACID, 10%
ACETIC ACID, 20%
ACETYLENE
ADIPIC ACID
ALUM
ALUMINUM ALUM
ALUMINUM CHLORIDE
ALUMINUM FLUORIDE
ALUMINUM HYDROXIDE
ALUMINUM OXYCHLORIDE
ALUMINUM NITRATE
ALUMINUM SULFATE
AMMONIA (GAS-DRY)
AMMONIUM ACETATE
AMMONIUM ALUM
AMMONIUM BIFLUORIDE
AMMONIUM CARBONATE
AMMONIUM CHLORIDE
AMMONIUM HYDROXIDE
AMMONIUM HYDROXIDE, 10%
AMMONIUM HYDROXIDE, 28%
AMMONIUM METAPHOSPHATE
AMMONIUM NITRATE
AMMONIUM PERSULFATE
AMMONIUM PHOSPHATE
AMMONIUM SULFATE
AMMONIUM SULFIDE
AMMONIUM THIOCYANATE
ANTHRAQUINONESULFONIC ACID
ANTIMONY TRICHLORIDE
ARSENIC ACID, 80%
BARIUM CARBONATE
BARIUM CHLORIDE
BARIUM HYDROXIDE
BARIUM SULFATE
BARIUM SULFIDE
BEER
BEET SUGAR LIQUORS
BENZOIC ACID
BISMUTH CARBONATE
BLACK LIQUOR
BLEACH (12% CL)
BORAX
BORIC ACID
BREEDERS PELLETS (fish derivative)
BROMIC ACID
CADMIUM CYANIDE
CALCIUM BISULFIDE
CALCIUM BISULFITE
CALCIUM CARBONATE
CALCIUM CHLORIDE
CALCIUM HYDROXIDE
CALCIUM HYPOCHLORITE
CALCIUM NITRATE
CALCIUM SULPHATE
CARBON DIOXIDE
CARBON MONOXIDE
CARBONIC ACID
CASTOR OIL
CAUSTIC POTASH
CAUSTIC SODA
CHLORAL HYDRATE
CHLORIC ACID, 20%
CHLORIDE (WATER)
CHLORINE WATER
CHROME ALUM
CITRIC ACID
COPPER CARBONATE
COPPER CHLORIDE
COPPER CYANIDE
COPPER FLUORIDE
COPPER NITRATE
CORN SYRUP
COPPER SULFATE
COTTONSEED OIL
CUPRIC FLUORIDE
CUPRIC SULFATE
CUPROUS CHLORIDE
DETERGENTS
DEXTRIN
DEXTROSE
DIAZO SALTS
DIGLYCOLIC ACID
DISODIUM PHOSPHATE
DISTILLED WATER
ETHYLENE GLYCOL
FATTY ACIDS
FERRIC CHLORIDE
FERRIC HYDROXIDE
FERRIC NITRATE
FERRIC SULFATE
FERROUS CHLORIDE
FERROUS SULFATE
FISH SOLUBLES
FLUOBORIC ACID
FLUORINE, GAS (WET)
FLUOROSILICIC ACID, 25%
FRUCTOSE
FRUIT JUICES & PULP
FREON 11
FREON 12
GALLIC ACID
GASOLINE, JET FUEL
JP-4
JP-5
GLUCOSE
GLYCERINE
GLYCOL
GLYCOLIC ACID
GRAPESUGAR
HYDROBROMIC ACID, 20%
HYDROCHLORIC ACID,
10%
30%
35%
HYDROCYANIC ACID
HYDROGEN
HYDROGEN PEROXIDE,
30%
50%
90%
HYDROGEN SULFIDE
HYDROQUINONE
HYDROXYLAMINE SULFATE
HYPOCHLORENE ACID
HYPOCHLOROUS ACID
KEROSENE
KRAFT LIQUORS
LACTIC ACID, 25%
LAURIC ACID
LEAD ACETATE
LEAD CHLORIDE
LEAD SULFATE
LINOLEIC ACID
LINSEED OIL
LITHIUM BROMIDE
LUBRICATING OIL
ASTM #1
ASTM #2
MACHINE OIL
MAGNESIUM CARBONATE
MAGNESIUM CHLORIDE
MAGNESIUM HYDROXIDE
MAGNESIUM NITRATE
MAGNESIUM SULFATE
MALEIC ACID
MALIC ACID
MANUFACTURED GAS
MERCURIC CHLORIDE
MERCURIC CYANIDE
MERCUROUS NITRATE
MERCURY
METHYL ALCOHOL
METHYL SULFURIC ACID
MILK
MOLASSES
MURIATIC ACID
NATURAL GAS
NICKEL CHLORIDE
NICKEL NITRATE
NICKEL SULPHATE
NICOTINE
NICOTINE ACID
NITROUS OXIDE
OILS & FATS
OIL, SOUR CRUDE
OLEIC ACID
OXALIC ACID
OXYGEN
OZONE
PALMITRIC ACID, 10%
PERCHLORIC ACID, 10%
PETROLEUM LIQUIFIER
PHOSGENE, GAS
PHOSPHORIC ACID, 10%
PHOSPHORIC ACID, 25%
PHOSPHORIC ACID, 75%
PHOSPHORIC ACID, 85%
PHOTO. SOLUTIONS DK #3
DEKTAL DEVELOPER
KODAK FIXER
KODAK SHORT STOP
POTASSIUM ALUM
POTASSIUM BICARBONATE
POTASSIUM BICHROMATE
POTASSIUM BORATE
POTASSIUM BROMATE
POTASSIUM BROMIDE
POTASSIUM CARBONATE
POTASSIUM CHROMATE
POTASSIUM CHLORATE
POTASSIUM CHLORIDE
POTASSIUM CYANIDE
POTASSIUM DICHROMATE
POTASSIUM FERRICYANIDE
POTASSIUM FERROCYANIDE
POTASSIUM FLUORIDE
POTASSIUM HYDROXIDE
POTASSIUM NITRATE
POTASSIUM PERBORATE
POTASSIUM PERCHLORATE
POTASSIUM PERMANGANATE, 10%
POTASSIUM SULFATE
PROPANE
PROPANE GAS
PLATING SOLUTIONS
BRASS
CADMIUM
COPPER
GOLD
INDIUM
LEAD
NICKEL
RHODIUM
SILVER
TIN
ZINC
RAYON COAGULATING BATH
SEA WATER
SEWERAGE
SILICIC ACID
SILVER CYANIDE
SILVER NITRATE
SILVER PLATING SOLUTION
SILVER SULFATE
SOAPS
SODIUM ACETATE
SODIUM ALUM
SODIUM BENZOATE
SODIUM BICARBONATE
SODIUM BISULFATE
SODIUM BISULFITE
SODIUM BROMIDE
SODIUM CARBONATE
SODIUM CHLORATE
SODIUM CHLORIDE
SODIUM CYANIDE
SODIUM DICHROMATE
SODIUM FERRICYANIDE
SODIUM FERROCYANIDE
SODIUM FLOURIDE
SODIUM HYDROXIDE,
10%
30%
50%
SODIUM HYPOCHLORITE
SODIUM NITRATE
SODIUM SULFATE
SODIUM SULFIDE
SODIUM SULFITE
SOUR CRUDE OIL (WEST TEXAS)
STANNIC CHLORIDE
STANNOUS CHLORIDE
STARCH
STEARIC ACID
SULFUR
SULFUR DIOXIDE, (DRY)
SULFUR TRIOXIDE
SULFURIC ACID, 3%
10%
20%
33%
50%
70%
SULFUROUS ACID
TAN OIL
TANNIC ACID
TARTARIC ACID
TANNING LIQUORS
TRISODIUM PHOSPHATE
UREA
URINE
VINEGAR
WATER, ACID MINE
WATER, DEIONIZED
WATER, DEMINERALIZED
WATER, DISTILLED
WATER, FRESH
WATER, SALT
WHISKEY
WHITE LIQUOR
WINES
ZINC CHLORIDE
ZINC SULFATE
ZINC NITRATE

RECOMMENDED
(@ 72°F)

ANTHRAQUINONE
ARYLSUFONIC ACID
BUTYL ALCOHOL
BUTYL PHENOL
CELLOSOLVE
CHLOROACETIC ACID
CRESYLIC ACID, 50%
CRUDE OIL
ETHYL ALCOHOL
FORMALDEHYDE
FORMIC ACID
GASOLINE
HEPTANE
HEXANOL, TERTIARY
HYDROFLUORIC ACID, 48%
LINOLEIC OIL
LUBRICATING OIL, ASTM #3
METHYL SULFATE
NAPTHA
NITRIC ACID, 10%
NITRIC ACID, 30%
NITRIC ACID, 60%
PHENYLDHYDRAZINE HYDROCHLORIDE
PHOSPHORUS (YELLOW)
PHOSPHORUS PENTRIOXIDE
POTASSIUM PERMANGANATE, 25% @ 125°F
PROPARGYL ALCOHOL
PROPYL ALCOHOL
TETRAETHYL LEAD
TRIETHANOLAMINE
TRIMETHYL PROPANE

NOT RECOMMENDED

ACETALDEHYDE
ACETIC ACID, PURE
ACETIC ACID, 80%
ACETIC ACID, GLACIAL
ACETIC ANHYDRIDE
ACETONE
ALLYL ALCOHOL, 96%
ALLYL CHLORIDE
AMMONIA (LIQUID)
AMMONIUM FLUORIDE, 25%
AMYL ACETATE
AMYL ALCOHOL
AMYL CHLORIDE
ANILINE
ANILINE CHLOROHYDRATE
ANILINE HYDROCHLORIDE
AQUA REGIA
AROMATIC HYDROCARBONS
BENZALDEHYDE, 10%
BENZALDEHYDE, ABOVE 10%
BENZENE
BROMINE, LIQUID
BROMINE WATER
BUTADIENE
BUTANE
BUTANOL, PRIMARY
BUTANOL, SECONDARY
BUTYL ACETATE
BUTYNE DIOL
BUTYRIC ACID
CARBON BISULFIDE
CARBON TETRACHLORIDE
CHLORINE (DRY)
CHLORINE, GAS
CHLORINE GAS (WET)
CHLOROBENZENE
CHLOROFORM
CHROMIC ACID, 10%
CHROMIC ACID, 50%
CRESOL
CROTONALDEHYDE
CYCLOHEXANOL
CYCLOHEXANONE
DIMETHYLAMINE
DIOCTYLPHTHALATE
ESTERS
ETHERS
ETHYL ACETATE
ETHYL ACRYLATE
ETHYL CHLORIDE
ETHYL ETHER
ETHYLENE BROMIDE
ETHYLENE CHLOROHYDRIN
ETHYLENE DICHLORIDE
ETHYLENE OXIDE
FLUORINE, GAS
FURFURAL
HEXANE
HYDROFLUORIC ACID, 50%
IODINE
KETONES
LIQUORS
METHYL CHLORIDE
METHYLENE CHLORIDE
METHYL ETHYL KETONE
METHYL ISO-BUTYL KETONE
NAPHTHALENE
NITRIC ACID, ANHYDROUS
NITRIC ACID, 68%
NITROBENZENE
OLEUM
PALMITRIC ACID, 70%
PERACETIC ACID, 40%
PERCHLORIC ACID, 15%
PERCHLORIC ACID, 70%
PHENYLHYDRAZINE
PHOSGENE, LIQUID
PHOSPHORUS TRICHLORIDE
PICRIC ACID
PROPYLENE DICHLORIDE
STODDARDS SOLVENT
SULFUR DIOXIDE, (WET)
SULFURIC ACID,
80%
85%
94%
95%
TETRAHYDROFURANE
THIONYL CHLORIDE
TITANIUM TETRACHLORIDE
TOLUOL OR TOLUENE
TRI BUTYL PHOSPHATE
TRICHLOROETHYLENE
TURPENTINE
VINYL ACETATE
XYLENE OR XYLOL

Unless specified, data is based on 70°F room temperature.

TABLE 1.47: POLYVINYL CHLORIDE TANK LINERS—PEABODY TECTANK

TECLINE TL990 liners are suitable for the storage of a wide variety of chemicals. A partial guide to chemicals which TECLINE TL990 liner will safely store includes:

Acetic Acid (10%)
Ammonium Hydroxide (30%)
Ammonium Phosphate*
Ammonium Sulfate*
Antifreeze (Ethylene Glycol)*
Animal Oil*
Boric Acid
Bromic Acid
Calcium Chloride Solutions*
Calcium Hydroxide
Chlorine Solution (20%)
Chromic Acid (10%)
Clorox
Crude Oil*
Diesel Fuel*
Ethyl Alcohol
Fertilizer Solutions*
Gasoline*
Glycerine*
Hydraulic Fluid
Hydrochloric Acid (50%)
Hydrofluosilicic Acid (30%)
Hydrogen Peroxide (30%)
Isopropyl Alcohol*
Jet Fuel (JP-4)*
Kerosene*
Magnesium Chloride
Magnesium Hydroxide
Methyl Alcohol
Mineral Spirits
Naptha
Nitric Acid
Phenol Formaldehyde
Phosphoric Acid (75%)
Potassium Chloride*
Potassium Sulphate*
Salt Water*
Sea Water*
Sodium Acetate Solution
Sodium Bisulfite Solution
Sodium Hydroxide (60%)*
Sulphuric Acid (40%)
Tannic Acid (50%)
Turpentine
Urea*
Zinc Chloride*

*May be stored in Peabody TecTank's Thermo-Thane 7000, factory-coated bolted tanks.

TABLE 1.48: POLYVINYLIDENE FLUORIDE—RILSAN

FORAFLON® in general resists mineral acids, bases, saline solutions, oxidizing agents, and halogens. However, it is attacked by concentrated hot sulphuric acid or nitric acid and very concentrated alkaline solutions.

FORAFLON® resists alcohols, chlorinated solvents, aliphatic and aromatic hydrocarbons and crude oil.

It swells in certain polar solvents like ketones and esters and dissolves in aprotic solvents like dimethylacetamide, dimethylformamide and N methylpyrrolidone. It is also attacked by hot amines.

As an indication, the following table shows the good resistance of FORAFLON® immersed under stress in some particularly aggressive reagents.

Test pieces are cut according to ASTM D 1708 from an extruded plate 0.7 mm thick, and either unbent or bent by the device recommended in standard ASTM D 1693; they are immersed in a reagent at the temperature indicated.

The tensile properties are checked periodically.

For the reagents indicated, the yield strength of both bent and unbent test pieces varied by at least 10% after one year, as compared with that of a control left in the air at the same temperature.

Reagents	Temperature °C
Concentrated hydrochloric acid, 36%	130
Sulphuric acid 80%	90
Nitric acid 32%	90
Chromatosulphuric mixture (CrO_3, 50%, H_2SO_4, 15%, H_2O, 35%)	90
Acetic acid 50%	130
Caustic soda 45%	90
Sodium carbonate 40%	90
Ethylene glycol, pure	90
	130
Perchloroethylene	90
Crude oil	90
	130

TABLE 1.49: TETRAFLUOROETHYLENE HOSE—EVERFLEX PRODUCTS

PARTIAL LIST OF CHEMICALS AND MATERIALS COMPATIBLE WITH TEFLON HOSE

"Teflon"® TFE fluorocarbon resin is so broadly chemically resistant that factors such as temperature, pressure and their fluctuations are usually the primary influence on the serviceability of this material in a specific application. Solvents and gases known to require special consideration due to these factors are indicated by asterisk(*).

Also, selection of material for fittings is influenced by reagent, concentration, duration of exposure and other considerations. For guidance only, our preliminary recommendations for coupling material are indicated by letter following the reagent, thus: (B) brass; (C) carbon steel; (S) stainless steel; (M) monel.

Acetal (B)
Acetaldehyde (B)
Acetate Solvents (S)
Acetic Acid (S)
Acetic Acid Anhydride (S)
Acetone (B)
Acetophenone (M)
Acetyl Chloride (B)
Acetylene (B)
Acrylonitrile (C)
Acid Crude Tar (B)
Aeroshell Oils (C)
Agricultural Spray Oil (B)
Air (B)
Alcohol (B)
Allyl Alcohol (B)
Allyl Chloride (S)
Alumina (C)
Aluminum Acetate (S)
Aluminum Chloride (M)
Aluminum Fluoride (M)
Aluminum Hydroxide (S)
Aluminum Sulfate (S)
Alum (S)
Ammonia, Anhydrous (C)*
Ammonia Gas (C)
Ammonia, Aqueous (C)*
Ammonia Liquor (C)
Ammonium Bicarbonate(S)
Ammonium Bisulfate (S)
Ammonium Bromide (S)
Ammonium Carbonate (S)
Ammonium Chloride (S)
Ammonium Hydroxide (S)
Ammonium Metaphosphate (S)
Ammonium Nitrate (S)
Ammonium Oxalate (S)
Ammonium Perchlorate(S)
Ammonium-Persulfate (S)
Ammonium Phosphate, Monobasic (S)
Ammonium Phosphate, Dibasic (S)
Ammonium Phosphate, Tribasic (S)
Ammonium Sulfide (S)
Ammonium Sulphate (S)
Ammonium Thiocyanate(S)
Amyl Acetate (B)
Amyl Alcohol (B)
Amyl Chloride (C)
Amyl Phenol (S)
Anhydrous Ammonia (C)*
Aniline Dyes (S)
Aniline Paint Oil (S)
Animal Fats (B)
Anti-Freeze (B)
Antimony Chloride 50%(C)
Aqua Regia (S)
Arsenic Acid (S)
ASTM Oil (B)
Asphalt (C)

Barium Carbonate (B)
Barium Chloride (B)
Barium Hydroxide (S)
Barium Nitrate (S)
Barium Sulfate (C)
Barium Sulphide (S)
Barium Salts (C)
Beer (S)
Beet Sugar Liquors (S)
Belt Oil (B)
Benzene (Benzol) (B)
Benzene Sulfonic Acid 10% (S)
Benzine, Petroleum Ether (B)
Benzine, Petroleum Naphtha (B)
Benzoic Acid (B)
Benzol Still Residue (B)
Bismuth Carbonate (C)
Black Sulfate Liquor (C)
Blast Furnace Gas (C)
Bleaching Powder (wet) (B)
Blood (Meat Juices) (S)
Boracic Acid (S)
Borax (B)
Bordeaux Mixture (B)
Boric Acid (S)
Brine (B)
Brine Saturated with Chlorine (S)

Bromine-Bromine Water (M)
Butadiene (B)
Butane-Butylene (B)*
Butanol (Butyl Alcohol) (C)
Butter-Buttermilk (S)
Butyl Acetate (B)
Butyl Ether (B)
Butyl Stearate (B)
Butyraldehyde (B)
Butyric Acid (S)

Cadmium Salts (B)
Calcium Bisulfate (S)
Calcium Carbonate (B)
Calcium Chlorate (B)
Calcium Chloride (B)
Calcium Chlorohypochlorite (B)
Calcium Hydroxide (B)
Calcium Hypochlorite (S)
Calcium Sulfate (S)
Calcium Salts (B)
Caliche Liquors (B)
Cane Sugar Liquors (S)
Carbolic Acid (S)
Carbon Dioxide (S)
Carbon Disulfide (S)
Carbon Monoxide (S)
Carbon Tetrafluoride (Freon 14) (B)
Carbonated Beverages (S)
Carbonic Acid (S)
Caster Oil (B)
Caustic (C)
Cellosolve (B)
Cellosolve Acetate (S)
Cellulose (S)
Cellulube Hydraulic Fluids (B)
Chine Wood Oil, Tung Oil (B)
Chlordane 5%, Water 95% (B)
Chlorine Water 3% (S)
Chlorinated Solvents (B)
Chloroacetic Acid (M)
Chloroacetone (B)
Chlorobenzene (B)
Chlorobenzol (B)
Chlorobromomethane (B)
Chloroform (S)
Chloropentanes (B)
Chlorosulfonic Acid (S)(M)
Chromic Acid (S)
Cider (S)
Citric Acid (S)
Coconut Oil (S)
Coal Spray Oil (B)
Cobalt Plating Solution (M)
CocaCola Syrup (S)
Coconut Oil (S)
Cod Liver Oil (S)
Coke Oven Gas (C)*
Compressor Oil (B)
Copper Acetate (S)
Copper Arsenate (S)
Copper Carbonate (S)
Copper Chloride (M)
Copper Cyanide (B)
Copper Nitrate (S)
Copper Sulfate (S)
Core Oil (B)
Corn Oil (S)
Cottonseed Oil (B)
Creosote (C)
Creosote, Coal Tar (C)
Creosote, Wood (C)
Cresol 95%, Xylene 5% (B)
Cresol 90%, Xylene 5%, DDT 5% (B)
Cresylic Acid (S)
Crude Light Oil or Coal Tar (B)
Crude Oil (B)
Cryolite 10% (S)
Cupric Sulfate (S)
Cyanogen Gas (S)
Cyclohexane (B)
Cyclohexanone (M)
Cyclohexanol (M)
Cymene (B)

DDT & Kerosene (B)
Decalin (B)
Decahydronaphthalene (B)
Diacetone (B)
Diacetone Alcohol (B)
Diamyl Naphthalene (B)
Diamyl Phthalate (B)
Diamyl Phenol (M)
Dibutyl Ether (B)
Dibutyl Phthalate (B)
Dibutyl Sebacate (B)
Dichlorethylene (B)
Dichlorobenzene (B)
Dichlorodifluoromethane (C)
Dichloromonofluoromethane (C)
Dichlorotetra Fluoroethane (C)
Diesel Oil (C)
Diethyl Amine (B)
Diethyl Carbonate (B)
Diethylene Glycol (B)
Diethyl Ketone (B)
Diethyl Phthalate (B)
Diethyl Sebacate (B)
Diisobutylene (B)
Diisobutyl Ketone (B)
Diisopropyl Ketone (B)
Dimethyl Aniline (B)
Dimethyl Ether (B)
Dimethyl Phthalate (B)
Dioctyl Adipate (B)
Dioctyl Phthalate (B)
Dioctyl Sebacate (B)
Dioxane (B)
Divinylbenzene (C)
Dodecylbenzene (B)
Dodecyltoluene (B)
Dowfume W-40 (B)
Dowtherin A (S)
Dowtherin E (S)
Drain Oil (B)
Drip Oil (B)

Epochlorohydrin (C)
Ethanolamine (B)
Ethers (B)
Ethyl Acetate (B)
Ethyl Alcohol (B)
Ethyl Amine (B)
Ethyl Benzoate (B)
Ethyl Bromide (B)
Ethyl Cellulose (C)
Ethyl Chloride (B)
Ethyl Dichloride (B)
Ethyl Iodide (B)
Ethyl Isobutyl Ether (B)
Ethyl Methyl Ketone (B)
Ethyl Propyl Ether (B)
Ethylene Bromide (B)
Ethylene Chloride (B)
Ethylene Dichloride (B)
Ethylene Glycol (C)
Ethylene Trichloride (B)
Ethylhexanol (B)

Feran (C)
Ferric Chloride (M)
Ferric Hydroxide (S)
Ferric Nitrate (S)
Ferric Sulfate (S)
Ferrous Chloride (S)
Ferrous Sulfate (S)
Fluorobenzene (S)
Fluosilicic Acid (B)
Formaldehyde (S)
Formic Acid (S)
Freon 11 (B)*
Freon 12 (C)*
Freon 13 (C)*
Freon 21 (C)*
Freon 22 (B)*
Freon 112 (B)*
Freon 113 (B)*
Freon 114 (C)*
Fruit Juices (S)
Fuel Oil (B)
Furfural (C)
Furfural Alcohol (C)
Fusel Oil (B)

Gallic Acid (C)
Gas, Liquified Petroleum (B)
Gasoline-Sour (S)
Gasoline, Aviation (B)
Gelatin (S)
Glucose (B)
Glue (C)
Glycerine (C)
Glycerol (C)
Glycol (C)
Grease Petro (B)
Green Sulfate Liquor (S)

Harness Oil (C)
Helium (B)*
Heptane (B)*
Hexaldehyde (C)
Hexane (B)*
Hexyl Alcohol (C)
Houghton Safe Oils (C)
Hydraulic Oil (C)
Hydraulic Polyalkylene Glycol (C)
Hydrobromic Acid (M)
Hydrochloric Acid (M)
Hydrocyanic Acid (S)
Hydrofluoric Acid (M)
Hydrofluosilicic Acid (B)
Hydrogen, Gas (B)*
Hydrogen Peroxide (S)
Hydrogen Sulfide (S)
Hydrolube (C)
Hykil No. 6 33%, Water 67% (C)
Hydraulic Fluid-Petroleum Based (C)
Hydraulic Fluid Phosphate-Ester Based (C)
Hyposulphite Soda (S)

Iodoform (S)
Ink Oil (C)
Insulating Oil (C)
Iodine (C)
Isoamyl Alcohol (C)
Isobutyl Acetate (B)
Isobutyl Aldehyde (C)
Isobutyl Alcohol (C)
Isobutylene (C)
Isopropanol (Isopropyl Alcohol) (C)
Iso Octane (C)
Isopropyl Acetate (B)
Isopropyl Ether (C)

Jet Fuels (JP-1 to JP-5) (C) (B)

Kerosene (B)
Kerosene 10%, Soap Water 90% (B)
Kerosene 95%, Xylene 5% (B)
Ketchup (S)
Ketone (C)

Lactic Acid (S)
Lactol (M)
Lacquers (S)
Lacquers Solvents (S)
Lard (C)
Lead Acetate (B)
Lead Arsenate (C)
Lead Sulfate (C)
Light Oil Residual (C)
Lime Water (C)
Lime-Sulfur (S)
Lindol (C)
Linseed Oil (B)
Lithium Hydroxide (C)
Lithium Salts (C)
Lubrication Oil (B)

Magnesium Carbonate (C)
Magnesium Chloride (C)(M)
Magnesium Hydroxide (C)
Magnesium Nitrate (C)
Magnesium Sulfate (C)
Malic Acid (S)
Manganese Salts (C)
Manganese Sulfate (C)
Manganese Sulfide (C)
Mash (S)
Mercuric Chloride (C)
Mercuric Cyanide (S)
Mayonnaise (S)
Mercurous Nitrate (C)
Mercury (C)
Mercury Salts (M)
Methyl Acetate (B)
Methyl Acetoacetate (B)
Methyl Acetone (C)
Methyl Alcohol (Methanol) (B)
Methyl Amine (C)
Methyl Amyl Acetate (C)
Methyl Amyl Carbinol (C)
Methyl Chloride (B)
Methyl Ethyl Ketone (B)
Methyl Isobutyl Ketone (C)
Methyl Isopropyl Ketone (S)
Methyl Methacrylate (C)
Methylene Chloride (C)
Milk (S)
Mineral Oils (C)
Mineral Spirits (B)
Miners Oil (C)
Molasses (S)
Monochlorobenzene (B)
Monochlorodifluoromethane (B)
Monochlorotrifluoroethane (C)
Monoethanolamine (C)
Monofluorotrichloromethane (B)
Motor Oils (C)
Mould Oil (C)

Naphtha (B)
Napthalene (B)
Natural Gas (C)*
Neutral Oil (C)
Nickel Chloride (S)
Nickel Nitrate (S)
Nickel Plating Solution (S)
Nickel Salts (S)
Nickel Sulfate (S)
Nicotine Bentonite (S)
Nicotine Salts (C)
Nicotine Sulfate (C)
Nitrana 2 (C)
Nitrana 3 (C)
Nitration Benzol (C)
Nitric Acid (S)
Nitrogen (B)
Nitrobenzene (C)
Nitrooctane (C)
Nitropropane (B)
Nitrosyl Chloride (S)
Nitrous Acid (S)

Octane (C)
Octyl Acetate (B)
Octylaldehyde (C)
Oil (SAE 50) (C)
Oils-Crude (S)
Oils-Vegetable, Mineral (S)
Oleic Acid (S)
Oleum Spirits (B)
Oxalic Acid (S)
Oxygen (B)
Ozone (B)

Paint (B)
Paint Oil (C)
Palm Oil (C)
Palmitic Acid (C)
Parafin (B)
Paraformaldehyde (S)
Para San (C)
Paris Green & Lime (C)
Pentane (B)
Pentachlorophenol (C)
Pentachlorophenol 10%, Kerosene 90% (C)
Perchloroethylene (C)
Perchloric Acid (S)
Petrolatum (C)
Petroleum Oils (refined)(B)
Petroleum Oils (sour)(S)
Phenol (S)
Phosphoric Acid (S)
Picric Acid-Molten (S)
Picric Acid-Water Solution (S)
Pine Oil (C)
Pine Tar (C)
Pine Coating Oil (C)
Plasticizers (Rubber & Plastics) (C)
Phosphate Ester Oils (C)
Potassium Bicarbonate (B)
Potassium Borate (C)
Potassium Bromide (C)
Potassium Carbonate (S)
Potassium Chlorate (C)
Potassium Chloride (C)
Potassium Chromate (S)
Potassium Cyanide (C)
Potassium Dichromate (S)
Potassium Ferricyanide (S)
Potassium Hydroxide (S)
Potassium Hypochlorite (S)
Potassium Nitrate (C)
Potassium Oxalate (S)
Potassium Permanganate (S)
Potassium Sulfate (C)
Potassium Sulfite (S)
Prestone (C)
Produce Gas (B)
Propane Gas (B)
Propane Liquid (B)
Propellor Oil (C)
Propionic Acid (S)
Propyl Acetate (B)
Propyl Alcohol (C)
Propylene Dichloride (B)
Purina Woody Plant Spray (C)
Pydraul Hydraulic Fluids (C)
Pyranol 1467 (C)
Pyranol 1476 (C)
Pyridine (B)
Pyrogallic Acid (S)
Pyrolineous Acid (B)

Quenching Oil (C)
Quinine Sulphate (S)

Range Oil (C)
Refined Oil (C)
Richfield "A" (B)
Richfield "D" (B)
Rosia Oil (S)
Rosin (S)
Rotenone & Water (C)

Sea Water (Salt Water (S)
Secondary Butylacetate (B)
Sewage (S)
Shellac (S)
Shell DD (C)
Silica Gel (C)
Silicone Oils (C)
Silver Salts (M)
Silver Nitrate (C)
Skydrol Hydraulic Fluid (C)
Soap Oil (C)
Soap Solutions (B)
Soap & Water (B)
Soda Ash Sodium Carbonate (C)
Sodan (C)
Sodium Acetate (B)
Sodium Bicarbonate (S)
Sodium Bisulfate (S)
Sodium Carbonate (S)
Sodium Chlorate (C)
Sodium Chloride (C)
Sodium Chromate (S)
Sodium Cyanide (C)
Sodium Fluoaluminate (C)
Sodium Fluoride (S)
Sodium Dichromate (S)
Sodium Hydroxide (C)
Sodium Hypochlorite (S)
Sodium Hyposulfite (S)
Sodium Metaphosphate (S)
Sodium Nitrate (C)
Sodium Nitrite (C)
Sodium Perborate (S)
Sodium Perchlorate (S)
Sodium Peroxide (S)
Sodium Phosphate-Monobasic (S)
Sodium Phosphate-Dibasic (S)
Sodium Phosphate-Tribasic (S)
Sodium Sulfate (C)
Sodium Sulfide (S)
Sodium Silicate (C)
Sodium Sulfite (S)
Sodium Thiosulphate "Hypo" (S)
Soybean Oil (S)
Solvesso (C)
Stannic Chloride (S)
Stannous Chloride (S)
Starch (S)
Steam 400°F (B)
Stearic Acid (S)
Stoddard Solvent (White Spirits) (B)
Strontium Hydroxide (S)
Strontium Nitrate (S)
Styrene (Monomer) (C)
Sugar (Liquid) (S)
Sulfonic Acid (C)
Sulfur (C)
Sulfur Chloride (S)
Sulfurous Acid (S)
Sulphur Dioxide (Dry)(C)
Sulphur Trioxide (Dry)(C)
Sulphuric Acid (S)
Sulphate Liquors (S)
Summer Oil (C)
Syrup (S)
Soup Solutions (S)

Tallow (C)
Tanners Oil (C)
Tannic Acid (S)
Tar (C)
Tartaric Acid (S)
Tetrachlorethane (B)
Tetrachlorodifluoroethane (B)
Tetrahydronaphthalene(B)
Toluene (Toluol) (B)
Toluidine (C)
Toxaphene (C)
Transformer Oil (C)
Trichloracetic Acid (M)
Trichloroethylene (B)
Trichlorobenzene (B)
Trichlorofluormethane(B)
Trichloropropane (B)
Trichlorotrifluoroethane(B)
Triethanolamine (B)
Trisodium Phosphate (S)
Tung Oil (C)
Turbine Oil (C)
Turpentine (S)
2, 4-D with 10% Fuel Oil (C)

Ucon Hydrolube Oils (C)
Uran (C)
Urine (C)
Urea (C)

Varnish (S)
Vegetable Oils (S)
Vinegar (S)
Vinyl Chloride (Monomer) (S)
Vinyl Fluoride (S)

Waste Oil (C)
Water (S)
Water Containing Oxidizing Salts (S)
Water Works Primer Solvent (S)
Wax Distillate (C)
White Oil 10% (C)
Whiskey & Wines (S)
Wool Oil (C)

Xylene (Xylol) (B)

Yeast (S)

Zinc Chloride (S) (M)
Zinc Cyanide (S)
Zinc Nitrate (S)
Zinc Sulfate (S)

Teflon is attacked by only two classes of chemicals:

a) Molten alkali metals such as sodium & potassium

b) Fluorochemicals such as chlorine trifluoride (ClF_3) and oxygen difluoride (OF_2), and fluorine gas at elevated temperature & pressure

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TABLE 1.50: TETRAFLUOROETHYLENE RESINS—DU PONT

Table I—Typical Chemicals with Which TEFLON Resins Are Compatible[1]

Abietic acid	Cetane	Ferric chloride	Nitrobenzene	Potassium hydroxide
Acetic acid	Chlorine	Ferric phosphate	2-Nitro-butanol	Potassium
Acetic anhydride	Chloroform	Fluoronaphthalene	Nitromethane	permanganate
Acetone	Chlorosulfonic acid	Fluoronitrobenzene	Nitrogen tetroxide	Pyridine
Acetophenone	Chromic acid	Formaldehyde	2-Nitro-2-methyl	Soap and detergents
Acrylic anhydride	Cyclohexane	Formic acid	propanol	Sodium hydroxide
Allyl acetate	Cyclohexanone	Furane	n-Octadecyl alcohol	Sodium hypochlorite
Allyl methacrylate	Dibutyl phthalate	Gasoline	Oils, animal and	Sodium peroxide
Aluminum chloride	Dibutyl sebacate	Hexachloroethane	vegetable	Solvents, aliphatic
Ammonia, liquid	Diethyl carbonate	Hexane	Ozone	and aromatic[2]
Ammonium chloride	Dimethyl ether	Hydrazine	Perchlorethylene	Stannous chloride
Aniline	Dimethyl formamide	Hydrochloric acid	Pentachloro-	Sulfur
Benzonitrile	Di-isobutyl adipate	Hydrofluoric acid	benzamide	Sulfuric acid
Benzoyl chloride	Dimethylformamide	Hydrogen peroxide	Perfluoroxylene	Tetrabromoethane
Benzyl alcohol	Dimethyl hydrazine,	Lead	Phenol	Tetrachloroethylene
Borax	unsymmetrical	Magnesium chloride	Phosphoric acid	Trichloroacetic acid
Boric acid	Dioxane	Mercury	Phosphorus	Trichlorethylene
Bromine	Ethyl acetate	Methyl ethyl ketone	pentachloride	Tricresyl phosphate
n-Butyl amine	Ethyl alcohol	Methacrylic acid	Phthalic acid	Triethanolamine
Butyl acetate	Ethyl ether	Methanol	Pinene	Vinyl methacrylate
Butyl methacrylate	Ethyl hexoate	Methyl methacrylate	Piperidene	Water
Calcium chloride	Ethylene bromide	Naphthalene	Polyacrylonitrile	Xylene
Carbon disulfide	Ethylene glycol	Naphthols	Potassium acetate	Zinc chloride
		Nitric acid		

1. Based on experiments conducted up to the boiling points of the liquids listed. Absence of a specific chemical does not mean that it is incompatible with TEFLON resins.
2. Some halogenated solvents may cause moderate swelling. Note: Values are averages only and not for specification purposes.

Table II—Exposure of TEFLON Resins to Acids and Bases.

Reagent		Exposure Temp., °C (°F)	Exposure Time	Weight Increase, %
Hydrochloric acid				
	10%	25 (77)	12 mo.	0
		50 (122)	12 mo.	0
		70 (158)	12 mo.	0
	20%	100 (212)	8 hr.	0
		200 (392)	8 hr.	0
Nitric acid	10%	25 (77)	12 mo.	0
		70 (158)	12 mo.	0.1
Sulfuric acid				
	30%	25 (77)	12 mo.	0
		70 (158)	12 mo.	0
		100 (212)	8 hr.	0
		200 (392)	8 hr.	0.1
Sodium hydroxide	10%	25 (77)	12 mo.	0
		70 (158)	12 mo.	0.1
	50%	100 (212)	8 hr.	0
Ammonium hydroxide	10%	25 (77)	12 mo.	0
		70 (158)	12 mo.	0.1

(continued)

TABLE 1.50: TETRAFLUOROETHYLENE RESINS—DU PONT (continued)

Table III—Exposure of TEFLON Resins to Solvents.

Solvent	Exposure Temp.* °C (°F)	Exposure Time	Weight Increase, %
Acetone	25 (77)	12 mo.	0.30
	50 (122)	12 mo.	0.4
	70 (158)	2 wk.	0
Benzene	78 (172)	96 hr.	0.5
	100 (212)	8 hr.	0.6
	200 (392)	8 hr.	1.0
Carbon tetrachloride	25 (77)	12 mo.	0.6
	50 (122)	12 mo.	1.6
	70 (158)	2 wk.	1.9
	100 (212)	8 hr.	2.5
	200 (392)	8 hr.	3.7
Ethyl alcohol (95%)	25 (77)	12 mo.	0
	50 (122)	12 mo.	0
	70 (158)	2 wk.	0
	100 (212)	8 hr.	0.1
	200 (392)	8 hr.	0.3
Ethyl acetate	25 (77)	12 mo.	0.5
	50 (122)	12 mo.	0.70
	70 (158)	2 wk.	0.7
Toluene	25 (77)	12 mo.	0.3
	50 (122)	12 mo.	0.6
	70 (158)	2 wk.	0.6

Table II and Table III Notes:

- Many of the laboratory evaluations were run at the boiling point of the chemicals listed. This should not be considered the upper use temperature for TEFLON resins in such environments, which can be considerably higher.
- These are essentially equilibrium test values: additional exposure times would not increase the values significantly.
- Weight changes less than 0.2% are not considered to be experimentally significant.
- Values are test averages only and are not for specification purposes.
- Tests at over the boiling point of the reagent were in an enclosed chamber, hence at its vapor pressure.

Table IV—Absorption of Representative Liquids in TEFLON® 160 FEP and TEFLON® 350 PFA fluorocarbon resins(1)

168 Hour Exposures to Solvents at Their Boiling Points(2)

	Temperature °C	°F	Range of Weight Gains %
Aniline	185	(365)	0.3-0.4
Acetophenone	201	(394)	0.6-0.8
Benzaldehyde	179	(354)	0.4-0.5
Benzyl Alcohol	204	(400)	0.3-0.4
n-Butyl Amine	78	(172)	0.3-0.4
Carbon Tetrachloride	78	(172)	2.3-2.4
Dimethyl Sulfoxide	190	(372)	0.1-0.2
Freon® 113	47	(117)	1.2(3)
Iso-Octane	99	(210)	0.7-0.8
Nitrobenzene	210	(410)	0.7-0.9
Perchloroethylene	121	(250)	2.0-2.3
Sulfuryl Chloride	68	(154)	1.7-2.7
Toluene	110	(230)	0.7-0.8
Tri-Butyl Phosphate	200(4)	(392)	1.8-2.0

168 Hour Exposure to Acidic Reagent

	Temperature °C	°F	Range of Weight Gains %
Bromine (anhyd.)	22	(−5)	0.5(3)
Chlorine (anhyd.)	120	(248)	0.5-0.6
Chlorsulfonic Acid	150	(302)	0.7-0.8
Chromic Acid, 50%	120	(248)	0.00-0.01
Ferric Chloride, 25%	100	(212)	0.00-0.01
Hydrochloric Acid, 37%	120	(248)	0.00-0.03
Phosphoric Acid (Conc)	100	(212)	0.00-0.01
Zinc Chloride, 25%	100	(212)	0.00-0.03

Table IV Notes:

(1) No significant differences between FEP and PFA resins in these tests.

(2) These are essentially equilibrium values; additional exposure times would not increase the values significantly.

(3) PFA data only.

(4) Not boiling.

(5) Values are test averages only and are not for specification purposes.

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP.

Chemical Resistance Co-Rezyn® Vinyl Ester Resins*

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
A					
Acetaldehyde	All	NR	NR		NR
Acetic Acid	0-25	210	210	210	150
	25-50	180	180	210	150
	50-75	150	150	180	
Acetic Anhydride	All	NR	NR		NR
Acetone	100	NR	NR		NR
Acrylic Acid	25	100	100	100	
Acrylonitrile	All	NR	NR	NR	NR
Alcohol, Butyl	All	100	100	120	
Alcohol, Ethyl	10	150	150	150	150
	100	80	80	100	
Alcohol, Isopropyl	10	150	150	150	150
	100	100	100	120	
Alcohol, Methyl	10	150	150	150	
	100	NR	NR		NR
Alcohol, Methyl Isobutyl	10	150	150	150	150
Alcohol, Secondary Butyl	10	150	150	150	150
Allyl Chloride	All	NR	NR	NR	NR
Alum	All	210	210	220	210
Aluminum Chloride	All	210	210	210	210
Aluminum Fluoride	All	80	80	80	80
Aluminum Hydroxide	All	180	180	200	150
Aluminum Nitrate	All	160	160	180	150
Aluminum Potassium Sulfate	All	210	210	220	210
Ammonia, Aqueous	0-20	140	140	140	140
Ammonia, Gas		100	100	180	100
Ammonia, Liquid		NR	NR	NR	NR
Ammonium Acetate	65	80	80	80	

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
Ammonium Bicarbonate	0-50	150	150	150	150
Ammonium Bisulfite	All	150	150	150	150
Ammonium Carbonate	All	150	150	150	150
Ammonium Chloride	All	210	210	210	210
Ammonium Citrate	All	150	150	150	150
Ammonium Fluoride	All	150	150	150	150
Ammonium Hydroxide	5	180	180	180	150
	10	150	150	180	150
	20	150	150	180	150
	29	100	100	150	100
Ammonium Nitrate	All	180	180	180	180
Ammonium Persulfate	All	180	180	180	180
Ammonium Phosphate	65	210	210	210	210
Ammonium Sulfate	All	210	210	210	210
Amyl Acetate	100	NR	NR	NR	NR
Aniline	All	NR	NR	NR	NR
Aniline Hydrochloride	All	150	150	180	150
Aniline Sulfate	All	210	210	210	210
Arsenious Acid	All	180	180	180	
B					
O-Benzoyl Benzoic Acid	All	180	180	180	
Barium Acetate	All	210	210	210	210
Barium Carbonate	All	210	210	210	210
Barium Chloride	All	210	210	210	210
Barium Hydroxide	0-10	150	150	180	150
Barium Sulfate	All	210	210	210	210
Barium Sulfide	All	180	180	180	180
Beer		120			

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
Benzene	100	NR	NR	NR	NR
5% Benzene in Kerosene		210	210	210	
Benzene Sulfonic Acid	All	210	210	210	210
Benzoic Acid	All	210	210	210	210
Benzyl Alcohol	100	NR	NR	180	NR
Benzyl Chloride	100	NR	NR		NR
Black Liquor Recovery, (furnace gasses)		325	325	350	
Brass Plating Solution:		180	180	180	
3% Copper Cyanide 6% Sodium Cyanide 1% Zinc Cyanide 3% Sodium Carbonate					
Bromine, Liquid		NR	NR	NR	NR
Bromine Water	5	180	180	190	
Bronze Plating Solution:		180	180	190	
4% Copper Cyanide 5% Sodium Cyanide 3% Sodium Carbonate 4.5% Rochelle Salts					
Butyl Acetate	100	NR	NR	NR	NR
Butyric Acid	0-50	210	210	210	
	100			100	
Butyl Benzyl Phthalate	100	150	150	150	
Butyl Carbitol	100			100	
Butyl Cellosolve	100			100	
Butylene Glycol	100	160	160	180	
C					
Cadmium Choride	All	180	180	180	180
Cadmium Cyanide Plating Soln.: 3% Cadmium Oxide 10% Sodium Cyanide 1% Caustic Soda		180	180	200	
Calcium Bisulfite	All	180	180	180	180
Calcium Carbonate	All	180	180	180	180
Calcium Chlorate	All	210	210	210	210
Calcium Chloride	All	210	210	210	210
Calcium Hydroxide	All	180	180	210	180
Calcium Hypochlorite	All	160	160	180	160
Calcium Nitrate	All	210	210	210	210
Calcium Sulfate	All	210	210	210	210
Calcium Sulfite	All	180	180	180	180
Cane Sugar Liquor	All	180	180	180	180
Caprylic Acid	100	180	180	210	180
Carbon Dioxide		210	210	240	210
Carbon Disulfide		NR	NR	NR	NR
Carbon Monoxide		210	210	240	210
Carbon Tetrachloride	100	100	100	150	
Carbon Acid		150	150	150	
Carbowax		100	100	100	
Castor Oil		210	210	210	210
Carboxy Methyl Cellulose	10	150	150	150	150
Chlorinated Brine Liquors (caustic chlorine cell)				190	
Chlorinated Wax	All	180	180	180	180
Chlorine Dioxide/Air	15	200	200	200	
Chlorine Dioxide, Wet Gas	Satd.	180	180	180	180
Chlorine, Dry Gas	100	210	210	210	210
Chlorine, Wet Gas	100	210	210	210	210
Chlorine, Liquid		NR	NR	NR	NR

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
Chlorine Water	All	180	180	190	
Chloroacetic Acid	25	120	120	120	
	50	100	100	100	
	Con.	NR	NR	NR	NR
Chlorobenzene	100	NR	NR	100	NR
Chloroform	100	NR	NR	NR	NR
Chlorosulfonic Acid	100	NR	NR	NR	NR
Chrome Plating Bath: 19% Chromic Acid Sodium Fluorosilicate Sulfate				140	
Chromic Acid	20	150	150	150	
	30	NR	NR	140	NR
Chromium Sulfate	All	150	150	180	
Citric Acid	All	210	210	210	210
Coconut Oil		210	210	210	210
Copper Chloride	All	210	210	210	210
Copper Cyanide	All	210	210	210	210
Copper Fluoride	All	210	210	210	210
Copper Nitrate	All	210	210	210	210
Copper Plating Solns. Copper Cyanide 10.5% Copper 14% Sodium Cyanide 6% Rochelle Salts		160	150	190	
Copper Brite Plating Caustic-Cyanide		160	160	190	
Copper Plating Soln. 45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid		180	180	200	
Copper Matte Dipping Bath: 30% Ferric Chloride 19% Hydrochloric		180	180	200	
Copper Pickling Bath: 10% Ferric Sulfate 10% Sulfuric Acid		200	200	200	
Copper Sulfate	All	210	210	210	210
Corn Oil		210	210	210	210
Corn Starch	Slurry	210	210	210	210
Corn Sugar	All	210	210	210	210
Cottonseed Oil		210	210	210	210
Cresylic Acid	100	NR	NR	NR	NR
Crude Oil, Sour	100	210	210	210	210
Crude Oil, Sweet	100	210	210	210	210
Cyclohexane	100	120	120	120	
Cyclohexanone	100	100	100	120	
D					
Detergents, Sulfonated	All	210	210	210	
Diallyl phthalate	All	150	150	180	
Di-Ammonium Phosphate	65	210	210	210	210
Dibromophenol	100	NR	NR	NR	NR
Dibutyl Ether	100	100	100	150	
Dichloro Benzene	100	NR	NR	120	NR
Dichloroethylene	100	NR	NR	NR	NR
Dichloromonomethane	100	NR	NR	NR	NR
Dichloropropane	100	NR	NR	NR	NR
Dichloropropene	100	NR	NR	NR	NR
Diesel Fuel	100	180	180	200	180
Diethanol Amine	100	80	80	120	
Diethyl Amine	100	NR	NR	NR	NR
Diethyl Benzene	100	80	80	100	
Diethyl Carbonate	100	NR	NR	NR	NR

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F			
		VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
Diethylene Glycol	100	150	150	200	
Diethylhexyl Phosphoric Acid (in Kerosene)	20	120	120	150	120
Diethyl Sulfate	100	NR	NR		NR
Diisobutylene	100	100	100	150	
Diisobutyl Phthalate	100	100	100	150	
Diisopropanol Amine	100	100	100	150	
Dimethyl Formamide	100	NR	NR	NR	NR
Dimethyl Morpholine	100	NR	NR		NR
Dimethyl Phthalate	100	150	150	180	
Dioctyl Phthalate	100	150	150	150	
Dipropylene Glycol	100	150	150	150	
DMA 4 Weed Killer 2,4D	100			120	
DMA 6 Weed Killer	100			120	
Dodecyl Alcohol	100	150	150	180	
E					
Electrosol	5	150	150	150	150
Epichlorohydrin	100	NR	NR	NR	NR
Epoxidized Soybean Oil	100	150	150	150	150
Esters, Fatty Acids	100	180	180	180	
Ethyl Acetate	100	NR	NR	NR	NR
Ethyl Acrylate	100	NR	NR	NR	NR
Ethyl Benzene	100	NR	NR		NR
Ethyl Bromide	100	NR	NR	NR	NR
Ethyl Chloride	100	NR	NR	NR	NR
Ethyl Ether	100	NR	NR	NR	NR
Ethylene Chlorohydrin	100			100	
Ethylene Glycol	All	210	210	210	210
Ethylene Glycol Monobutyl Ether	All			100	
Ethyl Sulfate	100	80	80	100	
F					
Fatty Acids	All	210	210	210	210
Ferric Chloride	All	210	210	210	210
Ferric Nitrate	All	210	210	210	210
Ferric Sulfate	All	210	210	210	210
Ferrous Chloride	All	210	210	210	210
Ferrous Nitrate	All	210	210	210	210
Ferrous Sulfate	All	210	210	210	210
8-8-8 Fertilizer		120	120	120	
Fertilizer-Urea Ammonium Nitrate		120	120	120	
Flue Gas		340	340	340	
Fluoboric Acid	All	180	180	210	180
Fluosilicic Acid	10	210	210	210	210
	20	180	180	180	180
Formaldehyde	All	150	150	150	
Formic Acid	10	180	180	180	180
	All	100	100	100	100
Freon 11		100	100	100	
Fuel Oil	100	180	180	180	180
Furfural	5	120	120	150	
	10	100	100	120	
	100	NR	NR	NR	NR

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
G					
Gas, Natural		210	210	210	210
Gasoline, Auto		180	180	180	
Gasoline, Aviation		180	180	180	
Gasoline, Ethyl	180	180	180	180	
Gasoline, Sour		180	180	180	
Gluconic Acid	50	180	180	180	180
Glucose	All	210	210	210	210
Gluteraldehyde	50	120	120	120	
Gluteric Acid	50	120	120	120	
Glycerine	All	210	210	210	210
Glycol, Ethylene	All	210	210	210	210
Glycol, Propylene	All	210	210	210	210
Glycolic Acid	10	180	180	200	
	70	80	80	100	
Glyoxal	40	80	80	80	
Gold Plating Solution: 63% Potassium Ferrocyanide .2% Potassium Gold Cyanide .8% Sodium Cyanide		180	180	180	180
H					
Heptane		150	150	150	150
Hexane		150	150	150	150
Hexylene Glycol		150	150	150	150
Hot Stack Gasses		340	340	340	
Hydraulic Fluid		210	210	210	210
Hydrazine		NR	NR	NR	NR
Hydrobromic Acid	0-25	180	180	200	
	25-60	100	100	200	
Hydrochloric Acid	0-20	210	210	210	210
	20-37	180	180	180	180
Hydrochloric Acid saturated with Chlorine gas	30	180	180	180	
Hydrocyanic Acid	All	180	180	180	180
Hydrofluoric Acid	10	150	150	150	150
	20	100	100	100	100
Hydrofluosilicic Acid	10	180	180	180	180
Hydrogen Bromide, Wet Gas	100	180	180	180	180
Hydrogen Chloride, Dry Gas	100	210	210	210	210
Hydrogen Chloride, Wet Gas	100	210	210	210	210
Hydrogen Peroxide	0-30	150	150	150	150
Hydrogen Sulfide, dry	All	210	210	210	210
Hydrogen Sulfide, Aqueous	All	210	210	210	210
Hydrogen Fluoride, Vapor		180	180	180	180
Hydrosulfite Bleach		180	180	180	180
Hypochlorous Acid	10	180	180	180	180
	20	150	150	150	150
Iron Plating Solution: 45% FeCl : 15% CaCl, $20FeSO_4$: 11% $(NH_4)_2SO_4$		180	180	180	
Iron and Steel Cleaning Bath: 9% Hydrochloric 23% Sulfuric		180	180	180	
Isopropyl Amine	All	100	100	120	100
Isopropyl Palmitate	100	210	210	210	210

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
J					
Jet Fuel		180	180	180	
K					
Kerosene		180	180	180	180
L					
Lactic Acid	All	210	210	210	210
Lasso (50% Chlorobenzene)		NR	NR	120	NR
Latex	All	120	120	120	
Laural Chloride	100	210	210	210	210
Lauric Acid	All	210	210	210	210
Lead Acetate	All	210	210	210	210
Lead Nitrate	All	210	210	210	210
Lead Plating Solution: 8% Lead, .8% Fluorboric Acid, .4% Boric Acid		180	180	180	
Levulinic Acid	All	210	210	210	210
Linseed Oil		210	210	210	210
Lithium Bromide	All	210	210	210	210
Lithium Sulfate	All	210	210	210	210
M					
Magnesium Bisulfite	All	180	180	180	180
Magnesium Carbonate	All	180	180	180	180
Magnesium Chloride	All	210	210	210	210
Magnesium Hydroxide	All	210	210	210	210
Magnesium Sulfate	All	210	210	210	210
Maleic Acid	All	210	210	210	210
Mercuric Chloride	All	210	210	210	210
Mercurous Chloride	All	210	210	210	210
Methylene Chloride	100	NR	NR	NR	NR
Methyl Ethyl Ketone	100	NR	NR	NR	NR
Methyl Isobutyl Carbitol	100	NR	NR	NR	NR
Methyl Isobutyl Ketone	100	NR	NR	NR	NR
Methyl Styrene	100	NR	NR	NR	NR
Mineral Oils		210	210	210	210
Molybdenum Disulfide	100	200	200	200	
Monochloro Acetic Acid	100	NR	NR	NR	NR
Monoethynolamine	100	NR	NR	NR	NR
Motor Oil		210	210	210	210
Myristic Acid	100	210	210	210	210
N					
Naphtha	100	180	180	180	180
Naphthalene	100	180	180	200	180
Nickel Chloride	All	210	210	210	210
Nickel Nitrate	All	210	210	210	210
Nickel Plating: 8% Lead, .8% Fluoboric Acid, .4% Boric Acid		180	180	180	180
Nickel Plating: 11% Nickel Sulfate, 2% Nickel Chloride, 1% Boric Acid		180	180	180	180
Nickel PLating: 44% Nickel Sulfate, 4% Ammonium Chloride, 4% Boric Acid		180	180	180	180
Nickel Sulfate	All	210	210	210	210

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical	Concentration % by Weight	VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
		Maximum Recommended Temperature °F			
Nitric Acid	5	150	150	150	150
	20	120	120	140	120
	52	NR	NR	120	NR
Nitric Acid Fumes		160	160	180	160
Nitrobenzene	100	NR	NR	NR	NR
O					
Oakite Rust Stripper		180	180	180	180
Octanoic Acid	100	180	180	210	180
Oil, Sour Crude	100	210	210	210	210
Oil, Sweet Crude	100	210	210	210	210
Oleic Acid	All	210	210	210	210
Oleum (Fuming Sulfuric)		NR	NR	NR	NR
Olive Oil	100	210	210	210	210
Oxalic Acid	All	210	210	210	210
P					
Perchlorethylene	100	100	100	100	100
Perchloric Acid	10	150	150	150	150
	30	100	100	100	100
Peroxide Bleach 2% Sodium Peroxide 96% .025% Epsom Salts, 5% Sodium Silicate, 42°BE 1.4% Sulfuric Acid, 66°Be		210	210	210	210
Phenol	100	NR	NR	NR	NR
Phenol Sulfonic Acid	100	NR	NR	NR	NR
Phosphoric Acid	All	210	210	210	210
Phosphoric Acid Fumes		210	210	220	210
Phosphorous Pentoxide	0-54	210	210	210	210
Phosphorous Trichloride	100	NR	NR	NR	NR
Phthalic Acid	All	210	210	210	210
Pickling Acids, Sulfuric and Hydrochloric		210	210	210	210
Picric Acid, Alcoholic	10	210	210	210	210
Polyvinyl Acetate Latex	All	210	210	210	210
Polyvinyl Alcohol	100	120	120	120	120
Polyvinyl Chloride Latex with 35 parts DOP		120	120	120	120
Potassium Alum Sulfate	All	210	210	220	210
Potassium Bicarbonate	0-50	150	150	150	150
Potassium Bromide	All	210	210	210	210
Potassium Carbonate	All	150	150	150	150
Potassium Chloride	All	210	210	210	210
Potassium Dichromate	All	210	210	210	210
Potassium Ferricyanide	All	210	210	210	210
Potassium Ferrocyanide	All	210	210	210	210
Potassium Hydroxide	All	150	150	150	150
Potassium Nitrate	All	210	210	210	210
Potassium Permanganate	All	210	210	210	210
Potassium Persulfate	All	210	210	210	210
Potassium Sulfate	All	210	210	210	210
Propionic Acid	20	200	200	200	200
	50	180	180	180	180
	100	NR	NR	NR	NR
Propylene Glycol	All	210	210	210	210
Pulp Paper Mill Effluent		180	180	180	
Pyridine	100	NR	NR	NR	NR
R					
Rayon Spin Bath		150	150	150	

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
S					
Salicylic Acid	All	160	160	160	160
Sebacic Acid	All	210	210	210	210
Selenius Acid	All	210	210	210	210
Silver Nitrate	All	210	210	210	210
Silver Plating Solution 4% Silver Cyanide 7% Potassium Cyanide 5% Sodium Cyanide 2% Potassium Carbonate		200	200	200	
Soaps	All	210	210	210	
Sodium Acetate	All	210	210	210	210
Sodium Aluminate	All	120	120	120	120
Sodium Alkyl Aryl Sulfonates	All	150	150	150	150
Sodium Benzoate	100	180	180	210	180
Sodium Bicarbonate	All	180	180	180	180
Sodium Bifluoride	All	120	120	120	120
Sodium Bisulfate	All	210	210	210	210
Sodium Bisulfite	All	210	210	210	210
Sodium Bromate	10	210	210	210	
Sodium Bromide	All	210	210	210	210
Sodium Carbonate	0-25	180	180	180	
	35	160	160	180	
Sodium Chlorate	All	210	210	210	210
Sodium Chloride	All	210	210	210	210
Sodium Chlorite	All	150	150	210	150
Sodium Chromate	50	210	210	210	210
Sodium Cyanide	All	210	210	210	210
Sodium Dichromate	All	210	210	210	210
Sodium Di-Phosphate	All	210	210	210	210
Sodium Ferricyanide	All	210	210	210	210
Sodium Ferrocyanide	All	210	210	210	210
Sodium Fluoride	All	180	180	180	180
Sodium Fluoro Silicate	All	150	150	150	150
Sodium Hexametaphosphates	All	120	120	120	120
Sodium Hydroxide	5	180	180	200	160
	10	150	150	200	150
	25	150	150	200	120
	50	180	180	200	160
Sodium Hydrosulfide	All	210	210	210	210
Sodium Hypochlorite	0-5	180	180	180	180
Sodium Hypochlorite	5-15	150	150	150	150
Sodium Lauryl Sulfate	All	180	180	180	180
Sodium Mono-Phosphate	All	210	210	210	210
Sodium Nitrate	All	210	210	210	210
Sodium Nitrite	All	210	210	210	210
Sodium Persulfate	20	130	130	130	130
Sodium Silicate	All	210	210	210	210
Sodium Sulfate	All	210	210	210	210
Sodium Sulfide	All	210	210	210	210
Sodium Sulfite	All	210	210	210	210
Sodium Tetra Borate	All	200	200	200	200
Sodium Thiocyanate	57	180	180	180	180
Sodium Thiosulfate	All	180	180	180	180
Sodium Tripolyphosphate	All	210	210	210	210
Sodium Xylene Sulfonate	All	210	210	210	210
Sorbitol Solutions	All	150	150	150	150
Sour Crude Oil	100	210	210	210	210

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F VE 8100 VE 8300	VE 8440	VE 8710	VE 8520
Soya Oil	All	210	210	210	210
Stannic Chloride	All	210	210	210	210
Stannous Chloride	All	210	210	210	210
Stearic Acid	All	210	210	210	210
Styrene	100	NR	NR		NR
Succiononitrile	All	100	100	100	
Sugar, Beet and Cane Liquor	All	180	180	180	180
Sugar, Sucrose	All	210	210	210	210
Sulfamic Acid	0-25	210	210	210	210
Sulfanilic Acid	All	210	210	210	210
Sulfated Detergents	All	210	210	210	210
Sulfur Dioxide, Dry or Wet		210	210	210	
Sulfur Trioxide/Air	All	210	210	210	210
Sulfuric Acid	0-50	210	210	210	180
	50-70	180	180	180	160
	75	120	120	120	
	Over 75	NR	NR	NR	NR
Sulfurous Acid	All	100	100	100	
Superphosphoric Acid 76% P_2O_5	105% H_3PO_3	210	210	210	210
T					
Tall Oil		150	150	150	
Tannic Acid	All	100	100	100	
Tartaric Acid	All	210	210	210	210
Tetrachloroethylene	100	80	80	100	
Tetrasodium Ethylene-Diamine	All	120	120	120	
Textone®- 50% Aqueous Sodium Chlorate		210	210	210	
Thioglycolic Acid	10	100	100	100	
Thionyl Chloride	100	NR	NR	NR	NR
Tin Plating: 18% Stannous Fluoroborate, 7% Tin, 9% Fluorboric Acid, 2% Boric Acid		200	200	200	
Toluene	100	NR	NR	100	NR
Toluene Solfonic Acid	All	210	210	210	210
Transformer Oils:					
Mineral Oil Types		210	210	210	210
Chloro-Phenyl Types		NR	NR	NR	NR
Trichlor Acetic Acid	50	210	210	210	210
Trichloroethane	100			100	
Trichloroethylene	100	NR	NR	NR	NR
Trichloromonofluoro-Methane	100	80	80	100	
Trichlorophenol	100	NR	NR	NR	NR
Tricresyl Phosphate		100	100	120	
Tridecylbenzene Sulfonate	All	210	210	210	210
Triethanolamine	100	120	120	120	
Trimethylene Chlorobromide	100	NR	NR	NR	NR
Trisodium Phosphate	All	210	210	210	210
Turpentine	100	100	100	150	
Tween* Surfactant	All	150	150	150	150
U					
Urea	0-50	150	150	150	
V					
Vegetable Oils		210	210	210	210
Vinegar		210	210	210	210

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical	Concentration % by Weight	Maximum Recommended Temperature °F VE8100 VE8300	VE 8440	VE8710	VE8520
Vinyl Acetate	100	NR	NR	NR	NR
Vinyl Toluene	100	80	80	80	
W					
Water					
Deionized		210	210	210	210
Demineralized		210	210	210	210
Distilled		210	210	210	210
Fresh		210	210	210	210
Salt	All	210	210	210	210
Sea		210	210	210	210
White Liquor (Pulp Mill)		180	180	180	
X					
Xylene	100	NR	NR	100	NR
Z					
Zinc Chlorate	All	210	210	210	210
Zinc Nitrate	All	210	210	210	210
Zinc Plating Solution: 9% Zinc Cyanide, 4% Sodium Cyanide, 9% Sodium Hydroxide		160	160	160	
Zinc Plating Solution: 49% Zinc Fluoborate, 5% Ammonium Chloride, 6% Ammonium Fluoroborate		200	200	200	
Zinc Sulfate	All	210	210	210	210

Co-Rezyn Vinyl Ester Resins

VE 8300
The most versatile of all the vinyl esters with excellent corrosion resistance from acids to alkalies and oxidizing chemicals. The most widely used resin of the family of vinyl esters for filament winding and custom fabricated hand lay-up reinforced plastic tanks, pipe, and process equipment. Outstanding toughness and fatigue properties as demonstrated by high cycle pressure values on thin wall filament wound pipe.
By suitable control of promoter — catalyst levels, Co-Rezyn® VE 8300 can be fabricated into thick sections without cracking or crazing and excess warping.
This resin demonstrates excellent adhesive properties which makes for reliable secondary bonding operations.
Used in: Filament winding
Hand lay-up and spray lay-up
BMC match metal die molding
Pultrusion
Tank linings
Coatings
VE 8300 has a viscosity of 500 cps and contains 45% styrene.

VE 8100
A lower chain length version of VE 8300 having lower intrinsic and evident viscosities. Contains 50% styrene with a nominal viscosity of 100 cps. Has essentially the same cured properties as VE 8300. Used for:
Centrifugal casting
Pultrusion

VE 8440
The fire resistant brominated counterpart of Ve 8300. When used with 3% antimony trioxide, has a flame spread rate of less than 25 per ASTM E 84 "Tunnel Test". Excellent physical properties and corrosion resistance in a Vinyl Ester resin. Lower halogen content and cost than VE 8400 and same competitive materials.

VE 8710
A higher cross link density resin than VE 8300 giving higher heat distortion and exceptional chemical resistance and hydrolytic stability. This is demonstrated by the exceptional caustic resistance of VE 8710. Attains good solvent resistance; as an example, is unaffected by chlorobenzene at ambient temperatures. Although a tough resin there is some sacrifice in this property versus VE 8300.

VE 8520
An extremely tough epoxy based vinyl ester having 20% elongation. This is a non-rubber resin, developed for SPI Liner applications to minimize cracking or crazing due to thermal or mechanical shock and physical abuse. Retains very good chemical resistance. Is 100% compatible with the other Co-Rezyn® Vinyl Esters to add additional toughness. Other uses:
Coatings
Tank linings
Primers
Adhesives

Co-Rezyn® MVR-Modified Vinyl Ester Resins

MVR 8000 - Good corrosion resistance and physical properties. An economic choice where the optimum vinyl ester resin properties are not required. - Non fire retardant.

MVR 8040 - Fire retardant, brominated Modified Vinyl Ester Resin with a flame spread of less than 25 per ASTM E 84 "Tunnel Test", when used with 3% antimony trioxide. Does not attain the optimum physical properties and corrosion resistance associated with the Vinyl Ester Resin, VE 8440.

MVR 8050 - Fire retardant, brominated Modified Vinyl Ester with a flame spread rate of less than 25, per ASTM E 84 "Tunnel Test", when used with 3% antimony trioxide. An economic choice where superior corrosion resistance and physical properties are required over fire retardant isophthalic polyester resins.

MVR 8060 - Fire retardant brominated Modified Vinyl Ester resin which does not require the use of antimony trioxide or other flame retardant chemicals to achieve the ASTM E 84 "Tunnel Test" rating of less than 25. Only a small sacrifice of chemical resistance and physical properties from the unmodified vinyl ester VE 8400.

(continued)

TABLE 1.51: VINYL ESTER RESINS—INTERPLASTIC CORP. (continued)

Chemical Resistance Co-Rezyn® MVR Resins

Chemical	Concentration % by Weight	Maximum Temperature MVR 8000	MVR 8040	MVR 8050	MVR 8060
Acetic Acid	0-25	170	170	170	200
	50	150	150	150	180
Acetone	100	NR	NR	NR	NR
Alcohol, Ethyl	100	80	80	80	80
	10	150	150	150	150
Alcohol, Methyl	100	NR	NR	NR	NR
	10	150	150	150	150
Alum	All	170	170	170	210
Ammonia, Aqueous	0-20	140	140	80	140
Ammonia, Gas		100	100	100	100
Ammonia, Liquid	NR	NR	NR	NR	NR
Ammonium Carbonate	All	150	150	120	150
Ammonium Hydroxide	0-20	150	150	80	150
	29	100	100	80	100
Benzene	100	NR	NR	NR	NR
Brine	All	200	200	200	210
Bromine, Liquid		NR	NR	NR	NR
Calcium Carbonate	All	170	170	170	180
Calcium Sulfate	All	200	200	200	210
Chlorine Gas, Wet or Dry	100	180	180	180	210
Chlorine, Liquid		NR	NR	NR	NR
Chlorine Dioxide	All	150	150	100	180
Chlorine Water	All	180	180	180	180
Chromic Acid	20	150	150	NR	150
Cyclohexane	All	120	120	80	120
Ethylene Glycol	All	180	180	180	210
Fluosilicic Acid	10	200	200	80	200
Gasoline, Auto		180	180	180	180
Aviation		180	180	180	180
Ethyl		180	180	180	180
Glycol, Ethylene	All	200	200	200	210
Hexane	All	150	150	150	150
Hydrochloric Acid	0-20	180	180	150	210
	20-37	150	150	120	180
Hydrofluoric Acid	10	150	150	150	150
	20	100	100	100	100
Hydrogen Sulfide	All	200	200	200	200
Jet Fuel		180	180	180	180
Kerosene		180	180	180	180
Naphtha		180	180	180	180
Nitric Acid	5	150	150	120	150
	20	120	120	100	120
	50	*80*	*80*	NR	NR
Oil, Sour		200	200	200	210
Oil, Sweet		200	200	200	210
Phosphoric Acid	All	200	200	170	210
Pickling Acids, Sulfuric & Hydrochloric		200	200	170	210
Potassium Hydroxide	10	150	150	120	150
	25	120	120	100	150
Sodium Carbonate	0-25	180	180	120	180
Sodium Hydroxide	0-10	140	140	NR	160
	10-25	120	120	NR	140
	50	180	180	NR	180
Sodium Hypochlorite	0-15	150	150	NR	150
Sulfur Dioxide, Dry or Wet	All	200	200	170	210
Sulfur Trioxide/Air	All	200	200	170	210
Sulfuric Acid	0-50	200	200	150	210
	50-70	160	160	80	180
	75	120	120	80	120
Toluene	100	NR	NR	NR	NR
Water, Distilled or Sea		200	200	200	210

TABLE 1.52: EPOXY AND POLYESTER PIPE AND FITTINGS—AMERON

BONDSTRAND CHEMICAL RESISTANCE CHART

CHEMICAL SOLUTION	Concentration %[1]	TEMPERATURE LIMIT: SERIES 2000 (Epoxy)[2] °F	°C	SERIES 4000 (Epoxy)[2] °F	°C	SERIES 5000 (Polyester) °F	°C	Adhesive for Series 5000[3]
Acetaldehyde		—	—	—	—	NR	NR	—
Acetic Acid	0-10	150	66	150	66	200	93	RP-48
Acetic Acid	11-20	NR	NR	NR	NR	200	93	RP-105
Acetic Acid	21-50	NR	NR	NR	NR	100	38	RP-105
Acetic Acid	51-100	NR	NR	NR	NR	NR	NR	—
Acetic Anhydride		—	—	—	—	NR	NR	—
Acetone		120	49	120	49	NR	NR	—
Acetonitrile		120	49	120	49	NR	NR	—
Acrylic Acid		NR	NR	NR	NR	NR	NR	—
Acrylonitrile		100	38	100	38	NR	NR	—
Air		300[4]	149[4]	300[4]	149[4]	200[4]	93[4]	RP-34
Alcohol, Amyl		200	93	200	93	100	38	RP-34
Alcohol, Butyl		200	93	200	93	100	38	RP-34
Alcohol, Ethyl		180	82	180	82	—	—	—
Alcohol, Isobutyl		180	82	180	82	100	38	RP-34
Alcohol, Isopropyl		180	82	180	82	100	38	RP-34
Alcohol, Methyl		150	66	150	66	—	—	—
Alcohol, Polyvinyl		150	66	150	66	100	38	RP-34
Allyl Chloride		120	49	120	49	—	—	—
Alum		270	132	270	132	200	93	RP-34
Aluminum Chloride		270	132	270	132	200	93	RP-34
Aluminum Chlorohydroxide	0-50	100	38	100	38	—	—	—
Aluminum Citrate		180	82	180	82	180	82	RP-34
Aluminum Hydroxide		200	93	200	93	150	66	RP-34
Aluminum Nitrate		250	121	250	121	180	82	RP-34
Aluminum Potassium Sulfate (Alum)		270	132	270	132	200	93	RP-34
Aluminum Sulfate		270	132	270	132	200	93	RP-34
Ammonium Bicarbonate	0-50	220	104	220	104	150	66	RP-34
Ammonium Carbonate	0-50	180	82	180	82	100	38	RP-34
Ammonium Chloride		270	132	270	132	200	93	RP-34
Ammonium Hydroxide	0-20	180	82	180	82	150	66	RP-34
Ammonium Hydroxide	21-29	150	66	150	66	100	38	RP-34
Ammonium Nitrate		225	107	225	107	200	93	RP-34
Ammonium Persulfate		—	—	—	—	180	82	RP-34
Ammonium Phosphate		200	93	200	93	150	66	RP-34
Ammonium Sulfate		270	132	270	132	200	93	RP-34
Ammonium Thiocyanate		150	66	150	66	100	38	RP-34
Ammonium Thiosulfate		150	66	150	66	100	38	RP-34
Amyl Acetate		100	38	100	38	NR	NR	—
Amyl Chloride		100	38	100	38	NR	NR	—
Aniline		NR	NR	NR	NR	NR	NR	—
Antimony Pentachloride		—	—	—	—	100	38	RP-34
Antimony Trichloride		220	104	220	104	150	66	RP-34

CHEMICAL SOLUTION	Concentration %[1]	TEMPERATURE LIMIT: SERIES 2000 (Epoxy)[2] °F	°C	SERIES 4000 (Epoxy)[2] °F	°C	SERIES 5000 (Polyester) °F	°C	Adhesive for Series 5000[3]
Aqua Regia		NR	NR	NR	NR	NR	NR	—
Arsenic Acid		180	82	180	82	180	82	RP-34
Arsenous Acid		180	82	180	82	180	82	RP-34
Barium Acetate		180	82	180	82	150	66	RP-34
Barium Carbonate		—	—	250	121	200	93	RP-34
Barium Chloride		250	121	250	121	200	93	RP-34
Barium Hydroxide	10	220	104	220	104	150	66	RP-34
Barium Sulfate		—	—	250	121	200	93	RP-34
Barium Sulfide	0-25	225	107	225	107	180	82	RP-34
Beer		200	93	—	—	—	—	—
Benzaldehyde		100	38	100	38	NR	NR	—
Benzene		150	66	150	66	NR	NR	—
Benzene Sulfonic Acid		220	104	220	104	200	93	RP-34
Benzonic Acid		220	104	220	104	200	93	RP-34
Black Liquor		—	—	200	93	150	66	RP-34
Borax		250	121	250	121	200	93	RP-34
Boric Acid		225	107	225	107	200	93	RP-34
Bromine (Dry)		NR	NR	NR	NR	NR	NR	—
Bromine (Liquid)		NR	NR	NR	NR	NR	NR	—
Bromine (Water)		NR	NR	NR	NR	NR	NR	—
Bromine (Wet)		NR	NR	NR	NR	NR	NR	—
Butadiene		150	66	150	66	—	—	—
Butane		150	66	150	66	—	—	—
Butyl Acetate		150	66	150	66	NR	NR	—
Butyl Cellosolve		150	66	150	66	NR	NR	—
Butyraldehyde		150	66	150	66	—	—	—
Butyric Acid		200	93	200	93	180	82	RP-34
Calcium Bisulfite		270	132	270	132	200	93	RP-34
Calcium Carbonate		—	—	270	132	200	93	RP-34
Calcium Chlorate		—	—	—	—	200	93	RP-34
Calcium Chloride		270	132	270	132	200	93	RP-34
Calcium Hydroxide		100	38	200	93	180	82	RP-34
Calcium Hypochlorite	0-5	NR	NR	NR	NR	200[4]	93[4]	RP-105
Calcium Hypochlorite	6-20	NR	NR	NR	NR	200[4]	93[4]	RP-105
Calcium Nitrate		250	121	250	121	200	93	RP-34
Calcium Sulfate		250	121	250	121	200	93	RP-34
Caprylic Acid		150	66	150	66	150	66	RP-34
Carbon Dioxide		250	121	250	121	200	93	RP-34
Carbon Disulfide		—	—	—	—	NR	NR	—
Carbon Monoxide		200	93	200	93	200	93	RP-34
Carbon Tetrachloride		150	66	150	66	NR	NR	—
Carbonic Acid		180	82	180	82	180	82	RP-34
Castor Oil		220	104	220	104	200	93	RP-34

(continued)

TABLE 1.52: EPOXY AND POLYESTER PIPE AND FITTINGS—AMERON (continued)

CHEMICAL SOLUTION	Concentration %[1]	TEMPERATURE LIMIT SERIES 2000 (Epoxy)[2] °F	°C	SERIES 4000 (Epoxy)[2] °F	°C	SERIES 5000 (Polyester) °F	°C	Adhesive for Series 5000[3]
Chlorine Dioxide (Wet)		NR	NR	NR	NR	150[4]	66[4]	RP-105
Chlorine Gas (Dry)		NR	NR	NR	NR	200[4]	93[4]	RP-105
Chlorine Gas (Wet)		NR	NR	NR	NR	200[4]	93[4]	RP-105
Chlorine Water		0-50 PPM 150	0-50 PPM 66	NR	NR	180[4]	82[4]	RP-105
Chloroacetic Acid	0-25	100	38	100	38	200	93	RP-105
Chloroacetic Acid	26-50	—	—	—	—	150	66	RP-105
Chlorobenzene		100	38	100	38	NR	NR	—
Chloroform		NR	NR	NR	NR	NR	NR	—
Chlorosulfonic Acid		—	—	—	—	NR	NR	—
Chromic Acid	0-5	NR	NR	NR	NR	200[4]	93[4]	RP-105
Chromic Acid	6-20	—	—	—	—	100	38	RP-105
Chromic Acid	21-30	NR	NR	NR	NR	—	—	—
Chrome Alum		200	93	200	93	200	93	RP-34
Citric Acid		250	121	250	121	200	93	RP-34
Copper Acetate		180	82	180	82	180	82	RP-34
Copper Chloride		250	121	250	121	200	93	RP-34
Copper Cyanide		220	104	220	104	200	93	RP-34
Copper Nitrate		250	121	250	121	200	93	RP-34
Copper Sulfate		220	104	220	104	200	93	RP-34
Corn Syrup		220	104	—	—	180	82	RP-34
Cresylic Acid		NR	NR	NR	NR	NR	NR	—
Crude Oil (Sweet and Sour)		250	121	250	121	200	93	RP-34
Cupric Fluoride		—	—	250	121	—	—	—
Cyclohexane		150	66	150	66	120	49	RP-34
Cyclohexanol		150	66	150	66	—	—	—
Detergents		180	82	180	82	150	66	RP-34
Diallyl Phthalate		180	82	180	82	180	82	RP-34
Dibutyl Phthalate		180	82	180	82	180	82	RP-34
Dicalcium Phosphate		150	66	150	66	120	49	RP-34
Dichloroacetaldehyde		—	—	—	—	NR	NR	—
Dichlorobenzene		120	49	120	49	NR	NR	—
Diesel Fuel		250	121	250	121	150	66	RP-34
Diethanolamine		NR	NR	NR	NR	NR	NR	—
Diethyl Ketone		—	—	—	—	NR	NR	—
Diethyl Ether		100	38	100	38	NR	NR	—
Diethylene Glycol		200	93	200	93	180	82	RP-34
Diethylenetriamine		NR	NR	NR	NR	NR	NR	—
Dimethylamine		NR	NR	NR	NR	NR	NR	—
Dimethyl Formamide		NR	NR	NR	NR	NR	NR	—
Dimethyl Phthalate		100	38	100	38	100	38	RP-34
Diphenyl Ether		120	49	120	49	—	—	RP-34
Dipropylene Glycol		200	93	200	93	150	66	RP-34
Disodium Methyl Arsenate		220	104	220	104	—	—	—

CHEMICAL SOLUTION	Concentration %[1]	TEMPERATURE LIMIT SERIES 2000 (Epoxy)[2] °F	°C	SERIES 4000 (Epoxy)[2] °F	°C	SERIES 5000 (Polyester) °F	°C	Adhesive for Series 5000[3]
Ethyl Acetate		150	66	150	66	NR	NR	—
Ethyl Cellosolve		150	66	150	66	NR	NR	—
Ethyl Chloride		NR	NR	NR	NR	NR	NR	—
Ethyl Ether		100	38	100	38	NR	NR	—
Ethylene Chlorohydrin		150	66	150	66	100	38	RP-34
Ethylene Diamine		NR	NR	NR	NR	NR	NR	—
Ethylene Dichloride		120	49	120	49	NR	NR	—
Ethylene Glycol		270	132	270	132	200	93	RP-34
Fatty Acids		225	107	225	107	200	93	RP-34
Ferric Acetate		200	93	200	93	180	82	RP-34
Ferric Chloride	0-20	220	104	220	104	200	93	RP-34
Ferric Chloride	21-60	205	96	205	96	200	93	RP-34
Ferric Nitrate		200	93	200	93	200	93	RP-34
Ferric Sulfate		225	107	225	107	200	93	RP-34
Ferrous Chloride		220	104	220	104	200	93	RP-34
Ferrous Nitrate		220	104	220	104	200	93	RP-34
Ferrous Sulfate		220	104	220	104	200	93	RP-34
Fluoboric Acid		200	93	200	93	200	93	RP-34
Fluorine		NR	NR	NR	NR	NR	NR	—
Fluosilicic Acid	0-10	—	—	150	66	200[4]	93[4]	RP-48
Fluosilicic Acid	11-25	—	—	—	—	100[4]	38[4]	RP-48
Formaldehyde	0-40	150	66	150	66	150	66	RP-34
Formic Acid	0-10	NR	NR	NR	NR	150	66	RP-34
Formic Acid	25	NR	NR	NR	NR	100	38	RP-34
Fuel Oil		220	104	220	104	180	82	RP-34
Furfural		NR	NR	NR	NR	NR	NR	—
Gasoline		225	107	225	107	150	66	RP-34
Gluconic Acid	0-50	180	82	180	82	100	38	RP-34
Glucose		220	104	—	—	200	93	RP-34
Glycerin		300	149	300	149	200	93	RP-34
Glyoxal	0-30	120	49	120	49	—	—	—
Green Liquor		—	—	200	93	—	—	—
Heptane		200	93	200	93	180	82	RP-34
Hexane		150	66	150	66	120	49	RP-34
Hydraulic Oils		250	121	250	121	200	93	RP-34
Hydrazine		NR	NR	NR	NR	—	—	—
Hydrobromic Acid	48	100	38	120	49	120	49	RP-34
Hydrochloric Acid	0-10	150	66	200	93	200	93	RP-34
Hydrochloric Acid	11-20	120	49	180[4]	82[4]	200[4]	93[4]	RP-34
Hydrochloric Acid	21-37	NR	NR	NR	NR	150[4]	66[4]	RP-34
Hydrofluoric Acid	0-5	NR	NR	NR	NR	150	66	RP-105
Hydrogen Peroxide	0-30	NR	NR	NR	NR	150[4]	66[4]	RP-105
Hydrogen Sulfide		250	121	250	121	180	82	RP-34

(continued)

TABLE 1.52: EPOXY AND POLYESTER PIPE AND FITTINGS—AMERON (continued)

CHEMICAL SOLUTION	Concentration %[1]	TEMPERATURE LIMIT						
		SERIES 2000 (Epoxy)[2]		SERIES 4000 (Epoxy)[2]		SERIES 5000 (Polyester)		
		°F	°C	°F	°C	°F	°C	Adhesive for Series 5000[3]
Hypochlorous Acid	10	--	--	--	--	180	82	RP-105
Iodine		--	--	--	--	100	38	RP-105
Jet Fuel		250[4]	121[4]	250[4]	121[4]	180[4]	82[4]	RP-34
Kerosene		250	121	250	121	180	82	RP-34
Lactic Acid		225	107	225	107	200	93	RP-34
Latex		225	107	--	--	120	49	RP-34
Lauric Acid		220	104	220	104	200	93	RP-34
Lead Acetate		250	121	250	121	200	93	RP-34
Lead Nitrate		220	104	220	104	200	93	RP-34
Levulinic Acid		220	104	220	104	200	93	RP-34
Lime		--	--	220	104	180	82	RP-34
Linseed Oil		250	121	250	121	200	93	RP-34
Lithium Chloride		225	107	220	104	200	93	RP-34
Lube Oil		250	121	250	121	200	93	RP-34
Magnesium Carbonate		220	104	220	104	150	66	RP-34
Magnesium Chloride		270	132	270	132	200	93	RP-34
Magnesium Hydroxide		270	132	270	132	150	66	RP-34
Magnesium Nitrate		250	121	250	121	200	93	RP-34
Magnesium Sulfate		270	132	270	132	200	93	RP-34
Maleic Acid		220	104	220	104	200	93	RP-34
Mercuric Chloride		220	104	220	104	200	93	RP-34
Mercurous Chloride		220	104	220	104	200	93	RP-34
Mercury		270	132	270	132	200	93	RP-34
Methacrylic Acid, Glacial		NR	NR	NR	NR	NR	NR	--
Methyl Chloride		NR	NR	NR	NR	NR	NR	--
Methyl Ethyl Ketone		100	38	100	38	NR	NR	--
Methyl Isobutyl Alcohol		180	82	180	82	120	49	RP-34
Methyl Isobutyl Carbitol		120	49	120	49	--	--	--
Methyl Isobutyl Ketone		150	66	150	66	NR	NR	--
Methyl Methacrylate		100	38	100	38	NR	NR	--
Methyl Sulfonic Acid		NR	NR	NR	NR	NR	NR	--
Methylene Chloride		NR	NR	NR	NR	NR	NR	--
Mineral Oil		270	132	270	132	200	93	RP-34
Naphtha		225	107	225	107	180	82	RP-34
Naphthalene		200	93	200	93	200	93	RP-34
Nickel Chloride		270	132	270	132	200	93	RP-34
Nickel Nitrate		220	104	220	104	200	93	RP-34
Nickel Sulfate		225	107	225	107	200	93	RP-34
Nitric Acid	0-5	NR	NR	NR	NR	150[4]	66[4]	RP-105
Nitric Acid	6-20	NR	NR	NR	NR	100	38	RP-105
Nitrobenzene		--	--	--	--	NR	NR	--
Nitrogen Solutions		150	66	150	66	100	38	RP-34
Oil, Sour Crude		250	121	250	121	200	93	RP-34

CHEMICAL SOLUTION	Concentration %[1]	TEMPERATURE LIMIT						
		SERIES 2000 (Epoxy)[2]		SERIES 4000 (Epoxy)[2]		SERIES 5000 (Polyester)		
		°F	°C	°F	°C	°F	°C	Adhesive for Series 5000[3]
Oil, Diesel		250	121	250	121	180	82	RP-34
Oil, Lubricating		220	104	220	104	180	82	RP-34
Oleic Acid		250	121	250	121	200	93	RP-34
Oleum		NR	NR	NR	NR	NR	NR	--
Olive Oil		220[4]	104[4]	--	--	200	93	RP-34
Oxalic Acid		270	132	270	132	200	93	RP-34
Palmitic Acid		220	104	220	104	200	93	RP-34
Perchloric Acid		NR	NR	NR	NR	--	--	--
Perchloroethylene		120	49	120	49	NR	NR	--
Petroleum Ether		100	38	100	38	NR	NR	--
Phenol	0-5	100	38	100	38	--	--	--
Phenol	6-100	NR	NR	NR	NR	--	--	--
Phosphoric Acid	0-85	100	38	100	38	200	93	RP-48
Phosphoric Acid	86-115	100	38	100	38	200	93	RP-48
Phosphorous Oxychloride		--	--	--	--	NR	NR	--
Phthalic Anhydride		220	104	220	104	200	93	RP-34
Picric Acid		100	38	100	38	--	--	--
Pine Oil		150	66	150	66	150	66	RP-34
Polyvinyl Acetate Emulsion		150	66	150	66	100	38	RP-34
Polyvinyl Alcohol		150	66	150	66	100	38	RP-34
Potassium Bicarbonate		120	49	270	132	150	66	RP-34
Potassium Bromide		220	104	220	104	200	93	RP-34
Potassium Carbonate	0-50	100	38	200	38	150	66	RP-34
Potassium Chloride		270	132	270	132	200	93	RP-34
Potassium Cyanide		225	107	225	107	180	82	RP-34
Potassium Dichromate	0-10	200	93	200	93	200	93	RP-34
Potassium Ferricyanide		220	104	220	104	200	93	RP-34
Potassium Ferrocyanide		220	104	220	104	200	93	RP-34
Potassium Hydroxide	0-25	100	38	180	82	120	49	RP-34
Potassium Hydroxide	26-75	--	--	180	82	--	--	--
Potassium Nitrate		270	132	270	132	200	93	RP-34
Potassium Permanganate	0-10	NR	NR	NR	NR	150	66	RP-48
Potassium Persulfate		NR	NR	NR	NR	180	82	RP-48
Potassium Phosphate		180	82	180	82	100	38	RP-34
Propane		150	66	150	66	100	38	RP-34
Propylene Glycol		270	132	270	132	200	93	RP-34
Quaternary Ammonium Salts		120	49	120	49	--	--	--
Silver Nitrate		220	104	220	104	200	93	RP-34
Sodium Acetate		220	104	220	104	200	93	RP-34
Sodium Benzoate		200	93	200	93	180	82	RP-34
Sodium Bicarbonate	0-10	250	121	250	121	180	82	RP-34
Sodium Bicarbonate	11-20	250	121	250	121	150	66	RP-34
Sodium Bisulfate		250	121	250	121	200	93	RP-34

(continued)

TABLE 1.52: EPOXY AND POLYESTER PIPE AND FITTINGS—AMERON (continued)

CHEMICAL SOLUTION	Concentration %[1]	TEMPERATURE LIMIT SERIES 2000 (Epoxy)[2] °F	SERIES 2000 (Epoxy)[2] °C	SERIES 4000 (Epoxy)[2] °F	SERIES 4000 (Epoxy)[2] °C	SERIES 5000 (Polyester) °F	SERIES 5000 (Polyester) °C	Adhesive for Series 5000[3]
Sodium Bisulfite		220	104	220	104	200	93	RP-34
Sodium Bromate		—	—	—	—	140	60	RP-34
Sodium Bromide		250	121	250	121	200	93	RP-34
Sodium Carbonate		100	38	200	93	150	66	RP-34
Sodium Chlorate	0-50	—	—	—	—	180	82	RP-105
Sodium Chloride		270	132	270	132	200	93	RP-34
Sodium Cyanide		225	107	225	107	200	93	RP-34
Sodium Dichromate	0-10	200	93	200	93	200	93	RP-34
Sodium Ferricyanide		270	132	270	132	200	93	RP-34
Sodium Ferrocyanide		270	132	270	132	200	93	RP-34
Sodium Hydrosulfide		120	49	120	49	—	—	—
Sodium Hydroxide	0-40	100	38	180[4]	82[4]	100	38	RP-34
Sodium Hydroxide	41-50	150	66	180[4]	82[4]	NR	NR	—
Sodium Hypochlorite	0-15	NR	NR	NR	NR	150[4]	66[4]	RP-105
Sodium Nitrate		270	132	270	132	200	93	RP-34
Sodium Nitrite		250	121	250	121	200	93	RP-34
Sodium Silicate		220	104	220	104	200	93	RP-34
Sodium Sulfate		270	132	270	132	200	93	RP-34
Sodium Sulfide	0-10	—	—	200	93	150	66	RP-34
Sodium Sulfite		200	93	200	93	200	93	RP-34
Sodium Thiocyanate		200	93	200	93	180	82	RP-34
Sodium Thiosulfate		150	66	150	66	200	93	RP-34
Stannic Chloride		220	104	220	104	200	93	RP-34
Stannous Chloride		220	104	220	104	200	93	RP-34
Stearic Acid		220	104	220	104	200	93	RP-34
Strontium Carbonate		200	93	200	93	200	93	RP-34
Styrene		100	38	100	38	—	—	—
Sugar Solutions		220[4]	104[4]	—	—	180	82	RP-34
Sulfite Liquors		150	66	150	66	200	93	RP-34
Sulfur Chloride		NR	NR	NR	NR	NR	NR	—
Sulfur Dioxide		NR	NR	NR	NR	200	93	RP-48
Sulfur Trioxide		—	—	—	—	160	71	RP-48
Sulfuric Acid	0-20	100	38	180	82	200	93	RP-105
Sulfuric Acid	21-50	100	38	150	66	180	82	RP-105
Sulfuric Acid	51-70	100	38	100	38	120	49	RP-105
Sulfuric Acid	71-80	NR	NR	NR	NR	—	—	—
Sulfuric Acid	81-100	NR	NR	NR	NR	NR	NR	—
Sulfurous Acid		200	93	200	93	200	93	RP-34
Tall Oil		200	93	200	93	200	93	RP-34
Tannic Acid		225	107	225	107	200	93	RP-34
Tartaric Acid		250	121	250	121	200	93	RP-34
Tetra Ethyl Lead		120	49	120	49	—	—	—
Thionyl Chloride		NR	NR	NR	NR	NR	NR	—
Toluene		150	66	150	66	NR	NR	—
Transformer Oil		300	149	300	149	200	93	RP-34
Trichloroethylene		100	38	100	38	NR	NR	—
Triethanolamine		150	66	150	66	—	—	—
Triethylamine		100	38	100	38	—	—	—
Triphenyl Phosphite		120	49	120	49	120	49	RP-34
Trisodium Phosphate	25	200	93	200	93	150[4]	66[4]	RP-34
Turpentine		150	66	150	66	—	—	—
Urea		200	93	200	93	150	66	RP-34
Vinegar		200[4]	93[4]	—	—	200	93	RP-34
Vinyl Acetate		150	66	150	66	NR	NR	—
Water, Deionized		250	121	250	121	180	82	RP-34
Water, Demineralized		250	121	250	121	200	93	RP-34
Water, Distilled		250	121	250	121	200	93	RP-34
Water, Fresh		250	121	250	121	200	93	RP-34
Water, Salt		270	132	270	132	200	93	RP-34
Water, Sea		270	132	270	132	200	93	RP-34
Water, Steam Condensate		250[4]	121[4]	—	—	—	—	—
White Liquor		100	38	200	93	150	66	RP-34
Xylene		150	66	150	66	NR	NR	—
Zinc Acetate		180	82	180	82	180	82	RP-34
Zinc Chloride		250	121	250	121	200	93	RP-34
Zinc Phosphate		180	82	180	82	200	93	RP-34
Zinc Sulfate		250	121	250	121	200	93	RP-34

NOTES:

1. Concentration
   Where **no concentration** is shown, recommendations apply to any concentration up to 100% or saturation.
   Where a **concentration range** is given, recommendations apply to any concentration within that range.
   Where a **single concentration** is given, only that specific concentration has been tested.
2. Use RP-34 adhesive for all applications except use RP-6A for food applications up to 200°F (93°C).
3. Use adhesive shown for field installation except use RP-105 or RP-6A adhesive for food applications.
4. Use Bondstrand filament-wound fittings and flanges. Molded flanges may be used in Series 5000 systems.

NR—Not Recommended

TABLE 1.53: PHENOL-FORMALDEHYDE AND FURFURYL ALCOHOL-FORMALDEHYDE RESINS– AMETEK, HAVEG DIVISION

Haveg 41 NA is a thermosetting plastic, based on a composition of phenol-formaldahyde resin and inert non-asbestos silicate fillers. It is generally recommended for service with mineral acid, salts and chlorinated aromatic hydrocarbons.

Haveg 61NA is a thermosetting plastic based on a composition of furfuryl alcohol-formaldehyde resin and inert non-asbestos silicate fillers. It is generally recommended for service with dilute acids, alkaline reactions and chlorinated aromatic hydro carbons.

Haveg 46 is a phenol-formaldehyde resin with a graphite filler. Its primary consideration is for use with hydrofluoric acid, fluosilicic acid, and related fluorine-bearing compounds.

Haveg 66 is furfuryl alcohol-formaldehyde resin with a graphite filler. In addition to its resistance to HF and related compounds, Haveg 66 has the same resistance to alkalies as Haveg 61 NA.

KEY:

E = Excellent. Can be used generally, and is to all intents and purposes not affected at all by chemicals at the test temperature.

G = Good. Can be used quite generally. Satisfactory in most services.

F = Fair. Can be used for some purposes. May involve some tendency to swell sample or discolor solution.

NR = Not recommended.

SODIUM HYDROXIDE (NaOH) AND HAVEG

For alkaline service, Haveg 61 NA is the recommended grade.

Haveg 61 NA can be used with varying concentrations of NaOH, even concentrations up to 50% at elevated temperatures; however, it is *affected* . There is a surface effect that can contribute to contamination of the solution.

Haveg 61 NA should be considered only where NaOH is used to neutralize acidic conditions or as a reactant in a particular process.

Haveg 41 NA, when exposed to 0.5% NaOH in water, will be seriously attacked overnight. 1% NaOH will begin its attack immediately.

Chemical Service	Grade	80°F	160°F	Maximum Temperature °F
Acetaldehyde, 90%	41 NA	NR		
	61 NA	NR		
Acetic acid (glacial)	41 NA	E		E-120
	61 NA	E		NR-120
Acetic acid, 30%	41 NA	E	E	E-212
	61 NA	E	G	G-212
Acetic anhydride	41 NA	Test		
	61 NA	G	F	NR-212
Acetone	41 NA	NR		
	61 NA	G		F-133
Acetonitrile, 20%	41 NA	F	NR	
	61 NA	G	F	
Acetyl chloride	41 NA	NR		
	61 NA	Test		
Acrylic acid, 90%	41 NA	G		
	61 NA	E		
Acrylonitrile	41 NA	F	NR	
	61 NA	G	F	
Aluminum chloride	41 NA	E	E	E-300
	61 NA	E	E	E-300
Aluminum sulfate	41 NA	E	E	E-300
	61 NA	E	E	
Ammonium hydroxide, 28%	41 NA	NR		
	61 NA	E	E	
n-Amyl alcohol	41 NA	E	E	NR-212
	61 NA	E	E	G-278
Aniline	41 NA	F	NR	
	61 NA	G	NR	
Aniline hydrochloride	41 NA	E	E	
	61 NA	Test		
Aqua regia	41 NA	NR		
	61 NA	NR		
Allyl chloride	41 NA	Test		
	61 NA	G		G-100
Benzaldehyde	41 NA	Test		
	61 NA	E	F	NR-212
Benzene	41 NA	E	E	
	61 NA	E	G	
Benzenesulfonic acid	41 NA	E	E	
	61 NA	E	E	
Benzenesulfonyl chloride	41 NA	E		
	61 NA	E		
Benzyl dichloride	41 NA	E	E	G-233
	61 NA	E	E	G-233

(continued)

TABLE 1.53: PHENOL-FORMALDEHYDE AND FURFURYL ALCOHOL-FORMALDEHYDE RESINS—AMETEK, HAVEG DIVISION (continued)

Chemical Service	Grade	80°F	160°F	Maximum Temperature °F
Benzotrichloride	41 NA	E	NR	
	61 NA	E	NR	
Benzoyl chloride	41 NA	E	NR	
	61 NA	G	F	
Benzyl alcohol	41 NA	Test		
	61 NA	E		E-140
Benzyl chloride	41 NA	E	G	
	61 NA	E		E-140
Boric acid	41 NA	E	E	E-300
	61 NA	E	E	E-300
Bromine, 3% maximum	41 NA	E	E	E300
	61 NA	E	E	E-300
n-Butyl alcohol	41 NA			NR-212
	61 NA	E	E	E-212
n-Butyl chloride, sec-butyl chloride	41 NA	Test		
	61 NA	E	E	
n-Butyric acid	41 NA	E	E	G-266
	61 NA	E	E	G-266
Calcium chloride	41 NA	E	E	E-300
	61 NA	E	E	
Calcium hypochlorite	41 NA	NR		
	61 NA	NR		
Carbon disulfide	41 NA	E	E	
	61 NA	E	E	
Carbon tetrachloride	41 NA	E	E	E-212
	61 NA	E	E	G-212
Chloral	41 NA	E	E	
	61 NA	E	E	
Chloral, 32% and MCB, 64%	41 NA			G-257
	61 NA	E	E	E-257
Chloral, 40% and MCB, 59%	41 NA		F	NR-203
	61 NA	E	E	E-203
Chloral hydrate	41 NA	G	G	
	61 NA	E	G	
Chlordane	41 NA	E	E	
	61 NA	Test		
Chlorine (wet or dry)	41 NA	G	G	
	61 NA	NR		
Chlorine water	41 NA	G	G	F-200
	61 NA	G	F	NR-200
Chloroform	41 NA	E	E	
	61 NA	NR		
Chlorophenol	41 NA	E	G	NR-212
	61 NA	G	NR	
Chlorosulfonic acid	41 NA	E	NR	
	61 NA	Test		
Chromic acid 30%	41 NA	NR		
	61 NA	NR		
Chromic acid, 10%	41 NA	NR		
	61 NA	NR		
Chromic acid, 2% (with sulfuric acid)	41 NA	NR		
	61 NA	NR		
Copper sulfate	41 NA	E	E	E-300
	61 NA	E	E	E-300
Cupric chloride	41 NA	E	E	E-300
	61 NA	E	E	E-300
Cyanogen chloride	41 NA	E	E	
	61 NA	Test		
Cyanuric acid	41 NA	E	E	
	61 NA	E	E	
Dibutyl ether	41 NA	E	E	E-212
	61 NA	E	E	E-212
Dibutyl phthalate	41 NA	E	E	E-212
	61 NA	E	E	E-212
Dibutyltin dichloride	41 NA	E	E	
	61 NA	E	E	
Dichlorobenzene	41 NA	E	E	G-212
	61 NA	E	E	E-212
Dichlorophthalic acid, 50%	41 NA	E	E	E-212
	61 NA	E	E	E-212
Diethylamine	41 NA	NR		
	61 NA	NR		
Diethyl ether	41 NA	G		
	61 NA	E		
Diethylketone	41 NA	E	E	G-212
	61 NA	G	G	G-212
Diethylene glycol	41 NA	Test		
	61 NA	E	E	E-230
Diisobutyl ketone	41 NA			F-212
	61 NA			G-212
Dimethyl phthalate	41 NA	E	E	E-212
	61 NA	E	E	E-212
Epichlorohydrin	41 NA	NR		
	61 NA	NR		
Ethyl acetate	41 NA	Test		
	61 NA	G	G	
Ethyl alcohol	41 NA	F	NR	
	61 NA	E	G	

(continued)

TABLE 1.53: PHENOL-FORMALDEHYDE AND FURFURYL ALCOHOL-FORMALDEHYDE RESINS—AMETEK, HAVEG DIVISION (continued)

Chemical Service	Grade	80°F	160°F	Maximum Temperature °F
Ethyl chloride	41 NA	E	E	
	61 NA	Test		
Ethyl chloroformate	41 NA	NR		
	61 NA	E	E	
Ethyl ether	41 NA	Test		
	61 NA	E		
Ethylene dichloride	41 NA	E	E	G-182
	61 NA	F	NR	
Ethylbenzene	41 NA	Test		
	61 NA	E	E	E-212
Ethylene glycol	41 NA	G	NR	
	61 NA	E	E	
Ferric chloride, 50%	41 NA	E	E	E-300
	61 NA	E	E	
Ferrous chloride, 40%	41 NA	E	E	E-300
	61 NA	E	E	
Formaldehyde, 37%	41 NA	E	E	E-212
	61 NA	E	G	NR-212
Formamide, 90%	41 NA	Test		
	61 NA		G	
Formic acid, 90%	41 NA	E	E	E-300
	61 NA	E	E	G-300
Furfural	41 NA	NR		
	61 NA	E	NR	
Furfuyl alcohol	41 NA	Test		
	61 NA	G	F	NR-212
Gasoline	41 NA	E	G	
	61 NA	E	E	
Glycerin	41 NA	E	E	
	61 NA	E	E	
n-Heptane	41 NA	E	E	E-212
	61 NA	E	E	E-212
Hydrobromic acid, 42%	41 NA	E	E	E-212
	61 NA	E	E	E-212
Hydrochloric acid, 100%	41 NA	E	E	E-300
	61 NA	NR		
Hydrochloric acid, 37%	41 NA	E	E	E-300
	61 NA	G	F	
Hydrochloric acid 32%	41 NA	E	E	E-300
	61 NA	G	G	
Hydrochloric acid, 20%	41 NA	E	E	E-300
	61 NA	E	E	E-212
Hydrocyanic acid	41 NA	E	E	
	61 NA	E	E	
Hydrofluoric acid, 38.0-49.8%	41 NA	NR		
	46	E	E	E-235
Hydrofluoric acid, 70%	41 NA	NR		
	46	G		G-140
Hydrogen peroxide	41 NA	NR		
	61 NA	NR		
Hydrogen sulfide	41 NA	E	E	E-300
	61 NA	E	E	
Hydroiodic acid, 58%	41 NA	E	E	F-212
	61 NA	F	NR	
Hydroiodic acid, 20%	41 NA	E	E	E-212
	61 NA	E	E	E-212
Hypophosphorous acid	41 NA	E	E	
	61 NA	E	E	NR-212
Iodine	41 NA	NR		
	61 NA	NR		
Iron iodide	41 NA	E		
	61 NA	E	E	G-212
Isoamyl alcohol	41 NA	E	F	
	61 NA	E	E	G-212
Isopropyl alcohol	41 NA	E	G	
	61 NA	E	E	
Isopropyl ether	41 NA	Test		
	61 NA	E	E	
Lactic acid, 80%	41 NA	E	E	NR-212
	61 NA	E	E	G-212
Lauryl chloride	41 NA	E	E	E-212
	61 NA	E	E	E-212
Lead acetate	41 NA	E	E	E-300
	61 NA	E	E	E-300
Levulinic acid	41 NA	G	NR	
	61 NA	G	NR	
Maleic acid	41 NA	E	G	F-212
	61 NA	E	E	E-212
Metaphosphoric acid	41 NA	E	E	E-300
	61 NA	E	E	E-300
Methallyl chloride	41 NA	G	F	
	61 NA	E	E	
Methyl alcohol	41 NA	G		G-140
	61 NA	G		G-140
Methyl acetate	41 NA	NR		
	61 NA	E	E	
Methyl chloride	41NA	E	E	E-300
	61 NA	Test		
Methylchloromethyl ether	41 NA	NR		
	61 NA	NR		
Methyl ethyl ketone	41 NA	NR		
	61 NA	G	F	
Methyl isobutyl ketone, 50%	41 NA	NR		
	61 NA	E	G	

(continued)

TABLE 1.53: PHENOL-FORMALDEHYDE AND FURFURYL ALCOHOL-FORMALDEHYDE RESINS—AMETEK, HAVEG DIVISION (continued)

Chemical Service	Grade	80°F	160°F	Maximum Temperature °F
Methyl isobutyl ketone, 100%	41 NA	NR		
	61 NA			G-212
Methylene chloride	41 NA	G		
	61 NA	G		
Monochloroacetic acid	41 NA	Test		
	61 NA	NR		
Monochloroacetone, 10%	41 NA	Test		
	61 NA		G	
Monochlorobenzene	41 NA	E	E	E-212
	61 NA	E	E	E-212
Monoethanolamine, 20%	41 NA	Test		
	61 NA			G-194
Monoethanolamine, 50%	41 NA	Test		
	61 NA			F-212
Monosodium methyl arsenate	41 NA	E	E	E-233
	61 NA	E	E	E-233
Naphthylene	41 NA	E	E	E-300
	61 NA	E	E	E-300
Nitric acid, 2% maximum (with sulfuric acid not recommended)	41 NA	E	E	
	61 NA	G	NR	
Nitrilotriacetic acid	41 NA	NR		
	61 NA	NR		
Nitrobenzene	41 NA	E	G	F-212
	61 NA	E	E	NR-212
Nitrophenol	41 NA	E	E	F-212
	61 NA	E	E	E-265
n-Octyl alcohol	41 NA			F-212
	61 NA	E	E	E-212
n-Octyl chloride	41 NA	E	E	E-212
	61 NA	E	E	E-212
Oleic acid	41 NA	E	E	E-265
	61 NA	E	E	G-265
Oxalic acid, 20%	41 NA	E	G	G-200
	61 NA	E	E	E-200
Paraffin	41 NA	E	E	E-212
	61 NA	E	E	E-212
Pentachloroethane	41 NA	E	E	E-212
	61 NA	E	G	G-212
Pentanedione	41 NA	NR		
	61 NA	G	F	
Perchloroethylene	41 NA	E	E	E-212
	61 NA	E	E	E-212

Chemical Service	Grade	80°F	160°F	Maximum Temperature °F
Phenol, 100%	41 NA	NR		
	61 NA	NR		
Phenol, 85%	41 NA	G	F	NR-212
	61 NA	NR		
Phenol, 9%	41 NA	E	G	F-212
	61 NA	G	NR	
Phenol, 6%	41 NA	E	E	G-212
	61 NA	E	F	NR-212
Phenyl ether	41 NA	NR		
	61 NA	E	E	
Phosgene	41 NA	E	E	
	61 NA	Test		
Phosphoric acid, 50%	41 NA	E	E	E-212
	61 NA	E	E	E-212
Phosphorous oxychloride	41 NA	G	G	G-212
	61 NA	E	E	G-212
Phosphorous trichloride	41 NA	E	E	E-300
	61 NA	E	E	E-300
Potassium bisulfate	41 NA	E	E	E-300
	61 NA	E	E	E-300
Potassium cyanide	41 NA	F		
	61 NA	E	E	E-212
Potassium dichromate, 5%	41 NA	F		
	61 NA	F		
Potasssium permanganate	41 NA	NR		
	61 NA	NR		
Propionic acid, 100%	41 NA	E	F	
	61 NA	E	F	
Propionic acid, 30%	41 NA	E	G	
	61 NA	E	E	E-212
Pyridine	41 NA	NR		
	61 NA	NR		
Resorcinol, 46%	41 NA	G	G	
	61 NA	G	G	
Sodium bisulfate	41 NA	E	E	E-300
	61 NA	E	E	E-300
Sodium bisulfite	41 NA	E	E	E-300
	61 NA	E	E	E-300

(continued)

TABLE 1.53: PHENOL-FORMALDEHYDE AND FURFURYL ALCOHOL-FORMALDEHYDE RESINS—AMETEK, HAVEG DIVISION (continued)

Chemical Service	Grade	80°F	160°F	Maximum Temperature °F
Sodium bromate, 20%	41 NA	E	E	
	61 NA	E	E	
Sodium carbonate	41 NA	NR		
	61 NA	E	E	E-212
Sodium cyanide	41 NA	G		
	61 NA	E	E	E-300
Sodium hydrogen sulfide	41 NA	NR		
	61 NA	E	E	
Sodium hydroxide	41 NA	NR		
	61 NA			
Sodium hypochlorite	41 NA	NR		
	61 NA	NR		
Sodium sulfate	41 NA	E	E	E-300
	61 NA	E	E	E-300
Sodium sulfite	41 NA	E	E	E-300
	61 NA	E	E	E-300
Sodium thiosulfate	41 NA	E	E	E-300
	61 NA	E	E	E-300
Spin bath solution, rayon	41 NA	E	E	E-300
	61 NA	E	E	E-300
Stearic acid	41 NA	E	E	E-212
	61 NA	E	E	E-212
Sulfur dioxide	41 NA	E	E	E-300
	61 NA	E	E	F-212
Sulfur trioxide	41 NA	E	E	E-300
	61 NA	Test		
Sulfuric acid, 96%	41 NA	E	NR	G-100
	61 NA	NR		
Sulfuric acid, 80%	41 NA	E	G	F-225
	61 NA	Test		
Sulfuric acid, 70%	41 NA	E	E	G-250
	61 NA	G	NR	
Sulfuric acid, 50%	41 NA	E	E	E-300
	61 NA			G-212
Sulfuric acid, 10%	41 NA	E	E	E-300
	61 NA	E	E	
Sulfurous acid	41 NA	E	E	
	61 NA	E	E	
Sulfuryl chloride	41 NA	NR		
	61 NA	NR		
Tall oil (crude)	41 NA	E	E	E-240
	61 NA	E	E	E-240
Tannic acid	41 NA	E	E	E-300
	61 NA	E	E	E-300
Tartaric acid, 50%	41 NA	E	E	
	61NA	E	G	

Chemical Service	Grade	80°F	160°F	Maximum Temperature °F
Terpenes	41 NA	Test	NR	
	61 NA	E	E	E-212
alpha-Terpineol	41 NA	Test	NR	
	61 NA	E	E	E-212
Tetrachloroethane	41 NA	E	E	G-212
	61 NA	E	E	
Tetrahydrofurfuryl alcohol	41 NA	E	NR	
	61 NA	E	E	F-212
Thionyl chloride	41 NA	E		
	61 NA	NR		
Toluene	41 NA	E	E	E-212
	61 NA	E	E	E-212
Toluene sulfonic acid	41 NA	E	E	G-212
	61 NA	E	E	NR-212
Trichloroacetic acid, 30%	41 NA	G		NR-212
	61 NA	G		
Trichlorobenzene	41 NA	E	E	E-300
	61 NA	E	E	E-300
Trichloroethylene	41 NA	E	E	G-188
	61 NA	E	E	
Triethanolamine, 50%	41 NA	Test		
	61 NA	E	E	
Trimethyl acetic acid	41 NA	Test		
	61 NA	E	E	
Trimethylamine	41 NA	E		
	61 NA	E		
Trimethyl phosphate	41 NA	NR		
	61 NA	E	E	G-244
Tungstic acid	41 NA	E	E	E-300
	61 NA	G	G	
Xylene	41 NA	E	G	
	61 NA	E	E	
Zinc chloride	41 NA	E	E	E-300
	61 NA	E	E	
Zinc sulfate	41 NA	E	E	E-300
	61 NA	E	E	E-300

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND

RESIN SERIES	CHARACTERISTICS	SUGGESTED APPLICATIONS
HETRON 92	Maximum fire retardancy. Class I flame spread can be achieved. Good corrosion resistance.	Primarily for severe fume handling equipment to 250°F.
HETRON 197	Halogenated polyester. Maximum corrosion and heat resistance. Class I or II flame spread can be achieved.	All equipment where maximum corrosion and heat resistance are required – intermittent service to about 600°F; continuously in 350°F range. Excellent for hot wet chlorine and other highly oxidizing environments.
HETRON 72	Similar to HETRON 197 series.	General corrosion resistant equipment. Linings, coatings, toppings.
HETRON 700	Bisphenol-A Fumarate resins. Excellent corrosion resistance. Non-fire retardant.	All corrosion resistant equipment except fume handling systems to about 250°F. Ideal for caustic and hypochlorite.
HETRON 900	Vinyl ester resins. Non-fire retardant. Excellent corrosion resistance.	All equipment except fume handling systems to about 250°F.
AROPOL 7240 Series (Includes 7241 and 7242)	Isophthalic resins. Non-fire retardant. Moderate corrosion resistance.	All equipment except fume handling systems to about 180°F. AROPOL 7242 can be used for FDA applications.
AROPOL 7430 Series (Includes 7530 and 7532)	Resilient isophthalic resins. Non-fire retardant. Moderate corrosion resistance.	All equipment except fume handling systems to about 150°F. Excellent for filament winding applications.
HETRON 99P	Fire retardant/isophthalic with good corrosion resistance. Class I flame spread can be achieved.	For fume handling equipment to 250°F.

The following definitions will aid readers using this Guide.

Service Temperature — Temperature data is **not** necessarily the **maximum** service temperature. It is the upper temperature at which a specific resin has been satisfactorily tested or used.

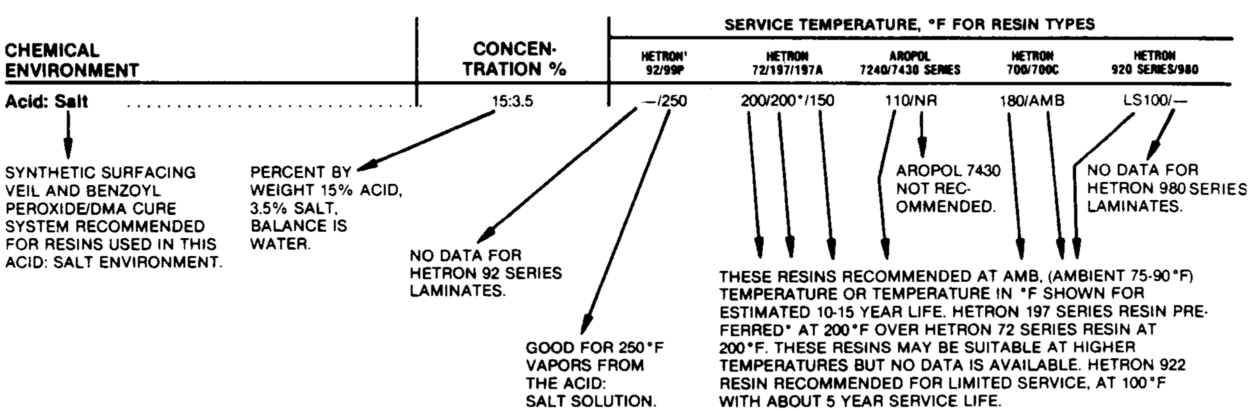
AMB — Refers to ambient temperature of 75-90°F.

Blank Space — Showing no service temperature recommendation indicates that insufficient resistance data was available. It **does not mean** that the resin is unsuitable for that environment.

Asterisks — Resins marked with an asterisk indicate that it is preferable to use this resin over another resin even though both are resistant at the temperatures listed in the Guide.

LS — Indicates that **limited service life** can be expected. This means that some chemical attack will occur but not enough to render the equipment useless.

NR — Resin is not recommended.



[1]HETRON 99P recommended for fume service only.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

List of Trademarks and Product Names

Trademark	Company
Adogen 442, 448	Sherex Chemical Co.
Aerosol	American Cyanamid Co.
Alipal	Chemical Div., GAF Corp.
Alodine	Amchem Products Inc.
Amchem	Amchem Products Inc.
Amerex	Drew Chemical Corp.
Amine Salt Solutions, 73973 M-A, M-B, M-C	W. R. Grace Co., Dewey & Almy Div.
Amsco BKOH Solvent	American Mineral Spirits Co.
Anthium Dioxide	International Dioxide Inc.
Apache	Wyandotte Chemical Co., J. P. Ford Div.
Armeen	Armak Co.
Arquad	Armak Co.
Bentec	Wyandotte Chemical Co., J. P. Ford Div.
Benzoflex: Brominex	Velsicol Chemical Corp.
Betz Sulfite 3	Betz Laboratories, Inc.
Biocide CWT-102	Drew Chemical Corp.
Bonderite	Oxy Metal Industries Corp., Parker Div.
Bowl Cleanse	Spartan Chemical Co., Inc.
Build	Colgate-Palmolive Co.
C-56	Hooker Chemicals & Plastics Corp.
Calgon	Calgon Corp.
Carbitol	Union Carbide Corp.
Cellosolve	Union Carbide Corp.
Cell Putty	Rowe Products Co.
Chem-Rez C-2006, C-2009, C-2075	Ashland Oil, Inc.
Chlorothene	Dow Chemical Co.
Citrex	Peabody Engineered Systems
Cleaner 508	Quaker Chemical Co.
CWT 102	Drew Chemical Corp.
Cyaf	American Cyanamid Co.
Cygon	American Cyanamid Co.
Darex	W. R. Grace Co., Dewey & Almy Div.
Dazad	W. R. Grace Co., Dewey & Almy Div.
DFR-121	Arapahoe Chemicals
Dicrobe	Huntington Laboratories
Diversey	Diversey Chemical Co.
Dowclene	Dow Chemical Co.
Drewsperse	Drew Chemical Corp.
Durez	Hooker Chemicals & Plastics Corp.
DW-875	Staley Chemical Co.
Dynel	Union Carbide Corp.
Electrasol	Economics Laboratory, Inc.
Elvase	Union Carbide Corp.
EP 52-A65	Ashland Oil, Inc.
Eptam	Stauffer Chemical Co.
Erional NW	Ciba-Geigy Corporation
EVA	Union Carbide Corp.
Exalt	Pennwalt Corp.
FC195, 203, 206A	3M Co.
Fluorolubes	Hooker Chemicals & Plastics Corp.
Fusion 12-62	Buffalo Color Corp.
G-61	Rohm & Haas
Glass Cleaner	Spartan Chemical Co., Inc.
Globrite 15, X-200	Ashland Oil, Inc.
Golden Glo	Spartan Chemical Co., Inc.
Halso 99	Hooker Chemicals & Plastics Corp.
Igepal	Chemical Div., GAF Corp.
Irgasol DA	Ciba-Geigy Corporation
Isocure	Ashland Oil, Inc.
Isoprep	The Richardson Co.
JM-235, JM-271	Johns-Manville
Kymene	Hercules Powder Co.
Lasso	Monsanto Co.
Lix 64N	General Mills Chemicals, Inc.
Magnifloc	American Cyanamid Co.
Matar	Huntington Laboratories
Mulsoline	Dye & Chemical Co. of Canada, Ltd.
Neodol	Shell Chemical Co.
Oakite	Oakite Products, Inc.
Olin	Olin Chemical
190 D	BASF Wyandotte Corp.
OPM-1, OPM-2	Olin Chemical
Parco	Oxy Metal Industries Corp., Parker Div.
Parco Cleaner	Oxy Metal Industries Corp., Parker Div.
Pax Hyspeed	G. H. Packwood Mfg. Co.
PD 64	Spartan Chemical Co., Inc.
Pep Set	Ashland Oil, Inc.
Plus 5	Spartan Chemical Co., Inc.
Polyco	Borden Co.
Polywet	Uniroyal, Inc.
Raylene	Wyandotte Chemical Co., J. P. Ford Div.
Richamide	The Richardson Co.
Richonate	The Richardson Co.
RJ-4	Ashland Oil, Inc.
Sani-Fresh	Envair, Inc.
SD-20	Spartan Chemical Co., Inc.
Skydrol	Monsanto Co.
Softener B	Sherex Chemical Co.
SP-181	Tretolite Div., Petrolite Co.
Stackfas Mastic	H. B. Fuller Company
Telone	Dow Chemical Co.
Tergitol	Union Carbide Corp.
Textone	Olin Chemical
Thermolin	Olin Chemical
35 D	BASF Wyandotte Corp.
Tinofix QF	Ciba-Geigy Corporation
U-3400, U-7000	Staley Chemical Co.
Ultrawet	Atlantic Richfield
Variquat	Sherex Chemical Co.
Varisoft	Sherex Chemical Co.
Varox 185E	Sherex Chemical Co.
Varsol	Exxon Company
Vidden	Dow Chemical Co.
Vivo-Zyne	Gooch Feed Mill Corp.
Zimmite	W. E. Zimmite, Inc.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

HETRON® and AROPOL™ Resin Selection Guide for Corrosion Resistant RTP Applications

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON† 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Acetaldehyde	100	NR/—	NR	NR	NR	NR
Acetaldehyde, 1% in air	—	—/90	—	—	—	—
Acetaldehyde Fumes	<40 lbs/ft³	90	—	—	—	90
Acetic Acid	10	150	210	170/150	210/200	210/220
Acetic Acid	15	125	210	170/150	210/200	210/220
Acetic Acid	25	125	210	170/150	210/200	210/220
Acetic Acid	50	AMB/90	125	150/125	150	180
Acetic Acid	75	—	—	—	160/150	150/—
Acetic Acid, about 10% in Hydrocarbon, Liquor and Vapor	—	—	—	—	—	160-220
Acetic Acid, Glacial	100	—	100°/100/100	NR	NR	NR/—
Acetic Acid, Glacial	100 @ 120°F	—	LS/LS/NR	NR	NR	NR
Acetic: Glacial: 70% Nitric: 49% Hydrofluoric	3:5:1 @ 100°F	NR/—	NR	NR	—	NR
Acetic Acid: HCl	50:20	AMB/—	AMB	—	—	—
Acetic: HCl: H_2O	50:18.5:31.5	86	86	—	—	—
Acetic: H_2O_2	95:1.5	AMB	AMB	—	—	—
Acetic Acid: Sodium Dichromate	70:30	—	160	—	—	—
Acetic Acid Vapor	100 @ 212°F	NR/—	—	—	—	—
Acetic Acid, Vapor & Condensate	25	180/—	180	—	—	—
Acetic Anhydride	100	—	100	NR	AMB/NR	NR/—
Acetic Anhydride	100 @ 120°F	—	LS/LS/NR	NR	NR	NR
Acetone	10	—	—	NR	—	NR
Acetone	100	NR	NR	NR	NR	NR
Acetone	100 @ 133°F	NR	NR	NR	NR	NR
Acetone: Cyclohexane: Hexane: Water	10:10:1:79	NR	NR	150	—	—
Acetone: Water	10:90	—	—	—	—	—/150
Acetonitrile	100	—	—	—	—	NR
Acetophenone	100	—	AMB	NR	NR	NR
Acetyl Chloride	100	—	—	—	NR	—
Acetyl Chloride	100 @ 130°F	NR/—	NR	—	NR	—
Acid Rinse, Photographic	—	—	AMB	—	—	—
Acidic Gaseous Atmosphere, Saturated, Weak Phosphoric, Hydrofluoric, Sulfurous, Etc., at 3600 fpm³	—	—	90	—	—	—
Acids (Sulfuric, Phosphoric, Acetic), Soda Ash, Organic Salts, Dye Stuffs, 3-5% Solids, pH 2-5	Unknown	—	—/to 165°/—	—	to 165/—	to 165/—
Acrylamide	50	—	—/80/—	—	—	—
Acrylic Acid	100 @ 100°F	NR	NR	NR	NR	—
Acrylic Acid	25	—	100	—	AMB	AMB/100
Acrylic Acid	10	—	100	100°	100	AMB/100
Acrylic dispersion: Acrylonitrile	98:2	—	AMB	—	—	—
Acrylic dispersion: Vinylidene Chloride	98:2	—	AMB	—	—	—
Acrylic Emulsion	—	—	—	120/—	—	—
Acrylic, Glacial	100	—	90	—	—	—
Acrylic Spray Liner, Water Reducible at 120°F (PPG Industries)	—	—	—/—/NR	NR[16]	SAT	SAT/—
Acrylic, Styrene Emulsions† DW-875, U-3400, U-7001	—	—	AMB	—	—	—
Acrylic Wet Ink Varnish, Water Reducible at 120°F (PPG Industries)	—	—	—/—/NR	NR[15]	SAT	SAT/—
Acrylonitrile	100	NR/—	NR	NR	NR	NR
Activated Carbon Beds, Water Treatment	—	—	200	—	—	—
Adipic Acid, Adipyl Chloride and Hydrochloric Acid	Unknown	—	—	—	NR	—
Adipyl Chloride, Adipic Acid and Hydrochloric	Unknown	—	—	—	NR	—
Adogen† 381: Xylene	25:75	—	100/100/NR	—	—	—
Adogen 442	—	120/—	120°	120°/120	120	120/—
Adogen 448	—	120/—	120°	120°/120	120	120/—
Aerosol†, Wetting Agent	—	AMB/—	AMB	—	—	—
Air, Humid, Trace Sulfur Fumes	—	—	200	—	—	—
Air: Methyl Sulfide: Methanol; Small Amounts H_2O, H_2S, Methyl Mercaptan, Acetone, Turpentine	85:2.5:6	—	165	—	—	—
Alcohol, Ethoxylated, pH 8.5, C_{12}-C_{16}	100	—	120°	—	120	—

NR = Not recommended
BP = Boiling Point
AMB = Ambient Temperature, 75 - 90°F
Conc. = Concentrated
— = Insufficient information available
LS = Limited Service
Sat'd under CONCENTRATION = Saturated

SAT under SERVICE TEMPERATURE = Satisfactory
With reference to recommendations under specific resin headings:
150/150/— = First two materials sat. at 150°F, third material resistance unknown
100°/100 = Both materials satisfactory, first preferred, etc.
125° = Preferred material, although others are suitable at 125
100-150 = Temperature varied within limits shown

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Algaecide, phenate based	100	—	125	125/—	125	—
Alipal CO433†	28	—	100	—	100	—
Alkaline Film Stripper; Butyl Cellosolve: Monoethanol-Amine @ 138°F	57:30	NR/—	NR	NR	NR	NR/—
Alkaline Soak Cleaner	10 oz/gal	—	—	NR	180	180/—
Alkanolamide, Fatty Acid	—	—	100	—	—	—
Alkanolamide Nonionic Surfactant	55 amide	—	120	—	120	—
Alkyl Benzene Sulfonic Acid	100	—	100	—	—	—
Alkyl Dimethyl Benzyl Ammonium Chloride: Phosphoric Acid: Inerts	0.1:25:75	—	100	—	—	100/—
Alkyl Dimethyl Benzyl Ammonium Chloride: Tributyl Tin Chloride/Ethylene Oxide/Amine: Hydrochloric Acid: Inerts	0.1:0.1:23.77	—	100	—	—	100/—
Alkyl Ether Amine Oxide Surfactant	—	—	120	120	120	120/—
Alkylate, Substituted Benzene Type, Refinery	—	—	AMB/—/—	AMB/—	—	—
Alkylate Sulfonates, Linear	Conc.	—	100	—	—	—
Alkylation, Aromatic Hydrocarbon	Unknown @ 105-120°F	—	—	—	NR	—
Allyl Chloride	100	—	—	—	NR	NR/80
Almond Oil	100	NR/—	—	—	—	—
Alodine 401/45†, pH 2	—	—	120	—	—	—
Alpha Olefin Sulfonate	100	—	120	—	—	—
Alum	10	—	200	170/150	220/200	210/220
Alum	Sat'd	—	160	160/150	200/150	210/220
Alum, Potassium	5	—	125	160/130	160*	210/220
Aluminum Chloride	All	—/120	210	170/150	210/150	210/220
Aluminum Chloride: Fluosilicic Acid[3]	Slurry:2	—	210	—	—	—
Aluminum Chloride Spent Catalyst Solution, 1000 ppm Benzene @ 130°F	—	—	—	—	NR	—
Aluminum Chlorohydrate	50	—	165	—	200/150	—
Aluminum Chlorohydroxide	50	—	—	170/150	200/150	—
Aluminum Citrate	Sat'd	—	—	170/120	200/150	180/—
Aluminum Desmutter & Deoxidizer[3]	—	—	AMB	—	—	—
Aluminum Etchant, Phosphate Free[3]	5 oz/gal	—	—	165/—	165/150	165/—
Aluminum Fluoride[3]	All	AMB/90	AMB	AMB	AMB	AMB/—
Aluminum Hardening Fixing Bath, Photographic	—	—	80	—	—	—
Aluminum Hardening Rapid Fixing Bath, Photographic	—	—	80	—	—	—
Aluminum Hydroxide[3]	Sat'd	—	—	—	AMB	180/200
Aluminum Hydroxide[3]	20	—	—	150	AMB	180/200
Aluminum Nitrate	Sat'd	—	—	160/140	170/150	160/160
Aluminum Oxide Drying	—	—	220/290/—	—	—	—
Aluminum Oxide Wet with HCl, Drying	—	—	220/290/—	—	—	—
Aluminum Plating, Sulfuric, Sodium Dichromate	—	—	160	—	—	—
Aluminum Potassium Sulfate	All	—/160	210	170/150	170/150	210/220
Aluminum Potassium Sulfate, Vapor & Condensate	5	180/—	180	—	—	—
Aluminum Reduction Pot Plant Roofing and Siding	Fumes	130/—	—	—	—	—
Aluminum Sulfate	All	250	250	180/150	170/150	210/230
Aluminum Trichloride	40	—	210	—	—	—
Amchem 6-16†: Nitric	6:16	—	65-95	—	65-95	—
Amerex 201†	100	—	125	LS125	125	—
Amerex 209†	100	—	125	125	125	—
Amine Salt Solutions, 73973 M-A, M-B and M-C†	—	—	85	—	—	—
2-Aminoethanol	100	—	85	—	—	—
Aminoethoxy Ethanol @ 270°F	100	NR/—	NR	NR	LS/NR	NR/—
Aminoethyl Piperazine	100	—	NR	NR	NR	NR/—
Ammonia, Dry	Gas	90	90	AMB/—	90	100/180
Ammonia, Liquid	100	NR/—	NR	NR	—	—
Ammonia, Wet	Gas	—/90	—	AMB/—	80/NR	100/150
Ammonia: Ammonium Nitrate: Hydrofluosilicic: Nitric: Phosphoric & Sulfuric, Wet Vapor[3]	15:5:2.5:2.5:Trace	—	250	—	NR	—

[1] HETRON 99P for fume service only
[2] Good test results after short exposure
[3] Synthetic surfacing veil recommended for maximum resistance
[4] Benzoyl Peroxide - Dimethyl aniline cure system recommended to assure satisfactory service
[5] Post-cure recommended
[6] Solution may discolor
[7] Nonthixotropic resins preferable
[8] Unsatisfactory as lining
[9] Acceptable as to odor and taste for AROPOL 7242 type resin. Steamed 4 hours with atmospheric steam prior to exposure
[10] Three 3 hour exposures to 30% nitric at 100°F to simulate cleaning
[11] No discoloration occurs at 5 ft²/gal. acid with AROPOL 7242 and HETRON 700 type construction if surfaces are acid or steam cleaned
[12] "C" veil only
[13] AROPOL 7240 only
[14] Appears to be erosion/corrosion
[15] AROPOL 7240 SAT at 120°F
†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON† 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Ammonia: Ammonium Sulfate: Sodium Chloride: Cupric Sulfate @ 195°F	1M:2M:500 ppm:0.1M	NR/—	—/LS/NR	—	SAT	SAT*/—
Ammonia Fortified Glass Cleaner	—	—	100	—	—	100/—
Ammonia: Nitric Fumes	—	—	AMB	—	—	—
Ammonia: SO_2 Scrubber Process	—	—	115	—	—	—
Ammonia: SO_2 Vapor	0.02:0.6 by vol	—	120	—	—	—
Ammonium Acetate	50	—/NR	—	—	—	80/—
Ammonium Acid Sulfite: Ammonium Sulfite: Ammonium Sulfate	18:3:5	—	115	—	—	—
Ammonium Acid Sulfite: Ammonium Sulfite: Ammonium Sulfate: Solids	25:4:6:3	—	120	—	—	—
Sulfite: Ammonium Sulfate: Solids	20:5:5:2	—	115	—	—	—
Sulfite: Ammonium Sulfate: Solids	24:8:5:3, pH6	—	115	—	—	—
Sulfite: Ammonium Sulfate: Solids	19:7:5:2	—	AMB	—	—	—
Ammonium Benzoate	All	—	—	—	—	100/—
Ammonium Bicarbonate	10	—	—	—	120/NR	180/—
Ammonium Bicarbonate	15	130/140	130	130/NR	120/NR	180/—
Ammonium Bicarbonate	20	—	—	120/NR	120/NR	180/—
Ammonium Bicarbonate[3]	Sat'd	—/140	—	NR	120/NR	150/—
Ammonium Bisulfate: Sulfuric: Surfactant	6:30:10	—	110	—	—	—
Ammonium Bisulfite Liquor	—	—	195	—	—	—
Ammonium Carbonate	10	NR/—	NR	NR	AMB	180/100
Ammonium Carbonate	30	—	120	NR	AMB	100
Ammonium Carbonate[3]	Sat'd	—/120	—	NR	AMB/—	100
Ammonium Chloride	Sat'd	200	200	180/150	220/200	210/220
Ammonium Chloride: Ammonium Nitrate: Urea	2.5:20:38	—	AMB	—	—	—
Ammonium Citrate	Sat'd	—	—	120/—	180	150/—
Ammonium Fluoride[3]	All	—	150	AMB/—	120	100/—
Ammonium Fluoride[3]	10	—	—	—	—	150/—
Ammonium Fluoride: Ammonium Hydroxide: Ammonium Nitrate, Trace Organics[3]	62:165:2 gpl	—	84	—	NR	NR/—
Ammonium Hydroxide[3]	5	AMB/90	175	AMB/NR	180	180
Ammonium Hydroxide[3]	10	AMB/90	175/175/AMB	AMB/NR	150	160/180
Ammonium Hydroxide[3]	20	NR	150	AMB/NR	150	150
Ammonium Hydroxide[3]	28	—	AMB	AMB/NR	100	125/—
Ammonium Hydroxide @ 125°F	28	—	—	LS/NR	SAT	SAT/—
Ammonium Hydroxide[3]	30	—	AMB	NR	100/—	—
Ammonium Hydroxide: Ammonium Fluoride: Ammonium Nitrate, Trace Organics[3]	165:62:2 gpl	—	84	—	NR	NR/—
Ammonium Hydroxide: Trace Quinoline, <½ % HF, F, NaOH, Nitrates, pH 7-10	4	—	—/80-160/—	—	—	—
Ammonium Lauryl Sulfate	100	—	130*	130*/—	130	130*/—
Ammonium: Manganese Sulfates, pH5	158:13 gpl	125*/—	125	125*	—	—
Ammonium: Manganese Sulfates: Sulfuric, pH2	135:13:40 gpl	125*/—	125	125*	—	—
Ammonium Metatungstate, pH 3.3 @ 180°F	50% WO_3	—	—/LS/—	—	LS/—	LS/—
Ammonium Nitrate	Sat'd	200	200	160/150	220/200	210/220
Ammonium Nitrate-fluoride nuclear waste solution[3]	—	—	100*	—	100	100/—
Ammonium Nitrate: Urea: Ammonium Chloride	20:38:2.5	—	AMB	—	—	—
Ammonium Nitrate: Urea: Water	10:40:50	—	—	—	—	120/—
Ammonium Nitrate: Urea: Water	30:20:50	—	—	—	—	120/—
Ammonium Nitrate: Urea: Water	44:35:21	—	120	—	—	—
Ammonium Orthophosphate, di-H	Unknown	—	200	—	—	—
Ammonium Persulfate	Sat'd	150	150	NR	180	180
Ammonium Phosphate, Dibasic	Sat'd	150	150	NR	180	210
Ammonium Phosphate, Monobasic @ 225°F	65	NR	—/LS/NR	170/150	180/AMB	210
Ammonium Salt of Primary Alcohol Glycol Ether Sulfate	100	—	100	—	—	—
Ammonium Sulfate	Sat'd	200	220	170/140	220/180	210/220
Ammonium Sulfate: Ammonia: Sodium Chloride: Cupric Sulfate @ 195°F	2M:M:500 ppm:0.1M	NR/—	—/LS/NR	—	SAT	SAT*/—
Ammonium Sulfate: Diammonium Phosphate	10:10	—	—	AMB	—	—
Ammonium Sulfate: Ferric Sulfate	10.5:20	180/—	180	—	—	—
Ammonium Sulfate: Manganese; SO_2 (Trace)	125:12 gpl	—	—/100*/100	—	100/—	—
Ammonium Sulfate: Sulfuric Acid: Manganese, pH9	125:30:13 gpl	—	—/100*/100	—	100/—	—
Ammonium Sulfate: Thiosulfate: Thiocyanate: Water	2.3:5.5:4:88	—	130/110/—	130*/110	130/110	130*/—
Ammonium Sulfide	25	—	120	—	AMB	100/—
Ammonium Sulfide	Sat'd	—	—	—	AMB	—
Ammonium Sulfite	10	—	—	—	—	100/—
Ammonium Thiocyanate	20	—	158-203	170/150	210/—	210/—
Ammonium Thiocyanate	Sat'd	—/120	180	120	AMB	120/—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Ammonium Thiocyanate: Hydrochloric Acid	Unknown	—	180	—	—	—
Ammonium Thiocyanate: Thiosulfate: Sulfate: Water	4:5.5:2.3:88	—	130/110/—	130*/110	130/110	130*/—
Ammonium Thiosulfate	60	—/NR	180	NR	—	100/—
Ammonium Thiosulfate: Thiocyanate: Sulfate: Water	5.5:4:2.3:88	—	130/110/—	130*/110	130/110	130*
Ammonium Tungstate	Sat'd	—	—	—	—	—
Amsco BKOH Solvent†	100	—	100/100/—	100*/—	LS/NR	100
Amyl Acetate	All	AMB/90	AMB	NR	NR	NR/100
Amyl Acetate @ 120°F	100	NR	NR	NR	NR	NR/—
Amyl Alcohol	All	200	200	100/NR	160/120	100/200
Amyl Alcohol	Vapor	140/—	140	140	140	—
Amyl Chloride @ 120°F	100	NR	—/LS/NR	NR	NR	NR/SAT
Anaerobic Sewage	—	85	85	85	85	85
Aniline	100	NR/—	125	NR	NR	NR/—
Aniline Hydrochloride	100	—	—	—	180/—	150/180
Aniline Hydrochloride, Substituted: HBr: HCl: Br_2: H_2O	15:4.5:1.5:1:78	—	140/140/LS140	—	140	140*/—
Aniline Sulfate	Sat'd	200/150	200	NR	225/220	180/220
Anionic Polyelectrolytes, Blend	100	—	125	LS125/NR	125	—
Anionic Surfactant	58	—	120*	—	120	—
Anodizing Solutions	—	—	AMB	—	—	—
Anthium Dioxide†	Conc.	—	100	—	—	—
Anthracene Oil	6	AMB/—	AMB	AMB	—	—
Anthraquinone Disulfonic Acid @ 150°F	1	—	—/SAT/NR	SAT/—	NR	SAT/—
Antimony Pentachloride	100	AMB/90	AMB	AMB	AMB	80/—
Antimony Trichloride	Sat'd	200/180	200	160/150	AMB	200/220
Apache†	50	—	150	—	—	—
Apple Acid	10	—	95	—	—	—
Aqua Regia (Conc. Hydrochloric: Conc. Nitric, 3:1)	Conc.	—	130*	NR	130/NR	NR
Aqua Regia	Conc. @ 160°F	—	—	NR	NR	NR
Aqua Regia Fumes	Conc.	AMB/—	AMB	NR	—	—
Armeen C†	Conc.	—	120	NR	NR	—
Armeen DMCD†	Conc.	—	120	120	120	—
Aromatic Hydrocarbon Alkylation	—	—	120	—	NR	—
Aromatic Solvent: Tributyl Phosphate	65:35	—	AMB	—	—	—
Arquad C/50†	Conc.	—	120	120	120	—
Arsenic Acid	All	—	—	—	—	80/—
Arsenous Acid	19° Be	180	180	AMB/—	180	180/—
Asphalt	—	—	—	195/—	—	—
Atmosphere, Chemical Plant	—	100/—	100	100	100	100
Atmosphere, Coal Dust	—	100/—	100	100	100	100
Atmosphere, 100% Relative Humidity	—	120/—	120	120	120	120
Azelaic Acid	Sat'd	—	AMB	—	—	—
"B" Crude Oil	—	—	—	AMB	—	—
Bactericide Phenate Based	100	—	125	125	125	—
Barium Acetate	Sat'd	—/NR	180	NR	180	190/—
Barium Carbonate[3]	All	200/180	200	LS180/NR	200	210/220
Barium Chloride	All	200	200	180/150	200	210/—
Barium Hydroxide[3]	10	NR/—	—	LS:AMB/NR	200/150	150/160
Barium Hydroxide[3]	Sat'd	NR/—	—	NR	150	150/—
Barium Sulfate	All	—/150	180	170/150	160	210/—
Barium Sulfide[3]	Sat'd	—/NR	—	NR	150/—	180/—
Beer	—	NR	NR	AMB	AMB/NR	AMB/NR
Beer, Brewing Kettle Fumes	—	150/—	150	150	—	—
Beet Sugar Liquor	—	—	—	—	—	180/—
Bentect†[2]	50	—	180	—	—	—
Benzal Chloride	100	—	—	NR	—	NR/—
Benzaldehyde	100	NR/—	NR	NR	NR	NR/—
Benzene	100	AMB/90	AMB	LS:AMB/NR	NR	NR/100
Benzene @ 120°F	100	NR/—	NR	NR	NR	NR
Benzene @ 200°F	100	NR/—	LS	NR	NR	NR
Benzene, HCl (trace), Water	Vapors	—	176	—	—	—
Benzene & Hydrogen Chloride Vapors	—	—	85	—	—	—
Benzene, Vapor	—	AMB/—	AMB	AMB	—	—
Benzene, Wet Acid (HCl)	—	AMB/—	AMB	—	—	—
Benzene: Ethyl Benzene	1/3:2/3	—	100	—	—	—
Benzene Disulfonic Acid	100	—	194	—	—	—
Benzene Sulfonic Acid	30	180	200	150/NR	200	210/220
Benzene Sulfonic Acid	100 @ 180°F	NR/—	NR	NR	—	SAT
Benzene Sulfonic Acid	Sat'd	AMB/90	100	NR	200	210/220
Benzene Sulfonic Acid: Sulfuric: Water	88:7:5	—	140*	140	140	140/—
Benzoflex 9.88†	100	—	120*	120	120	120/—
Benzoic Acid	Sat'd	250	250	170/150	220/200	210/—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Benzoic Anhydride	100	—	AMB	—	—	—
Benzotrichloride	100	NR/—	—	NR	—	NR/—
Benzoyl Benzoic Acid (0)	All	—	—	—	—	210/—
Benzoyl Chloride	100	NR/—	NR	NR	NR	NR/—
Benzoyl Chloride Vapors with HCl, H_2O, Benzoic Acid	Unknown @ 194-221°F	NR	—	—	—	NR/—
Benzyl Alcohol	100	—/NR	—	NR	AMB/NR	NR/80
Benzyl Benzoate	100	—	—	—	—	—
Benzyl Chloride	100	NR/—	NR	NR	NR	NR/80
Betz Sulfite 3†, pH 5.5	—	—	200	—	200	—
Biocide† 207	100	—	125	125	125	—
Biocide† 285 @ 125°F	100	—	LS/LS/NR	SAT	SAT	—
Biocide: Chlorophenate, Organic Sulfur Type	100	—	125	125	125	—
Biocide; Chlorophenol, Methylene Thiocyanate Blend @ 125°F	100	—	LS/LS/NR	SAT	SAT	—
Biodegradable, All Purpose Liquid Cleaner	—	—	100	100	100	100/—
Biodegradable Detergent, Liquid	—	—	100	100	100	100/—
Biodegradable Detergent Ultrawet† 60K	100	—	150	—	—	—
Biodegradable Detergent Ultrawet† 45DS	100	—	130	—	—	—
Biodegradable Detergent Ultrawett† 60L	100	—	100	—	—	—
BKOH, Amscot†, Solvent	100	—	100/100/—	100*/—	LS/NR	100/—
Black Chrome Bath: Chromic, Acetic, Barium, Acetate	—	—	115	—	—	—
Black Liquor, pH > 7	—	NR/—	—	NR	220/180	210/220
Black Liquor Recovery Furnace Gases @ 240-325°F	—	NR	—/SAT/NR	NR	NR	NR/SAT
Black Liquor Room Flooring, Spills	—	—	—	—	AMB	—
Black Liquor, Spent Sulfite, Calcium Base Mill pH 1.5-2 (Trace Formic & Acetate)	@ 212°F	—	—	—	NR	—
Blanch, Peanut, Hot Water, Detergent @ 160°F	—	—	—	—	NR	—
Bleach, Ferricyanide with K Bromide for Photography	—	—	80	—	—	—
Bleach Reactor - 6% Sodium Hypochlorite[4]	—	NR/—	140	NR	—	—
Bleached Pulp	—	—	190	—	—	—
Blow Gas Absorber	—	—	—	—	—	120/—
Bonderite† 73[3]	—	—	185	—	—	—
Bonderite† 722-C[3]	—	—	120	—	—	—
Bonderite† K-710-0, 701-P	—	—	100	—	—	—
Bonderite† K-761, pH 5-6	—	—	120	—	—	—
Bonderite† 37, 37S, 39[3]	—	—	150	—	—	—
Bonderite† 721-S[3]	—	—	85	—	NR	—
Bonderite† 1303 Make-up	—	—	NR	—	100	100*/—
Bonderite† 1303 Replenishing	—	—	NR	—	100	100*/—
Borax	Sat'd	—	167/180/167	180/140	220/140	210/—
Bordeaux Mixture	—	—	140	—	—	—
Boric Acid	Sat'd	—/180	200	180/150	200	210/220
Boric Acid: Nickel Chloride: Nickel Sulfate	8:12:53 oz/gal	—	180	—	—	—
Boric Acid: Sodium Sulfate with 0.25% Sulfuric Acid, 0.03% H_2O_2, 100 ppm Iron, 3000 ppm Chloride, Temperature Cycled[*]	15:25	—	—/206/206	—	—/206	206*/—
Bottle Washer Solution	5-10	—	—	—	—	170/—
Bowl Cleanse†	—	—	100	—	—	100/—
Bowl Cleanse, Mild†	—	—	100	100	—	100/—
Brake Fluid	100	—	—	—	—	NR/120
Brass Plating Solution 3% Copper: 1% Zinc and 5.6% Sodium Cyanides, 3% Sodium Carbonate[3]	—	—	180	—	180*	180/—
Brew Kettle Fumes	—	150/—	150	150	—	—
Brine, Cl, Sat., pH 2	300-310 gpl	—	220	NR	212/200	210/220
Brine, Dechlorinated; pH 2-3, Free Chlorine (Traces) @ 200-220°F	Sat'd	—	SAT	—	—	NR[3]/—
Brine, Salt	Sat'd	180	220	180/150	200	210/220
Broke Chest Fumes	—	SAT/90	SAT	—	—	—
Bromine, Dry Gas	100	AMB/90	AMB	NR	AMB	80/100
Bromine Fumes	—	140/—	140	NR	—	AMB/100
Bromine, Liquid	100	NR/—	NR	NR	NR	NR
Bromine Water	Sat'd @ 75°F	—	—	NR	—	SAT
Bromine: Water	5:95	—	—	—	—	180/200
Bromine, Wet Gas	100	AMB/90	AMB*	NR	—	80
Bronze Plating, 4% Copper, 5% Sodium Cyanides, 3% Sodium Carbonate, 4.5% Rochelle Salts	—	—	—	—	—	180/—
Brown Stock Washer Hoods, Ducts	—	SAT/—	SAT	—	SAT	—

†See list of trademarks and product names

[*]*HETRON 197 and 700 series resins appear to be unsuitable under cyclic conditions with some crazing but are resistant under static conditions.*

[']*Dissolved solids, 1574-2183 ppm: PO_4, 0.25 ppm: total PO_4, 1.3 ppm: Cu, 0.7 ppm, Zn, 3.4 ppm, Fe, 1.8 ppm: $CaCo_3$ 450 ppm max.; Chromate, hexa, 18-22 ppm. Cl_2 residual, 0.2-0.45 ppm: NaCl, 527-702 ppm.*

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON' 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Build† Detergent Solution, pH 9-10	10-12% Solids	—	120*	—	120	120/—
Butadiene Latex	—	—	—	80/—	—	—
2-Butoxyethanol	100	—	85	—	—	—
2,2-Butoxyethoxyethanol	100	—	85	—	—	—
Butyl Acetate	100	AMB/90	AMB	LS.AMB/NR	AMB	NR
Butyl Alcohol: Ethyl Hexylacetate: Di-Isobutyl Ketone	5:10:85	—	80	—	—	—
Butyl Alcohol, Normal	100	—/90	100	80/NR	100/NR	80/120
Butyl Alcohol, Secondary	100	—90	100	80/NR	—	80/120
Butyl Alcohol, Tertiary	100	—/190	100	80/NR	—	80/120
Butyl Carbitol†	100	—	85	—	—	NR/100
Butyl Cellosolve†	100	—/90	85	85/—	220/150	210/—
Butyl Cellosolve†: Monoethanolamine Film Stripper @ 138°F	57:30	NR/—	NR	NR	NR	NR/—
Butyl Ether	100	80/—	80	80*/—	80	80* —
Butyl Ether: Phosphoric: Hydrochloric	Unknown	—	AMB	—	—	—
Butyl Phthalate	100	—	100	—	—	—
Butylamine	100 @ 75°F	—	—	—	NR	—
Butylene Glycol	100	—/160	120	160/140	200/120	160/180
Butylene Oxide	100	NR/—	NR	NR	NR	NR/—
Butyric Acid	25	120/150	120	120	120	210/—
Butyric Acid	50	—/150	—	150/130	200/150	160/—
Butyric Acid	70	—/150	AMB	150/—	150	160/—
Butyric Acid	100	AMB/—	AMB	NR	AMB	NR/100
C-56†	100	—	200	—	NR	—
C-56†, Crude	—	—	180	—	—	180/—
C-56†; High Purity	100	90/—	90	—	—	—
C-56†; Reg. & High Purity Wet With H_2O	99+	90/—	90	—	—	—
Cadmium Cyanide Plating Bath, (3% Cadmium Oxide; 10% Sodium Cyanide; 1.2% Sodium Hydroxide)[3]	—	—	NR	NR	220/200	210/220
Calcium Bisulfide	Sat'd	—	—	160/—	—	—
Calcium Bisulfite	Sat'd	—/170	—	170/110	180	180
Calcium Carbonate[3]	Sat'd	—/160	—	160/140	210	210/220
Calcium Carbonate, 90%; Magnesium Hydroxide, 10%; Nickel & Iron Hydroxides[3]	25	—	—	—/LS120	—	—
Calcium Chlorate	Sat'd	250/180	250	150/120	200	210/220
Calcium Chloride	Sat'd	250	250	180/150	225/220	210/220
Calcium Chloride, pH 5.5	55	—	—/278*/—	—	278/—	—
Calcium Chloride, pH 8.5	35	—	—/238/—	—	238/—	—
Calcium Chloride: Phosphoric Acid	25:10	—	100	—	—	—
Calcium Chloride: Sodium Chloride: Magnesium Chloride	10:12:2	—	150	—	—	—
Calcium Hydroxide[3]	15	—/160	—	180/90	180	180/—
Calcium Hydroxide[3]	25	—/160	—	160/90	160	—
Calcium Hydroxide[3]	Sat'd	—/160	175*/175/—	—	160	—
Calcium Hypochlorite[3,4]	Sat'd	—/100	120	120/—	120	160/180
Calcium: Magnesium: Sodium Chlorides	10:2:12	—	150	—	—	—
Calcium Nitrate	Sat'd	—/180	—	180/150	220/200	210/220
Calcium Oxide	Sat'd	—	150	—	—	—
Calcium Sulfate	Sat'd	250/200	250	180/150	220/200	210/220
Camphene, Chlorinated 68%: Xylene	90:10	—	122	—	—	—
Camphor	100 @75°F	—/NR	—	NR	—	—
Can Cleaner, Acidic, pH 1.2, Sulfuric & Hydrofluoric, Aluminum & Oil Impurities[3]	—	—	120	—	—	—
Can Treatment, Chrome-Free, pH 5-6	—	—	120	—	—	—
Can Treatment, Chrome Phosphate, pH 2	—	—	120	—	—	—
Cane Sugar Liquor	—	—	—	—	—	180
Canning Plant Waste	—	—	—	AMB	—	—
Capric Acid	Sat'd	—	—	160/120	160	NR/80
Capric Acid	5	—	—	160/120	160	180/200
Caprylic Acid	Sat'd	—/160	140	160/100	160	NR/80
Caprylic Acid	5	—/160	140	160/100	160	180/200
Carbamide	Sat'd	—	160	150/90	160/90	160/—
Carbon Beds, Water Treatment	—	—	200	—	—	—
CO_2: SO_2: N_2: O_2: H_2O Vapors	12:0.1:70:5:14 by vol	—	120	—	—	—
Carbon Dioxide, Wet, Acidic	100	250	250	200/150	250/200	210/300
Carbon Disulfide	100	NR	NR	NR	NR	NR
Carbon Disulfide Recovery Fumes	—	140	—	NR	—	—
Carbon Disulfide Vapor	25	NR/—	—	NR	—	—
Carbon Monoxide Gas	100	160/200	160	200/150	160	210/300
Carbon Tetrachloride	100	125/—	125*	LS:AMB/NR	NR	LS:AMB/150
Carbon Tetrachloride, Vapor	100	140/AMB	140	AMB	NR	AMB/150
Carbonic Acid	Sat'd	160	160	160/130	AMB	AMB

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Carbowax	100	—	—	—	—	100/120
Carboxylmethyl Cellulose	10	—	—	—	—	150/180
Carpet Shampoo	—	—	100	LS:100/NR	100	100/—
Cascade Detergent Solution	5	210/—	210	—	—	210/220
Castor Oil	100	—	—	—	—	75/120
Catalytic Refining Feed	—	—	—	AMB/—	—	—
Cationic, Quaternary Ammonium Compound in Isopropanol	—	120/—	120*	120*/120	120	120/—
Caustic Etch Tank Vapor	10 @ 180°F	—	NR	—	—	—
Caustic Spent, Phenolic, Refinery	—	—	130	130/—	130	—
Caustic Spent, Phenolic, Refinery, Neutralized to pH 5-6	—	—	130	130/—	130	—
Caustic Spent, Sulfidic, Petrochemical	—	—	130	130/—	130	—
Caustic Spent, Sulfidic Petrochemical, Neutralized to pH 5-6	—	—	130	130/—	130	—
Cell Putty† 35	100	—	203	—	—	—
Cerous Nitrate	Sat'd	—	90	—	90	90/—
Cheese Water	—	—	—	175/—	—	—
Chem-Rez C-2006†	—	—	100	—	100	—
Chem-Rez C-2009†	—	AMB/—	100	—	200	—
Chem-Rez C-2075†	—	—	100	—	100	—
China Clay Slurry	—	—	80	—	—	—
Chlorendic Anhydride	66	—	176	—	—	—
Chlorinated 68%, Camphene: Xylene	90:10	—	122	—	—	—
Chlorinated Linseed Oil	—	—	90	—	—	—
Chlorinated Organic Contaminates: HCl (32%) (Phase separation - 1/3 organic; 2/3 acid)	11.7:88.3 @ 104°F	—	NR	—	NR	—
Chlorinated Organics: HCl (32%)	1:99	—	*104/104/—	—	—	—
Chlorinated Organics: Trichloroethylene: Hydrochloric (32%)	0.9:14:85.1 @ 104°F	—	NR	—	NR	—
Chlorinated Phenol Disinfectant	—	—	100	—	—	100/—
Chlorinated Pulp Stock	—	—	SAT	—	—	—
Chlorinated Rubber Polymer Reaction Wet with CCl_4 (liquid + vapor phases)	—	—	AMB	—	—	—
Chlorinated Washer Hoods, Ducts	—	—	150	—	—	—
Chlorinated Wax	100	—	—	—	—	180/200
Chlorine	Liquid @ 80°F	—	—	NR	NR	NR
Chlorine Gas Coolers & Strippers[4]	—	—	300/300/—	NR	—	NR/—
Chlorine Gas, Dry	100	—/200	200*	180/100	200	180/250
Chlorine, Wet	Fumes	285/—	285*/285*/—	NR	—	—
Chlorine, Wet Gas	100	AMB/90	220/220*/—	NR	200	180
Chlorine "Gunk": Wet Chlorine: Chlorine Water	—	—	90	—	—	—
Chlorine, HF, Nitric Oxide Fumes[3]	Unknown	—	HOT	—	NR	—
Chlorine: Hydrogen Chloride	Unknown	—	392/392/—	—	—	—
Chlorine: Hydrogen Chloride Saturated with Tetrachlorocyclopentane, CCl_4, Trace Hexachlorocyclopentane	35:65	—	125	—	—	—
Chlorine Absorption	Unknown	—	120	—	—	—
Chlorine Blow Gas Scrubbing with 20% NaOH[3,4]	—	—	—	NR	—	120/—
Chlorine Cell Plant Floor Walkways	Fumes/Spills	AMB	—	—	—	—
Chlorine Cell Plant Roofing and Siding	Fumes	AMB	—	—	—	—
Chlorine Kill Tanks, Caustic Chlorine	—	—	—	—	—	100/—
Chlorine, Liquid[2]	100	NR/—	LS/LS/NR	NR	-55	-55/—
Chlorine Scrubbed with Lime Slurry	Unknown	—	100	—	—	—
Chlorine Scrubbing—5% NaOH[3,4]	—	—	—	—	—	120/—
Chlorine Stripping	Unknown	—	150	—	—	—
Chlorine Water	Sat'd	195/125	200*	LS125/NR	AMB	100
Chlorine Water: Wet Chlorine: Chlorine "Gunk"	—	—	90	—	—	—
Chlorine Dioxide	15 @ 200°F	—	—	NR	NR	NR/—
Chlorine Dioxide[4]	5	—/90	120	AMB	—	120/—
Chlorine Dioxide[4]	15	—	AMB	NR	NR	NR/—
Chlorine Dioxide[4]	20	—	AMB	NR	NR	NR/—
Chlorine Dioxide Absorber (Water)[4]	—	—	45	—	—	—
Chlorine Dioxide, Chlorine, Steam[4]	—	—	150	—	—	—
Chlorine Dioxide, Condensate[4]	Sat'd	—	190	—	—	—
Chlorine Dioxide Generator, Effluent, R-2 System	—	—	130*	—	120	—
Chlorine Dioxide Generator, Olin Type[4]	—	—	160	—	—	—
Chlorine Dioxide Generator, Solvay Type[4]	—	—	145	—	—	—
Chlorine Dioxide Generator, Spent Acid	—	—	130	—	NR	—
Chlorine Dioxide, Hooker Single Vessel Process[4]	—	—	180	—	—	—
Chlorine Dioxide Process Absorbers[4]	—	—	130	—	—	—
Chlorine Dioxide Process Bleach Towers[4]	—	—	180	—	—	—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Chlorine Dioxide Process Generator Covers[4]	—	—	180	—	NR	—
Chlorine Dioxide Retention Tower[4]	—	—	180	—	—	—
Chlorine Dioxide: Sodium Carbonate and Bicarbonate, pH 8[4]	5:3 7	—	100	—	—	—
Chlorine Dioxide: Sodium Chloride[4]	35:23	—	120	—	—	—
Chlorine Dioxide, Vapor	Sat'd	—	200	—	NR	200
Chlorine Dioxide—Washer Hoods, Ducts	—	—	SAT	—	—	—
Chlorine Dioxide, Wet[4]	Sat'd	—	140	120/90	—	—
Chlorine Dioxide: Sulfuric (10.5 N)	—	—	120*	—	120	—
Chloroacetic Acid	25	NR	90	130/NR	90	150
Chloroacetic Acid	50	NR	AMB	NR	—	100
Chloroacetic Acid	Conc	NR	NR	NR	NR	NR/—
Chloroacetic Acid Plant Water Scrubber	30-40 @ 110°F	—	—	—	—	NR/—
Chlorobenzene	100	NR	NR	NR	NR	NR/80
Chlorobenzene Vapor & Condensate	100 @ 120°F	NR/—	—	—	—	—
Chlorofluocarbon	100	158/—	158	—	—	—
Chloroform Alkaloids, HCl, Acetic, Sodium Chloride, Water Fume System	—	—	AMB	—	—	—
Chloroform, Liquid	100	NR/—	NR	NR	NR	NR
Chloroform: Methylene Chloride: Carbon Tetrachloride, Small Amount Methyl Chloride, H_2O, HCl @ 100°F	39:65:5	NR	NR	NR	NR	NR/—
Chloroform, Vapor	100	NR/—	NR	NR	NR	NR/—
Chlorosulfonic Acid	100	NR/—	NR	NR	NR	NR
Chlorothene N.U.†	100 @ 80°F	—	NR	—	—	—
Chlorotoluene (o)	100 @ 200°F	NR/—	NR	—	—	—
Choline Chloride; Reaction of Trimethylamine HCl and Ethylene Oxide	—	—	NR	—	180	—
Chromate—Zinc Blend Inhibitor Stabilized	100	—	125	125	LS125/NR	—
Chrome Acid Plating Bath Vapor	—	—	200	—	—	—
Chrome Anodizing Solution	—	—	150	—	—	—
Chrome Barrel Plating Fumes	—	120/—	—	—	—	—
Chrome Bath, Black, Chromic, Acetic, Barium Acetate	—	—	115	—	—	—
Chrome Bath, 19% Chromic Acid with Sodium Fluorosilicate and Sulfate[3]	—	NR/—	200	NR	NR	100
Chrome Free Can Treatment, pH 6	—	—	120	—	—	—
Chrome, Hard, Plating Baths	—	—	130	—	NR	—
Chrome Phosphate Can Treatment, pH 2	—	—	120	—	—	—
Chrome Plating	@ 100°F	—	—	NR	NR	SAT
Chrome Plating Bath Vapors	@ 120°F	—	—	—	NR	—
Chrome Reduction Process	25	—	220/220/—	—	—	—
Chrome Reduction Process Liquor	—	—	230/230/—	—	—	—
Chromic Acid	5	200/—	200	AMB/—	NR	100/120
Chromic Acid	10	195/—	195	NR	NR	80/100
Chromic Acid	15	—	LS200*/LS200/NR	NR	NR	—/80
Chromic Acid	20	—	150	NR	NR	NR/80
Chromic Acid	30	—	140	NR	NR	NR
Chromic Acid	40	NR	140	NR	NR	NR
Chromic Acid	50	140 Vapor/—	140*/140/—	NR	NR	NR
Chromic Acid	8.5 lbs/gal	—	150	—	—	—
Chromic Acid	60	—	150	—	NR	NR
Chromic Acid	Sat'd	NR	120	NR	NR	NR
Chromic Acid Evaporator, Vacuum, Recovery Units with 20% by Volume Concentrated Sulfuric @ 160°F	55 oz/gal	NR	SAT/—/—	NR	NR	NR
Chromic Acid, Intermittent	15-20	—	200	NR	NR	NR
Chromic: Nitric: Hydrofluoric Acids[3]	5:2:3	—	80	—	NR	—
Chromic: Nitric: Hydrofluoric Acids[3]	6:2:1.5	—	80	—	NR	—
Chromic: Phosphoric: Hydrofluoric Acids[3]	7:40:2	—	100	—	NR	—
Chromic: Phosphoric: Hydrofluoric Acids[3]	9.3:8.5:11	—	100	—	NR	—
Chromic Acid: Sodium Fluoride, High Agitation[3]	36:ppm	—	138	—	—	—
Chromic: Sulfuric Acids	40:0.4 oz/gal	150/—	150	NR	—	—
Chromic: Sulfuric Acids	53:53 oz/gal	—	140	NR	NR	—
Chromic: Sulfuric Acids	33:0.33 oz/gal	—	140	NR	NR	—
Chromic: Sulfuric Acids	53:0.53 oz/gal	—	177	NR	NR	—
Chromic: Sulfuric Acids	3:16	—	155	—	NR	NR/—
Chromic: Sulfuric Acids	20:20	—	180	NR	NR	NR/—
Chromic: Sulfuric Acids	12.5:16	—	225/225/—	—	NR	—
Chromic: Sulfuric Acids[4]	20:32	—	90	NR	NR	—
Chromic: Sulfuric: Hydrofluosilicic Acids[3]	35.2:0.2:0.4	—	115	—	—	—
Chromic: Sulfuric: Hydrofluosilicic (Chrome Plating)[3]	45:0.3:0.5 oz/gal	—	115	—	—	—
Chromic Oxide in 300°F and 180°F Air, Quenched with 100°F Water, 50-60 fps	< 2	No chemical attack with 197, not suitable due to abrasion				

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Chromic: Phosphoric: Hydrofluoric Acids[3]	7:40:2	—	100	—	NR	—
Chromic: Phosphoric: Hydrofluoric Acids[3]	9.3:8.5:11	—	100	—	NR	—
Chromic Sulfate	All	—	—	—	—	150
Chromium Hardening Fixing Bath, Photographic	—	—	80	—	—	—
Chromium Hardening Stop Bath, Photographic	—	—	80	—	—	—
Chromium Potassium Sulfate	Sat'd	—	—	—	140	—
Chromous Sulfate	Sat'd	—	150	170/140	140	150
Citrate Process for SO_2 Removal	—	—	140	—	—	—
Citrex† Process for SO_2 Removal	—	—	140	—	—	—
Citric Acid	50	—/200	180	180/150	180	210/220
Citric Acid	Sat'd	BP/200	BP*	160/150	220	BP*
Citric Acid	Sat'd @ 265°F	—	—	NR	NR	NR
Citric: Lactic Acids	—	—	150	—	—	—
Citric Acid/Sulfate/Chloride in Mixed Solvents—Mineral Spirit Type @ 75-220°F	Unknown	—	—/—/LS	—	—	—
Clay Slurry 20%, 20% Potash in Sat. Brine @ AMB	40 Slurry	197 SAT @ 12 fps	—	—	—	—
Cleaner 508†	100	—	160	—	—	—
Cleaner, Biodegradable, All Purpose Liquid	—	—	100	100	100	100
Cleaner & Disinfectant, Pd 64†	100	—	100	—	—	100
Coal Dust Scrubber	—	—	150	—	—	—
Coal, Med. Sulfur, Particulate Scrubber, pH 1.9-3.6, Cl560-1200 ppm, 300,000 ACFM	Liquor	—	150	—	—	—
Coal/Water Slurry @ 80°F	10/90	Hetron 197-3 with abrasion resistant Filler Satisfactory at 7 fps				
Coatings, Water Reducible @ 120°F						
Acrylic Wet Ink Varnish (PPG Industries)	—	—	—/—/NR	NR[15]	SAT	SAT/—
Polyester White Enamel (PPG Industries)	—	—	—/—/NR	NR[15]	SAT	SAT/—
Epoxy Spray Liner (PPG Industries)	—	—	NR	NR	NR	NR/—
Acrylic Spray Liner (PPG Industries)	—	—	—/—/NR	NR[15]	SAT	SAT/—
Cobalt di (2 ethyl hexyl) phosphate: tri-m-butyl phosphate: Shell's livestock spray base	30:5:65	—	176	—	—	—
Cobalt Nitrate	Sat'd	—	—/140/—	—	140/—	140*/—
Cocamidopropyl Betaine	100	—	120	120/—	120	120/—
Cocamidopropyl Dimethylamine	100	—	120	120/—	120	120/—
Coconut Fatty Acid Diethanol Amide	100	—	100	—	—	—
Coconut Oil	100	—	—	140-175/—	140-175	150/180
Codliver Oil	100	—	—	AMB	—	—
Coffee Roasting Fumes	—	150/—	—	—	—	—
Combustion Gases, Particulate, Cooling and Washing with Water	—	100/—	100	—	—	—
Condensable Liquor, pH 9, Pulp and Paper Mill	—	—	130*	—	130	130*/—
Cooling Tower Inhibitor, Chromate-Zinc Blend, stabilized	100	—	125	125	LS125/NR	—
Cooling Towers	—	AMB	AMB	AMB	AMB	AMB
Cooling Water[17], ph 5.5-7	—	—	180	150/130	—	170
Cooling Water, 20 ppm Chromate	—	—	180*	180/130	—	180
Copper Acetate	Sat'd	—/120	—	160/—	180	160/180
Copper Chloride	Sat'd	250	250	180/150	220/200	210/220
Copper Chloride: Silver Nitrate	15:33	—	AMB	—	—	—
Copper Cyanide[3]	Sat'd	200/90	200	90/NR	200*	210/220
Copper Cyanide Plating	Fumes	—	180	—	—	—
Copper Cyanide Plating Bath, (10.5% Copper and 14% Sodium Cyanides; 6% Rochelle Salts)[3] @ 180°F	—	NR/—	NR	—	SAT	120/—
Copper Cyanide, Potassium Cyanide, Potassium Hydroxide[3]	8:3:2 oz/gal	—	175	—	200	—
Copper Electrolytic Cells	—	—	150	—	—	—
Copper Extractant, Ion Exchange Oxime Type	100	—	115	—	—	—
Copper Fluoride[3]	Sat'd @ 75°F	—/NR	—	NR	—	—
Copper Leach Tanks	—	—	150	—	—	—
Copper Matte Dipping Bath, 30% $FeCl_3$; 19% Hydrochloric	—	—	180	—	—	200/—
Copper Nitrate	Sat'd	140/160	140	160/140	220/200	210/220
Copper Oxide: $PbSO_4$: S: FeO: $ZnSO_4$: $Bi_2(SO_4)_3$ Dust	18:25:25:10:8:3	—	200	—	—	—
Copper Oxychloride	20	140/—	—	NR	—	—
Copper Oxychloride	Sat'd	AMB/—	—	NR	—	—
Copper Pellet Smelter	Fumes	—	300/300/—	—	—	—
Copper Pickle Bath, Sulfuric/Water	1 gal/9 gal	—	175	—	—	—

[17]Dissolved solids, 1574-2183 ppm: PO_4, 0.25 ppm; total PO_4, 1.3 ppm; Cu, 0.7 ppm; Zn, 3.4 ppm; Fe, 1.8 ppm; $CaCo_3$ 450 ppm max.; Chromate, hexa, 18-22 ppm. Cl_2 residual, 0.2-0.45 ppm; NaCl, 527-702 ppm.

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES 980
Copper Pickling Bath ($Fe_2(SO_4)_3$, H_2SO_4)	—	—	220	—	220/220	210/—
Copper Plating Solution (45% $Cu(BF_4)_2$; 19% Copper Sulfate; 8% Sulfuric[3]	—	—	180	—	—	180
Copper Refining Cells	—	—	SAT	—	—	—
Copper Smelter Fumes	—	—	150	—	—	—
Copper Sulfate	Sat'd	250	250	180/120	220/200	210/250
Copper Sulfate: Sulfuric	5:18	—	150	—	—	—
Copper Sulfate: Sulfuric	50:200 gpl	150/—	—	—	150	—
Copper Sulfate: Sulfuric Acid	12:28	—	120	120*/—	120	120*/—
Corn Oil	100	—	—	—	180/100	150/200
Corn Starch	Slurry	—	—	—	—	210/220
Corn Sugar	All	—	—	—	—	210/220
Corn Syrup, Acid, Decolorizing	100	—	100	—	—	—
Corn Syrup, Crude Acidic	100	—	100	—	—	—
Cottonseed Oil	100	100/—	100	100	180/100	150/200
Cresol	100	—/NR	—	NR	—	—
Cresol Fumes	100	—/NR	AMB	NR	—	—
Cresylic Acid	100 @ 75°F	—/NR	—	NR	NR	NR
Cresylic Acid Fumes	100	—/NR	80	NR	—	—
Cresylic Acid: Sodium Hydroxide[3]	12:5	—	—	—	—	180/—
Cresylics, Water, Neutral Oils, Mercaptans, H_2S, Waste Liquor, pH 5-6	—	—	130	130/—	130	—
Crude Oil, B	—	—	—	AMB	—	—
Crude Oil, Sour	100	—	210	180/150	200	210/220
Crude Oil Storage Tank Bottoms	—	—	—	130/110	—	100
Crude Oil, Sweet	—	—	210	180/150	200	210/230
Cupric Sulfate: Ferric Sulfate: Sulfuric Acid	10:10:20	—	180	—	—	—
Cutback Diluent, Refinery	—	—	—	AMB/—	—	—
CWT† 102	100	—	125	125	LS125/NR	—
Cyaf 5101†	—	—	—	90	—	—
Cyanoacetic: Methyl Isobutyl Ketone; 0.8 Sulfuric in Saturated Sodium Chloride @ 100°F	8:60	—	LS-SAT	—	—	—
Cyanuric Acid Tank with 16% Sulfuric, Steam and Calcined Urea	—	—	212*	212/NR	212/200	—
Cyanuric Chloride Scrubbed with 5.25% NAOH[3]	—	—	—	—	LS to 210/NR	—
Cyclohexane	Vapor	175	175	175/—	NR	180
Cyclohexane	100	140/—	140	160/NR	NR	80/120
Cyclohexane: Acetone: Hexane: Water	10:10:1:79	—	NR	150/—	NR	—
Cyclohexanone	100	—	—	NR	—	—
Cyclohexylamine: Hydrochloric Acid	95:5 @ 100°F	—	NR	—	—	—
Cyclo-Octadiene	100	—	100	—	—	—
Cygon† 400	3.75	—	150	—	150	NR/—
Cygon† 400	100	NR/—	NR	—	150	NR/—
Darex† 45	—	—	180	—	—	—
Dazad† 30	—	—	180	—	—	—
DDT, Insecticide Solution	2.5	140/—	—	—	—	—
Decanol	100	—	—	160	—	—
Dechlorinated Brine pH 2-3, Free Chlorine (Traces)	Sat'd	—	200	—	—	NR[6]/—
Deionized Water[6]	100	—	180	180/90	80	210/220
Deionized Water, High Purity, 1.5 μmho/cm.	100	—	—	AMB[18]/NR[19]	—	—
Demineralized Water	100	100	212	180/212	—	210/220
Depleted Na & K Brines	Sat'd	—	200	—	—	—
Desmutter & Deoxidizer for Aluminum[3]	—	—	AMB	—	—	—
Desulfurizer Feed/Refinery	—	—	—	AMB*/—	AMB/—	—
Desulfurizing SO_2, H_2S with Monoethanolamine	100	NR/—	NR	NR	NR	NR/—
Detergent Alcohols	100	—	—	—	—	120/180
Detergent Base—Tridecylbenzene Sulfonate	—	—	120	—	120	120*/—
Detergent, Biodegradable, Liquid	—	—	100	100	100	100/—
Detergent, Dimethyl Benzyl N-Alkyl Type with 23% HCl, 77% Inerts	—	—	100	—	—	100/—
Detergent, Dimethyl Benzyl N-Alkyl Type with 25% Phosphoric, 75% Inerts	—	—	100	—	—	100/—
Detergent, Dishwashing, Liquid, Biodegradable	—	—	100	100	100	100/—
Detergent, Organic pH 10-11[3]	100	160/—	160	—	—	—
Detergent, Pax Hyspeed†	Sat'd	—	140	—	—	—
Detergent, pH 8	3	180/—	—	—	—	—
Detergent Solution, Buildt† pH 9-10, 10-12% Solids[3]	—	—	120*	—	120	120/—
Detergents, Germicidal	Conc.	100/—	—	—	—	—
Detergents, Organic	—	—	100	NR	—	100
Detergents, Sulfated	—	—	—	180/—	—	—

[18]*No change in water at 0.1 ft³ laminate/gal. as in 20-30,000 gal tank.*
[19]*AROPOL 7530 satisfactory.*

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Detergents, Sulfonated	—	—	—	160/100	200*	210/220
Developer, Photographic, Caustic[3]	—	—	80*/80/80	—	—	—
Developer, Photographic, Moderately Alkaline	—	—	80*/80/80	—	—	—
Developers, Color	—	—	80*/80/80	—	—	—
DFR-121†	—	—	100	100*/100	100	100/—
Diallylphthalate	All	—	—	160/130	180	150/180
Di-Ammonium Phosphate @ 225°F	65	—	LS/LS/NR	—	—	180/SAT
Di-Ammonium Phosphate: Ammonium Sulfate	10:10	—	—	AMB	—	—
Di-Ammonium Phosphate Vapor	—	90	—	—	—	—
Dibromophenol	—	NR/—	LS/LS/NR	NR	NR	NR
2, 3-Dibromopropanol @ 120°F	100	—	—	—	NR	NR
Dibromopropanol; Small Amount Tribromopropane & Brominated Organics	100 @ 80-120°F	—	—	—	NR	NR
Dibutyl Ether	100	80	80	80*/—	80	80*/150
Dibutyl Phthalate	100	—	AMB	AMB	150/AMB	150/200
Dibutyl Sebacate	100	—	—	—	—	210/150
Dicalcium Phosphate "gas": Liquid; Scrubbing pH 3-4	—	—	300	—	—	—
2, 6-Dichloro-4-Aniline in 32% HCl @ 170°F	—	—	—/LS/NR	LS/NR	LS/NR	LS/—
Dichloroacetaldehyde	100 @ 100°F	NR/—	NR	—	—	—
Dichloroacetic Acid	100 @ 265°F	—	—	NR	—	NR
Dichlorobenzene	100	NR/—	NR	NR	NR	NR/100
1, 2-Dichloroethane	100	NR/—	NR	NR	NR	NR/—
Dichloroethene	100	NR/—	NR	NR	NR	NR/—
Dichloroethylene	100	NR/—	NR	NR	NR	NR
Dichloromethane	100	NR/—	NR	NR	NR	NR
Dichloropene: Dichloropropane	@ 100°F	—	NR	—	—	NR
Dichlorophenol	100	NR/—	NR	NR	NR	NR/—
Dichlorophenoxyacetic Acid	2	140	—	—	—	—
Dichloropropane	100	NR/—	NR	NR	NR	NR
Dichloropropane: Dichloropene	@ 100°F	—	NR	—	—	—
Dichloropropene	100	NR/—	NR	NR	NR	NR
Dichloropropionic	100	—	—	—	—	NR
Dichromate Bleach, Sulfuric, Photographic	—	—	80	—	—	—
Dicoco Dimethyl Ammonium Chloride	—	120/—	120*	120*/120	120	120/—
DiCrobe NN†, Germicidal Detergent	—	—	100	—	—	—
Dicyclopentadiene	100	—	100	—	—	—
Diesel Fuel	100	175/—	175	175/140	—	150/200
Diesel Fuel, Premium	—	—	—	AMB/—	—	—
Diethanol Amine	30	—	110	AMB/—	—	80/120
Diethanol Amine	100	—/90	110	—	—	80/120
Diethyl Benzene	100	—	120*	NR	NR	80/120
Diethyl Carbonate	100	—	—	—	—	NR
Diethyl Ether	100 @ 75°F	NR/—	NR	NR	NR	NR
Diethyl Formamide	100 @ 75°F	—	—	—	NR	NR
Diethyl Ketone	100	—	—	NR	NR	NR
Diethyl Maleate	100 @ 75°F	—	—	NR	NR	—
Diethyl Maleate: Water	97:3 @ 212°F	NR/—	NR	NR	NR	NR/—
Diethyl Sulfate	100	—	100	—	—	NR/100
Diethylamine	100	—	—	—	—	NR
Diethylene Glycol	100	—/180	100	180/150	200	150/200
Diethylene Glycol N-butyl Ether	100	—	85	—	—	90
Diethylene Imide Oxide	10	—	100	—	—	—
Diethylene Triamine[4]	100	NR/—	NR	—	NR	—
Diethylene Triamine: Ethylene Diamine: Sodium Hydroxide: Water[3]	10:10:10:70	—	—	—	NR	—
Diethylhexyl Phosphoric Acid (in Kerosene)	20	—	—	—	—	120/150
Digester Blow Down Vapors @ up to 220°F	—	NR/—	—/SAT/—	—	LS	—
Digester Room, Pulp Mill, Floors, Spills	—	—	—	—	AMB	—
Diglycolamine@ 270°F	100	NR/—	NR	NR	LS/NR	NR/—
Diglycolamine, Sat'd. with CO_2 and H_2S @ 270°F	100	NR/—	NR	—	LS/NR	NR/—
Dihydrogenated-Tallow Dimethyl Ammonium Chloride: Aqueous Isopropanol	75:25	120/—	120*	120*/120	120	120/—
Diisobutyl Ketone: Ethyl Hexylacetate: Butyl Alcohol	85:10:5	—	80	—	—	—
Diisobutyl Phthalate	100	—	AMB	—	—	100/150
Diisobutylene	100	—	100	—	—	AMB/100
Diisocyanate, Diphenyl Methane	100	—	—	120	NR	—
Diisopropanolamine	100	—	—	—	—	80/120
Dimethyl Acetamide	70	NR/—	150	—	NR	—
Dimethyl Acetamide	100 @ 75°F	NR/—	NR	—	NR	—
Dimethyl Benzyl N-Alkyl Type Detergents with 23% HCl or 25% phosphoric and rest inerts	—	—	100	—	—	100/—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Dimethyl Distearyl Ammonium Chloride:						
Aqueous Isopropanol	72:25	120/—	120*	120*/120	120	120/—
Dimethyl Formamide	7.2	—	100	—	—	—
Dimethyl Formamide	30	—	90	NR	—	NR/—
Dimethyl Formamide @ 90°F	100	—	NR	NR	NR	NR
Dimethyl Formamide: Terephthalic						
Acid: HCl: Water	7:14:28:51	—	100	—	—	—
Dimethyl Morpholine @ 120°F	100	NR/—	LS/LS/NR	NR	NR	NR/100
Dimethyl Phthalate	100	—/NR	—	NR	150	120/150
Dimethyl Phthalate: Methyl Ethyl Ketone:						
MEK Peroxide	36:63:1	—	—/LS85/NR	—	—	—
Dimethyl Sulfoxide	100 @ 75°F	NR	NR	NR	NR	—
Dimethyl Tin Dichloride	50	—	65-80	—	—	—
Dimethylamine	4	—	130	—	—	—
Dimethylamine	60	NR/—	—/LS80/NR	—	—	—
DMP: MEK: MEK Peroxide	36:63:1	—	—/LS85/NR	—	—	—
Dinitrobutyl Phenol in 25% Sulfuric						
Acid Waste @ 150°F	Up to 16	NR/—	—	—/NR	—	—
Dioctyl Phthalate	100	—/NR	—	NR	150	120/150
Dioxane	100	—	—	—	NR	NR
Diphenyl Ether	100 @ 75°F	NR	—	NR	—	80/120
Diphenyl Methane Diisocyanate	100	—	—	120	NR	—
Diphenyl Oxide	100	NR	—	NR	—	80/120
Dipropylene Glycol	100	160	—	160/120	180	150/180
Dipropylene Glycol Dibenzoate	100	—	120*	120	120	120/—
Dishwashing Detergent, Liquid,						
Biodegradable	—	—	100	100	100	100
Dishwashing Liquid	100	—	120	—	—	—
Disinfectant, Chlorinated Phenol Type	—	—	100	—	—	100
Disinfectant & Cleaner, Pd 64†	—	—	100	—	—	100/—
Dispersant, Anionic, Blend	100	—	125	125	—	—
Dispersant, Nonionic, Blend	100	—	125	—	125	—
Dispersing Agents	100	—	125	125	125	—
Distilled Water[3]	100	160/—	210	160/140	200	210/220
Di-Syston	1 to 10 Dilution	—	120	—	—	—
Diversey 514†[3]	14 oz/gal	—	80	—	—	—
Diversey 808†[3]	5.3 oz/gal	—	140	—	—	—
Divinyl Benzene	100	—	AMB	NR	NR	NR/120
Dodecane	100	—	—	—	—	80/150
Dodecene	100	NR	AMB	NR	—	—
Dodecene, Trace HCl	100	—	120	NR	—	—
Dodecyl Alcohol	100	—	100	—	—	150/180
Dodecyl Benzene Sulfonic Acid:						
Sulfuric Acid: Water: Oil	85:10:4:1	150/—	150	—	—	—
Dodecylbenzene Sulfonic Acid	All	—	—	—	—	210/220
Dolomite Kiln Gases, Wet	—	—	150	—	—	—
Dowclene EC†	100	—	80	—	—	—
Drain Cleaner, Liquid (Spartan Chemical)						
@ 80°F	—	NR/—	NR	—	—	—
Drewsperse 732†	100	—	125	125	125	—
Drewsperse 734†	100	—	125	125	125	—
Drewsperse 735† @ 125°F	100	—	SAT	LS/NR	SAT	—
Drewsperse 738† @ 125°F	100	—	SAT	LS/NR	SAT	—
Drewsperse 741† @ 125°F	100	—	SAT	LS/NR	SAT	—
Drewsperse 780†	100	—	125	125	125	—
DW-875†, Styrene, Acrylic Emulsion	—	—	80	—	—	—
DXE: Xylene; Trace H_2SO_4; Flake Caustic	50:50 @ to 185°F	NR/—	NR	NR	NR	—
Dye Plant Water Treatment, pH 2-3	—	—	180	—	—	—
EDTA	38	—	AMB	—	AMB	AMB
Electrasol† Detergent	5	—	—	—	—	150
Electronics Plant Waste	—	—	—	—	—	AMB
Electrostatic Precipitator Fumes, ½%						
Carbonate, 3% Sulfate, 1/10% Fluorides,						
1/10% Bicarbonates	—	—	185*	—	185	185/—
Electrostatic Precipitators, S; H_2S; SO_2	—	—	280/280/—	—	—	—
Elvase†	—	—	100	100*/100	100	100/—
Emulsifier, Oil and Grease,						
Alkanolamide Type	100	—	120	—	120	—
EP 52-A65†	100	—	AMB	AMB	AMB	AMB/—
Epichlorohydrin	100	—	—	—	—	NR
Epoxidized Soybean Oil	100	—	125	—	—	120/150
Epoxy Spray Liner, Water Reducible						
@ 120°F (PPG Industries)	—	—	NR	NR	NR	NR/—
Eptam†, Herbicide[6]	Conc.	—	120	—	—	—
Erional NW†	100	—	AMB	—	AMB*	AMB/—
Esters, Fatty Acid	100	—	120	180/150	180	180

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700 700C	HETRON 920 SERIES/980
Etchant, Fresh (50% Ammonium Hydroxide)[3]	—	—	120	—	120*	120/—
Etchant, Spent; Ammonium Hydroxide Based; 18 oz/gal Cu[3]	—	—	120	—	120*	120/—
Ethanol Chloride	100 @ 130°F	NR/—	NR	—	—	—
Ethanol Vapor & Condensate	95	120	120	—	—	—
Ethanolamine	100 @ 75°F	—	SAT	NR	SAT	SAT
Ether	100 @ 75°F	NR/—	NR	NR	—	—
Ethoxylated Alcohol, pH 8.5, C_{12}-C_{16}	100	—	120*	—	120	—
Ethoxylated Nonyl Phenol	100	—	100	—	—	—
Ethyl Acetate	Sat'd	NR	NR	NR	NR	NR
Ethyl Acetate	100	NR	NR	LS80/NR	NR	NR
Ethyl Acetate: Methylene Chloride: Caustic, 50%	16:83:1	NR/—	NR	NR	NR	NR
Ethyl Acetate, Vapor & Condensate	100 @ 120°F	NR/—	—	—	—	—
Ethyl Acetoacetate	Sat'd	—	80	—	—	—
Ethyl Acrylate	100	—	—	—	—	NR
Ethyl Alcohol	50	150/—	150	AMB/—	140/AMB	100
Ethyl Alcohol	50-100	120	125	AMB/—	140/NR	100
Ethyl Alcohol	95-100	—	—	—	—	NR/100
Ethyl Benzene	100	NR/—	NR	NR	NR	NR/100
Ethyl Benzene: Benzene	2/3:1/3	—	100	—	—	—
Ethyl Bromide	100	NR/—	NR	NR	NR	NR
Ethyl Chloride	100	AMB/—	AMB	NR	—	NR
Ethyl Chloroformate	100	—	80	—	—	—
Ethyl Ether	100	NR/—	NR	NR	NR	NR/—
Ethyl Hexylacetate: disobutyl ketone: Butyl alcohol	10:85:5	—	80	—	—	—
Ethyl Parathion	—	—	—	—	—	NR/—
Ethyl Silicate	100	—	100	—	—	—
Ethyl Sulfate	100	—	100	—	—	80/100
Ethylene Chloride	100	NR/—	NR	NR	NR	NR
Ethylene Chloride: Fatty Acids @ 150°F	77:23	—	NR	—	—	—
Ethylene Chlorohydrin	100	—	—	—	—	NR/100
Ethylene Chlorohydrin	100	200/—	200	NR	100	—
Ethylene Diamine	100 @ 75°F	NR/—	—	—	—	—
Ethylene Dibromide	100	NR	NR	NR	NR	NR/—
Ethylene Dibromide: Methyl Bromide	70:30 @ 75°F	NR/—	NR	—	—	—
Ethylene Dichloride	100	NR/—	NR	NR	NR	NR/—
Ethylene Glycol	All	250	250/250/200	180/150	220/200	210
Ethylene Glycol Monobutyl Ether	100	—/90	AMB	AMB/—	220/150	150
Ethylene Glycol: Water @ 212°F	50:50	—	—	—	700 NR as molding cpd.	—
Ethylenediamine: Diethylene Triamine: Sodium Hydroxide: Water	10:10:10:70	—	—	—	NR	—
Ethylenediamine Tetra Acetic Acid	38	—	AMB	—	AMB	AMB/100
Ethylenediamine Tetra Acetic Acid	100	—	—	—	—	80/100
EVA†	—	—	100	100*/100	100	100/—
Exalt†	—	—	—	—	80	80/—
Exxon Emulsion of Polymer/Toluene in Water with Alipal CO433†	—	—	NR	—	NR	—
Exxon Latex in Water with Small Amount Alipal CO433†	62	—	100	—	100	—
Fat Splitting Exhaust Gas	—	—	—	195/—	—	—
Fatty Acid, Alkanolamide	—	—	100	—	—	—
Fatty Acid, 2-5% Sulfuric	—	—	—	—	—	100/—
Fatty Acids	Sat'd	250	250	180/150	200	210/220
Fatty Acids: Ethylene Chloride @ 150°F	23:77	—	NR	—	—	—
Fatty Nitrogen Compounds: Xylene	25:75	—	100	—	—	—
FCU Feed	—	—	—	AMB/—	—	—
Ferric Acetate	Sat'd	—	—	—	—	180
Ferric Chloride	Sat'd	250	250	180/150	220/200	210/220
Ferric Chloride: Ferrous Chloride	5:20	—	145-240	—	—	—
Ferric Chloride: Ferrous Chloride: Hydrochloric Acid	48:0.2:0.2	—	165	—	—	—
Ferric Chloride: HCl	29:18.5	—	180	—	—	—
Ferric Chloride Mist: Hydrocarbons	Unknown	—	—/250/—	—	—	—
Ferric Nitrate	Sat'd	250	250	180/150	220/200	210/220
Ferric Sulfate	Sat'd	200	200	180/150	220/200	210/220
Ferric Sulfate: Ammonium Sulfate	20:10.5	180/—	180	—	—	—
Ferric Sulfate: Cupric Sulfate: Sulfuric Acid	10:10:20	—	180	—	—	—
Ferricyanide Bleach, K Bromide, Photography	—	—	80	—	—	—
Ferrous Chloride	Sat'd	220	220	180/150	220/200	210/220
Ferrous Chloride: Ferric Chloride	20:5	—	145-240	—	—	—
Ferrous Nitrate	Sat'd	160	—	160/140	220/200	210/220
Ferrous Sulfate	Sat'd	220	220	180/150	220/200	210/220
Fertilizer Fumes	—	150/100	—	—	—	—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON' 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Fertilizer Scrubbing	—	150/—	—	—	—	—
Fertilizer Solution	8-8-8	—	—	—	—	120/150
Fertilizer Solution	10-34-0	—	—	80[20]	—	—
Fertilizer Solution, Nitrogen	28	—	—	80[20]	—	—
Fire Retardant Liquid (Osmose Co.)	50 & 16	—	—	82/—	—	—
Fish Oil and Meal Exhaust Gas	—	—	175	175*/—	175	175/—
Fish Tanks[6]	—	—	—	AMB	—	—
Fixing Baths, Photography	—	—	80	—	—	—
Floor Wax Polymers	—	—	80	—	—	—
Flue Gas[21] @ 280-340°F	—	180	SAT/SAT/NR	NR	—	—
Flue Gas[22] @ 180-280°F	—	180	SAT/SAT/NR	NR	—	NR/—
Flue Gas, Boiler up to 450°F	—	180	SAT/SAT/NR	NR	—	NR/—
Flue Gas, Chemical Incinerator	—	—	300/300/—	—	—	—
Flue Gas, Coal Fired up to 350°F	—	180	SAT*/SAT*/NR	NR	SAT/NR	NR/—
Flue Gas, Garbage Incinerator	—	—	180	—	—	—
Flue Gas, Hog Fuel, Some HCl, pH 3.7-7	—	—	155	—	LS155/—	—
Flue Gas, Recovery Boiler up to 400°F	—	—	SAT/SAT/NR	NR	—	NR/—
Flue Gas Scrubbing, Ammonia Process	—	—	125	—	—	—
Flue Gas, Wet[23]	—	180	120-140	—	—	—
Flue Gases; Some Sulfuric Acid Fumes, Abrasive Clay Particles	—	—	—	190-225/—	—	—
Fluoboric Acid[3]	10	BP/180	BP	—	180	210/220
Fluoboric Acid[3]	Sat'd	—/90	—	AMB	120	180/200
Fluoride Salts + HCl[3]	30:10	—	120	—	—	—
Fluorinated, Chlorinated Acid Organics Neutralized With Lime, Effluent[3]	—	—	105	—	—	—
Fluorine[3]	100 @ 75°F	NR/—	—	NR	—	—
Fluorine Gas[3]	100	—	—	NR	—	—
Fluorine: Phosphorus Pentoxide[3]	1.5:1.5	—	85	—	—	—
Fluorine Scrubber, Recover H_2SiF_6[3]	—	—	160	—	—	—
Fluorolubes†, Oils and Greases	100	AMB/—	AMB	—	—	—
Fluosilicic Acid[3]	10	100	180	100/—	150/100	150
Fluosilicic Acid[3]	25	—/AMB	180	AMB	AMB	120
Fluosilicic Acid[3]	35	NR	160	NR	AMB	100
Fluosilicic Acid[3]	Sat'd	—	100	—	—	100
Fluosilicic Acid Fumes, Wet[3]	—	—	150	—	150	150/200
Fluosulfonic Acid	100 @ 80°F	NR/—	NR	NR	—	—
Fly Ash Slurry	—	—	AMB	AMB	—	—
Formaldehyde	to 25	200	200	150/120	—	80/120
Formaldehyde	25-37	—/90	150	AMB	AMB/NR	100
Formaldehyde	50-52	—/90	150	—	—	150*/—
Formaldehyde @ 150°F	37-44	—/90	SAT	AMB	NR	AMB
Formaldehyde, Phenol, Sulfuric Fumes	Unknown @ 200°F	NR/—	—	—	—	—
Formamide	100	—	100*	100*/LS	100/LS	100/—
Formic: Acetic Acids	10:10	—	—	—	—	—
Formic Acid[3]	10	200	200	150/90	150	180
Formic Acid[3]	25	AMB	140*	120/—	150	120
Formic Acid[3]	50	AMB	100*	NR	AMB	120
Formic Acid[3]	100	NR	100*	NR	—	—
Formic Acid 60%, Sat'd with NACl: Unknown Organics	50:50	—	40	—	—	—
Formic Acid Vapor[3]	10	194/—	194	—	—	—
Fourdrinier Drying Section Fumes	—	130/90	130	—	—	—
Fourdrinier Liquor	—	—	120	—	—	—
Freon II	100	—	—	—	—	75
Fruit Juices[6]	—	—	—	AMB	—	—
Fuel Oil, No. 1 and No. 2	100	170/—	170	170/130	AMB	120
Fuel Oil, Naval, MIL-F-859A	100	175/—	175	—	—	—
Fumigant, Soil	Conc.	NR/—	NR	—	—	—
Fumigants	Conc.	NR/—	NR	NR	—	—
Fungicide, Phenate Based	100	AMB/—	125	125	125	—
Fungus, 95% Relative Humidity MIL E-5272C						
Aspergillus Flavus (10836)	—	86/—	86	86	—	—
Chaetomium Globosum (6205)	—	86/—	86	86	—	—
Memenoniella Echinata (9597)	—	86/—	86	86	—	—
Penicillium Citrinum (9849)	—	86/—	86	86	—	—
Furfural	5	AMB	AMB	—	—	120/150
Furfural	10	—	—	—	—	100/120
Furfural	50-100	NR/—	—	NR	NR	NR
Furfuryl Alcohol	100	—	100	—	—	—
Furnace Oil	—	—	—	AMB/—	—	—

[20] AROPOL 7343 satisfactory.

[21] Vol. %: SO_2, 0.25; SO_3, 0.03; CO_2, 12.5; N_2, 74.6; O_2, 4.9; H_2O, 7.8; fly ash, 5.0 grams/ft³; velocity 60 fps

[22] Vol. %: SO_2, 0.25; SO_3, 0.003; CO_2, 12.5; N_2, 74.6; O_2, 4.9; H_2O, 7.8; fly ash, 1.2 grams/ft³; velocity 8 fps

[23] 0.12% SO_2/5% O_2/12% CO_2/70% N_2/13.4% H_2O; 5 grams/ft³ of 1-2% H_2SO_4, 2-3000 ppm HCl, 10-20 ppm HF, rust water.

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Fusion 12-62† @ 175°F	—	NR	NR	NR	NR	NR
G-61†	100	—	125	—	—	—
Gallic Acid	Sat'd	—	80	—	—	—
Gallotannin	100	—	200	—	—	—
Galvanizing Line Fumes	—	—	200	—	—	—
Garbage Incinerator Fumes	—	—	180	—	—	—
Garbage Incinerator Water Scrubber	—	—	180	—	—	—
Gas Oil, Dirty, Refinery	—	—	—	AMB/—	—	—
Gasohol; 91.8% Unleaded: 8.2% Ethanol	—	—	80	100[13]/NR	—	—
Gasohol; 93.6% Unleaded: 6.4% Ethanol	—	—	—	100[13]/NR	—	—
Gasoline	100	194/130	194	130/100	100	100
Gasoline, Aviation	100	175/—	175	175/100	—	100
Gasoline: Benzene	90:10	—	AMB	AMB	NR	—
Gasoline Components	—	—	—	AMB/—	—	—
Gasoline, Ethyl	100	100/—	100	100	—	100
Gasoline, Lead Free	—	—	—	160/100	—	100
Gasoline, Marine	100	—	80	80	—	—
Gasoline, MS-08	—	—	AMB/—/—	—	—	—
Gelatine[4]	—	—	—	100	—	—
Geothermal Water	—	—	—	125/—	—	—
Germicidal Detergents	Conc.	—	100	—	—	—
Geyser Water, Condensate	—	—	—	125/—	—	—
Glass Cleaner, Fortified with NH_4 (Spartan Chemical Co.)	—	—	100	—	—	100/—
Globrite 15†	—	—	160	160/100	180/150	180/—
Globrite X-200†	—	—	100	100	100	100/—
Gluconic Acid	50	—/120	125	125	100	100/125
Glucose	100	180	180	180/150	100	210/220
Glycerin Still Tailings with Small Amount Sulfuric to 330°F	—	—	—	—	NR	NR/—
Glycerine	100	200	200	180/150	160	210/220
Glycerine in Salt Sat'd. Water	70	—	70-240	—	—	—
Glycerol Dibromohydrin; Small Amount Tribromopropane & Brominated Organics	100 @ 80-120°F	—	—	—	NR	NR/—
Glycol	All	250/—	250/250/200	180/150	220/200	200
Glycolic Acid	35	140	140	140/120	140	180/200
Glycolic Acid	70-100	120	100	120	100	AMB/100
Glyoxal	40	—	—	—	—	80
Glyoxylic Acid @ 215°F	25	NR/—	NR	NR	LS[*]/NR	LS/—
Glyoxylic Acid: SO_2 @ 215°F	25:Sat'd	NR/—	NR	NR	LS[*]/NR	LS/—
Gold Pickling, Sulfuric	25	—	150	150/—	150	150
Gold Plating, pH 4.4	—	—	—	—	125/—	—
Gold Plating Solution (23% Potassium Ferrocyanide with Potassium Gold Cyanide and Sodium Cyanide),	—	—	200	—	200	180/—
Gold Smelting Furnace Gas and Dust, Wet up to 400°F	—	NR/—	SAT/SAT/NR	NR	NR	NR
Golden-Glo†	—	—	100	100	100	100/—
Golf Ball Scouring-Cleaning Solution	—	AMB/—	—	—	—	—
Green Liquor	@200°F	NR/—	NR	—	SAT/—	SAT
Gypsum Slurry + 1% H_3PO_4, + Trace HF[3]	—	—	100	—	—	—
Gypsum Slurry Cooler (Fertilizer Plant)	—	—	190	—	—	—
Halso 99†	100	NR	NR	NR	NR	NR/—
Hard Chrome Plating Baths	—	—	130	—	—	—
HAS (Hydroxylammonium Acid Sulfate): Sulfuric: Water[4]	20:60:20	—	100	—	—	—
HAS (Hydroxylammonium Acid Sulfate): Sulfuric: Water[4]	11:75:14	—	100	—	—	—
HCl: Methylimino Ether: Methanol: Isobutyronitrile: Impurities	23:74:2:0.3:1	—	—/77/—	—	—	—
Heating Oil	—	—	—	AMB/—	—	—
Helium, Liquid	100	HETRON 31 SAT, No Vei , to -452°F				
Heptane, Dissolved Heavy Organics, Traces H_2O, $ZnCl_2$, HCl - 60% Methanol, H_2O, HCl, $ZnCl_2$, Organics - 2 Phases	—	—	140	—	—	—
Heptane, normal	100	AMB/120	200/200/—	200/—	200/150	160
Heptane, Traces Water, HCl; Other Heavy Organics	—	—	208	—	—	—
Heptane, Vapor & Condensate	100	120	120	120	—	120
Herbicide, Liquid[4]	1 to 10	—	120	80/NR	—	—
Herbicide Powder & Fumes	—	—	100	—	—	—
Hexachlorocyclopentadiene	100	80/—	200	NR	NR	180
Hexachlorocyclopentadiene, Crude	—	—	180	—	—	180
Hexachlorocyclopentadiene; High Purity	100	90/—	90	—	—	—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Hexachlorocyclopentadiene; Reg. & High Purity Wet With H_2O	99 +	90/—	90	—	—	—
Hexachloroendomethylene Tetra-hydrophthalic Anhydride, Wet	100	86/—	86	—	—	—
Hexamethylenetetramine	28	80	80	—	80	—
Hexane	100	—	80-156*	80-156/—	80-156	100
Hexylene Glycol Ammonium Chloride	—	120/—	120*	120*/120	120	120/—
High Purity Water, 1.5 μmho/cm.	100	—	—	AMB[11]/NR[11]	—	—
Hog Fuel Flue Gases, Some HCl, pH 3.7-7	—	—	155	—	LS155/—	—
"Huff", Missouri, Okla. or Texas	100	—	90/—/—	90/—	—	—
Humid Air, Trace Sulfur Fumes	—	—	200	200/—	—	—
Humid Atmosphere	100 RH	120	120	120	120	120
Hydraulic Fluid, Skydrol 500†	100	—	160	130/100	—	150/180
Hydrazine	10	—	100	—	—	—
Hydrazine	70	NR/—	NR	NR	NR	NR
Hydriodic Acid	10-58	—	—	NR	—	—
Hydrobromic Acid	18	—/160	200	160/100	200/160	210/220
Hydrobromic Acid	25	—/160	200	160/100	200/160	200
Hydrobromic Acid	48	—	200	160/—	160	150
Hydrobromic Acid: Copper Oxide: Bromine	50:5:Trace	—	AMB	—	—	—
Hydrobromic Fumes @ 290°F	100	—	SAT/SAT/NR	—	—	—
Hydrocarbon Alkylation	Unknown	—	120	—	—	—
Hydrocarbon With About 10% Acetic Acid, Liquor and Vapor	—	—	—	—	—	160-220/—
Hydrocarbons: Ferric Chloride Mist	Unknown	—	—/250/—	—	—	—
Hydrochloric Acid[3]	1-5	—	—	180/150	LS200	210/220
Hydrochloric Acid[3]	10	230	230	180/150	230/200	210/220
Hydrochloric Acid[3]	15	230	230	150	150	210/220
Hydrochloric Acid[3]	20	230	230	150/100	150	210/220
Hydrochloric Acid[3]	32	85/90	180*	125/90	150	180
Hydrochloric Acid[3]	36	85/90	150	125/90	150/120	150
Hydrochloric Acid[3]	36-37	85/—	100*	100/NR	140/—	100
Hydrochloric Acid[3]	37.5	—	—	—	LSAMB/NR	—
Hydrochloric: Amine @ 200°F[3]	1.1:2.9	—	SAT/SAT/NR	—	SAT/NR	SAT/—
Hydrochloric: Ammonium Thiocyanate	Unknown	—	160	—	—	—
Hydrochloric Acid (12%) + Aqueous Ammonia to pH 0.3	—	—	180	—	180	180*/—
Hydrochloric Acid, 20° Be: Amine	98.8:0.2w/w	—	77	—	—	—
Hydrochloric Acid @ B.P.	20	—	—	—	NR	—
Hydrochloric: Brighteners[3]	10:30	—	120	—	—	—
Hydrochloric: Chlorinated Hydrocarbons	32:<5 @ 80°F	—	—	—	—	NR/—
Hydrochloric (32%):Chlorinated Organic Contaminates (phase separation — 2/3 acid: 1/3 organic)	88.3:11.7 @ 104°F	—	NR	—	—	—
Hydrochloric Acid (32%): Chlorinated Organics	99:1 @ 104°F	—	NR	—	—	—
Hydrochloric (32%): Chlorinated Organics: Trichloroethylene	88.1:0.9:14@ 104°F	—	NR	—	—	—
Hydrochloric: Cl_2; Aromatic Sulfonic Acid; H_2SO_4	25	—	80	—	—	—
Hydrochloric Acid, Cl_2, Water, Chlorinated Organics	Unknown	—	80*/80/NR	—	—	NR/—
Hydrochloric Acid: 2, 6-Dichloro-4-aniline @ 170°F	32	—	—/LS/NR	LS/NR	LS/NR	LS/—
Hydrochloric: Fluoride Salts[3]	10:30	—	120	—	—	—
Hydrochloric Acid + Free Cl_2	All	200/—	200	—	—	—
Hydrochloric Acid, Fumes @ 225-290°F	—	—	—/SAT/NR	—	—	—
Hydrochloric: Hydrofluoric: Nitrate[3]	77:13:10	—	100	—	—	—
Hydrochloric Acid: Inerts: N-Alkyl Dimethyl Benzyl Ammonium Chloride: Tributyl Tin Chloride/Ethylene Oxide/Amine	23:77:0.1:0.1	—	100	—	—	100/—
Hydrochloric: Methyl Isobutyl Ketone	15:100	158-203/—	—/158-203/NR	—	—	—
Hydrochloric: Methyl Isobutyl Ketone; NH_4CNS	15	—	203	—	—	—
Hydrochloric: Nitric Acid[12]	20:5	—	210/210/—	—	—	—
Hydrochloric: Nitric: Sulfuric @ up to 225°F	6 Molar:10-20:10	NR/—	—	NR	—	NR/—
Hydrochloric: Phenol: Aqua Regia	Conc:0.5:0.5	—	80	—	—	—
Hydrochloric: 500 ppm Phenol; 50 ppm Octyl, Decyl, Butyl, Phosphorous Chlorides	37	—	100	—	—	—
Hydrochloric Acid: Phenol: Water	10:20:70	NR/—	NR	NR	NR	NR/—
Hydrochloric: Phosphoric Acids	Unknown	—	120	—	—	—
Hydrochloric: Phosphoric: Butyl Ether	Unknown	—	120	—	—	—
Hydrochloric Acid Pickling Tank Covers & Fumes[3]	30	—	—/to 215/—	—	—	—
Hydrochloric: Silicone Oils	21	—	195	—	—	—

[11]No change in water at 0.1 ft.[2] laminate/gal. as in 20-30,000 gal. tank.
[12]AROPOL 7530 satisfactory.

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON† 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Hydrochloric: Sulfuric	14:45	—	140	—	—	—
Hydrochloric: Sulfuric: Antimony Trioxide	15:35:5	—	100	—	—	—
Hydrochloric: Sulfuric: Nitric	30:20:10	—	90	—	—	—
Hydrochloric: Terephthalic Acid: Dimethyl Formamide: Water	28:14:7:51	—	100	—	—	—
Hydrochloric Acid, Trace Phenol; Octyl, Decyl, Butyl Chlorides & Phosphorous Trichloride	37	—	80	—	—	—
Hydrochloric (aqueous) + Organic Solvents	Unknown @ 194°F	—	NR	—	—	—
Hydrochloric with 2, 6 Dichlor-4-nitroaniline	32	—	170	NR	170	—
Hydrochloric, 10% by volume with Ferric and Ferrous Chlorides, pH 1	—	—	120	—	—	—
Hydrochloric, Sat'd. Ferrous Chloride[3]	15	NR/—	240/240/—	—	—	—
Hydrochloric, Small Amount Acetone	—	—	—	—	—	120/—
Hydrochloric, Trace Organics	36	—	80	80	—	—
Hydrochloric, Trace Phenol and Cresylic Acid @ 175°F	32	NR/—	LS/LS/NR	LS/NR	NR	NR/—
Hydrochloric, Trace Toluene & Chlorotoluene	25-30	—	140	—	—	—
Hydrochloric Trimethylamine	37:100	—	130	—	—	—
Hydrochloric, 60% by Vol.: Hydrofluoric, 20% by Wt.: Sulfuric, 28% by Wt.: Sodium Dichromate, 3% by Wt.[3]	—	—	120	—	—	—
Hydrocyanic Acid	Sat'd	200	200	100/—	200	150/—
Hydrofluoric Acid[3]	5M @ BP	NR/—	NR	NR	NR	NR
Hydrofluoric Acid[3]	8M @ BP	NR/—	NR	NR	NR	NR
Hydrofluoric Acid[3]	10	100	AMB	100/NR	100	150
Hydrofluoric Acid[3]	15	100	90	90/—	90	100
Hydrofluoric Acid[3] @ 195°F	20	NR	SAT/SAT/NR	NR	100	100
Hydrofluoric Acid[3] @ 195°F	22	—	SAT/SAT/NR	NR	LS/NR	LS/—
Hydrofluoric Acid[3]	40	—	AMB	NR	NR	NR
Hydrofluoric Acid @ 100°F	15	SAT	—/—/LS	NR	—/LS	SAT
Hydrofluoric: Chlorine: Nitric Oxide Fumes[3]	Unknown - Hot	—	—	—	NR	—
Hydrofluoric: Chromic: Nitric Acids[3]	3:6:2	—	80	—	—	—
Hydrofluoric, 49%: Glacial Acetic: 70% Nitric	1:2:5 @ 110°F	NR/—	NR	—	—	—
Hydrofluoric, 49%: Glacial Acetic: 70% Nitric	1:3:8 @ 100°F	NR/—	NR	—	—	—
Hydrofluoric: Hydrochloric: Nitric[3]	13:77:10	—	100	—	—	—
Hydrofluoric, 20% by Wt.: Hydrochloric, 60% by Vol.: Sulfuric, 28% by Wt.: Sodium Dichromate, 3% by Wt.[3]	—	—	120	—	—	—
Hydrofluoric Acid: Nitric[3]	5:15	—	165	—	—	—
Hydrofluoric Acid: Nitric[3]	2.5:7.5	—	165	—	—	—
Hydrofluoric Acid: Nitric[3]	2-3:20	—	135	—	—	—
Hydrofluoric: Nitric Acids	24:12 @ 80°F	NR/—	NR	NR	NR	NR
Hydrofluoric: Nitric Acids	4:15 @ 190°F	—	—	—	NR	—
Hydrofluoric: Nitric Acids	5:50 @ 120°F	NR/—	NR	NR	NR	NR
Hydrofluoric: Nitric Pickling[3]	Unknown	—	Hot	—	—	—
Hydrofluoric: Nitric Pickling Solution[3]	3.5:20	—	105	—	105/—	105/—
Hydrofluoric: Phosphoric: Chromic[3]	2:40:7	—	100	—	—	—
Hydrofluoric: Phosphoric: Chromic[3]	11:8.5:9.3	—	100	—	—	—
Hydrofluoric Acid: Stannous Fluoride	20:50 @ 220°F	NR	—	—	—	—
Hydrofluosilicic Acid[3]	10	100	180	100/—	150/100	150
Hydrofluosilicic Acid[3]	35	NR	160	NR	AMB	100
Hydrogen	100	250	250	—	—	—
Hydrogen Bromide, Dry	100	90	—	AMB	—	180
Hydrogen Bromide, Wet	100	—	—	AMB	—	180
Hydrogen Chloride	Conc. @ 210-212°F	—	—	NR	NR	—
Hydrogen Chloride, Absorber	36	—	235/235/—	NR	—	—
Hydrogen Chloride, Anhydrous	100	250	250	AMB	—	—
Hydrogen Chloride and Benzene Vapors	—	—	85	—	—	—
Hydrogen Chloride: Chlorine Saturated with Tetrachlorocyclopentane, CCl_4, Trace Hexachlorocyclopentane	65:35	—	125	—	—	—
Hydrogen Chloride, Cl_2, CO_2, CO, H_2, N_2, O_2	—	—	AMB	—	—	—
Hydrogen Chloride Fumes @ 350°F	Unknown	—	SAT/SAT/NR	—	—	—
Hydrogen Chloride Gas: Chlorine @ 392°F	Unknown	—	SAT/SAT/NR	—	—	—
Hydrogen Chloride Gas, Dry	100	—	120	120	180/AMB	210/220
Hydrogen Chloride Gas, Wet	100	120	120	120	—	210/220
Hydrogen Chloride, Steam[3]	Unknown	—	240/240/—	—	NR	—
Hydrogen Fluoride, Cl_2, Nitric Oxide Fumes[3]	Unknown	—	Hot	—	—	—
Hydrogen Fluoride, Vapor[3]	35	95	95	—	95	—
Hydrogen Fluoride, Wet[3]	12	90	160	—	—	180/200
Hydrogen Fluoride, Wet[3]	100	90	—	AMB	—	AMB
Hydrogen Iodide: Iodine Vapor	—	150/—	150	—	—	—
Hydrogen Iodide: Sulfuric	66 gpl:25 gpl	—	158	—	—	—
Hydrogen: Ozone	—	—	100	—	—	—
Hydrogen Peroxide	5	—	210	180/NR	AMB	150

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON' 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Hydrogen Peroxide	30	—	—	—	—	100
Hydrogen Peroxide	35	105/120	105/105/NR	—	AMB	LS180/—
Hydrogen Peroxide	50	100*/—	100*/100/—	NR	NR	—
Hydrogen Peroxide: Sulfuric: $ZnSO_4$:NA_2S:O_2	2:1.5:Traces	—	—	—	—	210/—
Hydrogen Peroxide, Vapor & Condensate	5	120/—	120	—	—	—
Hydrogen Peroxide Vapors	50	100	140	—	—	—
Hydrogen Sulfide	All	250	250	140	140	210/220
Hydroxyacetic Acid	35	140	140	—	—	—
Hydroxyacetic Acid	70	—	100	—	—	—
Hydroxyacetic: Phosphoric: Sulfuric Acids[4]	29:51:20	—	243/243/—	—	—	—
Hydroxylamine Acid Sulfate (Hydroxylammonium Acid Sulfate)	90	—	212	—	—	—
Hydroxylamine Acid Sulfate: Sulfuric	Sat'd:70	—	125	—	—	—
Hydroxylammonium Acid Sulfate (Hydroxylamine Acid Sulfate)	90	—	212	—	—	—
Hydroxylammonium Acid Sulfate: Propionic Acid: Water	89:1:10	—	175	—	—	—
Hydroxylammonium Acid Sulfate: Sulfuric	86-90:10	—	180	—	—	—
Hydroxylammonium Acid Sulfate: Sulfuric Water[4]	11:75:14	—	100	—	—	—
Hydroxylammonium Acid Sulfate: Sulfuric Water[4]	20:60:20	—	100	—	—	—
Hypochlorous Acid	10	104	104	104	AMB	150
Hypochlorous Acid	20	AMB	AMB	AMB/NR	AMB	120
Hypochlorous Acid	Conc.	AMB	AMB	AMB/NR	—	AMB
Hypophosphoric Acid	50	—	—	—	—	100
Hypophosphorous Acid	50	—	115	—	—	AMB
Igepal CO — 630†	100	—	105	—	—	—
Ilmenite Ore: Sulfuric, Steam-Air Agitation @ 220°F	30-40:10-20	NR[14]/—	—	—	—	—
Iminoethyl Alcohol	100	—	110	—	—	—
Incinerator, Chemical	Flue gas	—	300/300/—	—	—	—
Incinerator, Garbage, Fumes	—	—	180	—	—	—
Incinerator Water Scrubber	—	—	180	—	—	—
Iodine: Hydrogen Iodide Vapor	—	150	150	—	—	—
Iodine-Kerosene-Brine	—	—	120	—	—	—
Iodine Vapor	100	175/180	175	—	—	—
Irgasol DA†	100	—	AMB	—	AMB*	AMB/—
Iron Perchloride	—	—/140	—	—	—	—
Iron Perchloride	20	140/—	—	—	—	—
Iron Plating Solution 45% $FeCl_2$; 15% $CaCl_2$; 20% $FeSO_4$; 11%; $(NH_4)_2SO_4$	—	—	180	—	—	—
Iron and Steel Cleaning Bath, 9% Hydrochloric; 23% Sulfuric	—	—	180	—	—	200/—
Isobutyl Alcohol	All	—	—	—	—	100/120
Isocure† 306	100	—	AMB*	AMB*	AMB*	AMB/—
Isocure† 308	100	—	AMB	AMB	AMB	AMB/—
Isocure† 608	100	—	AMB	AMB	AMB	AMB/—
Isocyanate, Polymethylene Polyphenyl	100	—	—	120	NR	—
Iso-Decanol	All	—	150	160/—	—	150/180
Isoprep 33†	5 oz/gal	—	—	165/150	165	165/—
Isoprep 44†	10 oz/gal	—	—	NR	180	180/—
Isopropyl Alcohol	100	—/90	158/158/—	80/NR	AMB	80/100
Isopropyl Alcohol	10	—	158/158/—	130/80	AMB	80/100
Isopropyl Alcohol: Sodium Xylene Sulfate: O-Phenylphenol: Potassium Ricinoleate: Inerts	10:10:6:6:67	—	100	—	—	100/—
Isopropyl Amine	100	—	AMB	—	—	100/120
Isopropyl Palmitate	100	—/180	—	180/—	220/—	210/220
Itaconic Acid	25	—	95	—	125	120/210
Itaconic Acid	10	—	100	—	125	120/210
Jet Fuel A	—	—	—	AMB/—	—	—
Jet Fuel (JP-4)	100	—	—	180/150	AMB	120
Jet Fuel PFB	—	—	—	AMB/—	—	—
JM-235† Adhesive	—	—	100	100	100	100/—
JM-271† Adhesive	—	—	100	100	100	100/—
JP-9 Fuel	100	—	—	80	—	—
JP-10 Fuel	100	—	—	80/—	—	—
Kaolin Slurry	—	—	80	80	—	—
Kerosene	100	175/120	175	180/150	150	150
Kerosene, 70%, 10% Isodecanol, 20% organics: 30% Phosphoric	—	—	150	—	—	—
Kerosene: Vapor & Condensate	100	120	120	—	—	—
Kerosene: Xylene: 85% Phosphoric	33:33:35	—	100	—	—	—
Knotter Fumes	—	—	180	—	—	—
Kymene†, Resin Solution	30-40	—	90	—	—	—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Lactic Acid	All	200	200	160/130	220/200	210/220
Lactic: Citric Acids	Sat'd	—	160	160/130	—	—
Lasso EC†	100@ 140°F	—	NR	—	NR	NR/—
Lasso EC†	100	—	80	—	80	80/100
Lasso† Herbicide[6]	1 to 10 Dilution	—	120	—	—	—
Latex, Acrylic	All	—	—	—	—	100
Latex Dispersion in Water	62	—	100	—	100	—
Latex, Rubber	All	—	—	—	—	100
Latex, Vinyl	All	—	—	—	—	100
Lauric Acid	Sat'd	—	—	160/130	220/200	210/220
Lauric/Myristic Monoethanolamide: Sodium Xylene Sulfonate Solution	—	—	120*	—	120	120/—
Lauryl Alcohol	100	—	120	120/—	120	120/—
Lauryl Chloride	100	—	212	—	—	—
Lauryl Chloride, Crude, Acidic	100	—	212	—	—	—
Lauryl Mercaptan	100	—	120	—	—	—
Lauryl Pyridinium Chloride	10	—	155	—	—	—
Lead Acetate	All	160	160	160/—	160	210/220
Lead Chloride	Sat'd	—	—	—	220/200	210/220
Lead Nitrate	Sat'd	—	—	—	220/200	210/220
Lead Plating, Acid; Fluoboric, Boric Acids[3]	—	—	200	—	200	160/—
Lead Plating, Alkaline, Pb $(C_2H_3O)_2$, NaOH[3]	—	NR/—	NR	—	180	—
Lead: S: CuO: FeO: $ZnSO_4$: $Bi_2(SO_4)_3$ Dust	25:25:18:10:8:3	—	200	—	—	—
Lead Smelter Fumes, Duct	—	—	SAT	—	—	—
Leather Dyeing & Finishing	—	SAT/—	SAT	—	—	—
Leather Tanning, Drums	—	—	SAT	—	—	—
Levulinic Acid	Sat'd	—	—	160/—	—	210/220
Light Gas Cycle Storage	—	—	—	AMB/—	—	—
Light Water, FC195†	100	160/—	160	—	—	—
Light Water, FC203†	100	NR/—	120	120*	120	NR/—
Light Water, FC206A†	100	NR	120	120*	120	NR
Lignin: Crude Tall Oil: Spent Acid: Sulfuric, pH3	60:10:29:1	—	200	—	200	NR/—
Lignosulfonate, pH 1.5-2	— @ 212°F	—	—	—	NR	—
Ligno-Sulfonic Acid	—	—	AMB	—	—	—
Lime Kiln Stack Gases	—	—	300	—	—	—
Lime Neutralization Effluent; Chlorinated Fluorinated Organics, Chlorides, Fluorides, HCl, HF, H_2O[3]	—	—	105	—	—	—
Lime Slurry	Sat'd	180	180	170/80	—	170
Lime, Thiosorbic	Sat'd	—	150	—	—	—
Limestone Injection, SO_2 Removal, Fossil Fuel, Mist After Scrubber, pH 2-12	—	—	140	—	—	—
Linear Alkylate Sufonates	Conc.	—	100	—	—	—
Linoleic Acid	100	—	—	160/—	—	—
Linseed Oil	100	150/—	203	160/130	200/150	210/220
Linseed Oil, Chlorinated	—	—	90	—	—	—
Liquid Chlorine[2]	100	—	LS-55	NR	-55	-55/—
Lithium Bromide	All	—	—	—	—	210/220
Lithium Carbonate[3]	Sat'd	NR/—	180	—	180	150
Lithium Chloride	0-45	250/—	250/250/—	—	180	210/220
Lithium Chloride	28-40	—	285/285/—	—	—	210/220
Lithium Chloride	45-55	140/—	140	140/—	—	210/220
Lithium Chloride	Sat'd	160	160	160/—	—	210/220
Lithium Chloride: Methyl Alcohol	25:75	—	170	—	—	—
Lithium Hydroxide[3]	Sat'd	NR/—	NR	—	180*	150
Lithium Sulfate	All	—	—	—	—	210/220
Livestock Spray Base (Shell's): cobalt di(2-ethyl hexyl) phosphate: tr-m-butyl phosphate	65:5:30	—	176	—	—	—
Lix 64N†	100	—	115	—	—	—
LPC	10	—	155	—	—	—
Machine Oil & Sulphur Fumes	—	—	HOT	—	—	—
Magnesite Mill Spent Liquor	—	—	150	—	—	—
Magnesite Recovery Boiler Blow-Down; Acetic: Sulfuric: Sulfurous: Formic Acids; Acetone	—	—	212	NR	212/200	—
Magnesium Bicarbonate	Sat'd	—/150	—	180/130	180	180
Magnesium Bisulfite	All	—	—	—	—	180
Magnesium Bisulfite Acid Liquor, 5% SO_2, Chlorides, pH 4.5-5[10]	—	—	180	—	—	—
Magnesium: Calcium: Sodium Chloride Solution	2:10:12	—	150	—	—	—
Magnesium Carbonate	Sat'd	160	160	180/150	150	180
Magnesium Chloride	Sat'd	220	220	180/150	220/200	210/220
Magnesium Chloride, Hexahydrate; Filter Aid; Activated Carbon	66	—	310/310/—	—	—	—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Magnesium Chloride, Occasional HCl Vapors	Conc. @ 275°F to 500°F at times	—	—	—	NR	—
Magnesium Chloride: Sodium Chloride: Calcium Chloride	2:12:10	—	150	—	—	—
Magnesium Hydroxide[3]	Sat'd	—	—	—/NR	200	210/220
Magnesium Nitrate	Sat'd	—/160	—	160/130	—	160
Magnesium Oxide	Sat'd	—	150	—	—	—
Magnesium Oxide Acid Condensate	—	—	160	—	—	—
Magnesium Oxide — Fluoride Mist and Fumes[3]	—	150/—	—	—	—	—
Magnesium Sulfate	Sat'd	200	200	180/150	200	210/220
Magnifloc 509-C†	—	—	—	90	—	—
Magnifloc 573-C†	—	—	—	90	—	—
Magnifloc E343†	—	—	—	90	—	—
Maleic Acid	5	—	—	—	—	210/220
Maleic Acid	Sat'd	200/—	200	160/100	200	180
Maleic Acid, Trace Phthalic, Fumaric, Benzoic, Quinone	18	—	120/120/—	—	—	—
Maleic Anhydride	100	—	—	150/120	—	150
Maleic Residue	—	—	185	—	—	—
Maleic Residue, > 0.5% Phenol	— @ 185°F	NR/—	NR	—	NR	—
Malic Acid	10	—	95	—	—	—
Manganese: Ammonium Sulfates, pH5	13:158 gpl	125*/—	125	125*	—	—
Manganese: Ammonium Sulfates: Sulfuric pH5	13:135:40 gpl	125*/—	125	125*	—	—
Manganese Sulfate	Sat'd	—	—	—	—	210/220
Manganese Sulfate: Sulfuric	90:10	—	100	—	—	—
Manganese Sulfate: Sulfuric Acid	50:28 (gpl)	—	203	—	—	—
Marine Fouling	—	100/—	100	—	—	—
Marine Gasoline	100	—	80	80	—	—
Matar†, Germicidal Detergent	Conc.	—	100	—	—	—
MEK: DMP: MEK Peroxide	63:36:1	—	—/LS-85/NR	—	—	—
MEK, 100%: Sulfuric Acid, 50%	10:90	80/—	80*	80*/—	80	80*/—
MEK: Toluene: Steam: Maleic Acid; Chlorides present	0-30:0-30:-:trace	—	—	—	—	—
Melamine Resin	—	—	80	—	—	—
Mercaptan, Aromatic	100	—	80	NR	—	—
Mercaptan, Organic, H_2S, H_2O, Butanol	—	125/—	—	—	—	—
Mercapto-Ethanol	100	—	65-80	—	—	—
Mercapto-Ethanol Tall Oil	100	—	65-80	—	—	—
Mercapto-Ethanol Tallate	100	—	65-80	—	—	—
Mercaptopropionic Acid	100	NR/—	NR	NR	NR	NR/—
Mercaptopropionic, Crude Acid	100	NR/—	NR	NR	NR	NR/—
Mercuric Chloride	Sat'd	212	212	180/150	220/200	210/220
Mercurous Chloride	Sat'd	212	212	180/130	220/200	210/220
Mercury	100	250	250	180/—	220/200	—
Metal Phosphate Salts	Sat'd	—	80	—	—	—
Metal Phosphates, Trace HF, Hydrofluosilicic[3]	30	—	80	—	—	—
Metal Sulfate-Salts: Sulfuric Acid	24:10	—	135	—	—	—
Methacrylic Acid	100 @ 145°F	NR/—	NR	NR	—	—
Methacrylic Acid	10	—	100	—	—	—
Methacrylic, Glacial	100	—	90	—	—	—
Methallyl Chloride @ 165°F	100	—	—/LS/NR	NR	—	—
Methanamide @ 100°F	100	—	SAT*	SAT/LS	SAT/LS	LS
Methanol 60%, H_2O Trace, HCl, $ZnCl_2$, Organics, Heptane, Dissolved Heavy Organics, Traces H_2O, HCl, $ZnCl_2$, 2 Phases	—	—	140	—	—	—
Methanol/Nitrogen Oxide Fumes, @ 220°F	Unknown	—	—	—	NR	—
Methyl Acrylamide	48	—	90	—	—	—
Methyl Alcohol	100	AMB	125	90/NR	150/NR	NR/120
Methyl Alcohol: Lithium Chloride	75:25	—	170	—	—	—
Methyl Alcohol: Methyl Chloride: Hydrochloric	94:0.4:0.2	—	135	—	—	—
Methyl Alcohol: Turpentine	to 85: to 48 @ 150°F	—	—	—	—/NR	NR/—
Methyl Alcohol: Water: Hydrochloric @ 150°F	93:5:2 Vapor	—	—/LS/NR	—	—/NR	—
Methyl Bromide: Ethylene Dibromide	30:70 @ 75°F	NR/—	NR	—	—	—
Methyl Chloride	100	40/—	40	—	—	—
Methyl Chloroform	100	—	80	—	—	—
Methyl Ethyl Ketone	100	NR/—	NR	NR	NR	NR
Methyl Ethyl Ketone @ 120°F	100	NR	NR	NR	NR	NR
Methyl Ethyl Ketone: Dimethyl Phthalate: MEK Peroxide	63:36:1	—	—/LS-85/NR	—	—/NR	NR
Methyl Ethyl Ketone, Vapor & Condensate	100 @ 120°F	NR/—	—	—	—	—
Methyl Isobutyl Ketone	100	—	50	NR	NR	NR
Methyl Isobutyl Ketone; 200 gpl Fluorides; 500 gpl Sulfuric Acid[2,3]	—	—	80	—	—	—

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON® 92/99P	HETRON 72,197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Methyl Isobutyl Ketone; 300 gpl Fluorides; 40 gpl Hydrofluoric Acid[2,3]	—	—	80	—	—	—
Methyl Isobutyl Ketone: Hydrochloric Acid	100:15	158-203/—	—/158-203/NR	—	—	NR
Methyl Methacrylate	100 @ 75°F	—	—	NR	NR	NR
Methyl Parathion	—	—	—	—	—	NR/—
Methyl Phenol Fumes	100	—	80	—	—	—
Methyl Styrene	100	NR/—	NR	NR	NR	NR
Methylene Bisthiocyanate, Polychlorophenol Blend @ 125°F	100	—	—/LS/NR	SAT/—	SAT	—
Methylene Chloride	100	NR	NR	NR	NR	NR
Methylene Chloride: Chloroacetic Acid	90:5	NR	—	NR	—	NR/—
Methylene Chloride: Chloroform: Carbon Tetrachloride, Small Amount Methyl Chloride, H_2O, HCl	65:39:5	NR	NR	NR	NR	NR/—
Methylene Chloride Distillate Bottoms; High Caustic, Water, to 212°F	—	NR	NR	NR	NR	NR/—
Methylene Chloride: Ethyl Acetate: Caustic, 50%	83:16:1	NR	NR	NR	NR	NR/—
Methylene Chloride: Toluene	50:50	—	—	—	—	—
Methylene Chloride: Toluene: Xylene: MEK & MIBK: Benzenes: TCE: CCl_4	33:39:9:2:3:6:1	—	—	—	—	—
Methylene Succinic Acid	25	—	100	—	—	—
Methylimino Ether: Methanol: Isobutyronitrile: HCl: Imputities	74:2:0.3:23:1	—	—/77/—	—	—	—
Methylisobutyl Ketone: Cyano-acetic; 0.8 Sulfuric in Saturated Sodium Chloride @ 100°F	60:8	—	LS-SAT	—	—	—
Methylol Acrylamide	48	—	—/90/90	—	90	—
Milk & Milk Products	—	—	—	AMB*	AMB	AMB
Milk Wagon Cleaner	Acid	—	—	—	80	80/—
Milk Waste	—	—	—	180/150	—	180/—
Mineral Oils	100	AMB/180	AMB	180/150	220/AMB	200/210
Mineral Wool Slurry	Unknown	Hetron® 197-3 with filler satisfactory for agitated tank. Ambient				
Moisture	100 RH	120	120	—	—	—
Molten Salt	Splash & Spills	750/—	750	—	—	—
Monel & Nickel Cleaning Baths; HCl, $CuCl_2$	—	—	180	—	—	—
Monel & Nickel Cleaning Baths; HCl, $Fe_2(SO_4)_3$	—	—	180	—	—	—
Monochloroacetic Acid	50	—	AMB	—	—	—
Monochloroacetic Acid	80 @ 160°F	NR/—	NR	NR	NR	NR/—
Monochloroacetic Acid	100 @ 145°F	NR/—	NR	NR	NR	NR/—
Monochlorobenzene	100	NR	NR	NR	NR	NR/75
Monoethanolamine	100	—	AMB	NR	AMB	NR/AMB
Monoethanolamine: Butyl Cellosolve Film Stripper @ 138°F	30:57	NR	NR	NR	NR	NR/—
Monoethanolamine Desulfurizing SO_2, H_2S	100	NR	NR	NR	NR	NR/—
Monohydroxysuccinic Acid	10	—	95	—	—	—
Monosodium Phosphate, pH 1-3	5-10	—	200	—	—	—
Morpholine	10	—	100	—	—	—
Morpholine @ 120°F	100	NR	NR	NR	NR	NR/—
Motor Oil	100	—	—	—	—	210/220
MS-08 Gasoline	—	—	AMB/—/—	—	—	—
Mulsoline 6000†	—	—	150	—	—	—
Muriatic Acid		See Hydrochloric Acid				
Mustard (3% Sodium Chloride, 5% Acetic Acid)	—	—	—	160/—	—	—
Myristic Acid	All	—	—	—	—	210/220
Myristic/Lauric Monoethanolamide: Sodium Xylene Sulfonate Solution	—	—	120*	—	120	120/—
Naphtha	100	200	200	180/150	150	180/200
Naphthalene	100	AMB/130	AMB	150/120	180	180/200
Naphthenic Acid	Sat'd	—	—	180/—	—	—
Naphthoquinone, 1, 4	Sat'd	—	150	—	—	—
Naphthoquinone (scrubbing with water)	Unknown	—	150	—	—	—
Naphthylamine Sulfonic Acid	Sat'd	—	108/—	—	—	—
Neodol 25-3S†	100	—	120*	—	120	—
Neopentyl Glycol	90	—	150	—	—	—
Nickel Anolyte Liquor (Inco Metals)	81 Ni etc.	—	—	—	150/—	—
Nickel, Bright	—	—	180	—	—	—
Nickel Chloride: Nickel Sulfate: Boric Acid	12:53:8 oz/gal	—	180	—	—	—
Nickel Chloride	Sat'd	220	220	180/150	220/200	210/220
Nickel-Cobalt + Solvent Extraction Circuit; pH 1.8-4.5; 0.3-1.5 gpl fluorides	—	—	185	—	—	—
Nickel Electrolyte, Purified (Inco Metals)	—	—	—	—	140/—	—
Nickel & Monel Cleaning Bath; HCl, $CuCl_2$	—	—	180	—	—	—
Nickel & Monel Cleaning Bath; HCl, $Fe_2(SO_4)_3$	—	—	180	—	—	—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES 980
Nickel Nitrate	Sat.	220	220	180/150	220/200	210/220
Nickel Plating; Electrorefining pH 1.5	—	—	150	—	—	—
Nickel Plating (Nickel Sulfamate: Magnesium Chloride: Boric Acid) pH 3.7	50:3.5.3 oz/gal	—	150	—	145/—	—
Nickel Plating Solution (11% Nickel Sulfate: 2% Nickel Chloride: 1% Boric Acid)	—	—	200	—	200	180/—
Nickel Plating Solution (44% Nickel Sulfate, 4% Ammonium Chloride: 4% Boric Acid)	—	—	—	—	200	180/—
Nickel Soap Catalyst	—	—	AMB	—	—	—
Nickel Sulfate	Sat'd	220	220	180/150	220/200	210/220
Nickel Sulfate: Nickel Chloride: Boric Acid	53:12:8 oz/gal	—	180	—	—	—
Nickel Sulfate: Nickel Chloride: Boric Acid: Brightener (Nickel Plating)	40:8:6: Trace oz/gal	—	150	—	—	—
Nitrating Acid Spent	—	NR/—	80/80/NR	NR	NR	NR/—
Nitrating Acid, Strong	—	NR/—	80/80/NR	NR	NR	NR/—
Nitration, Spent Acid	@ 160°F	—	—	—	NR	—
Nitric Acid	2	—	—	—	—	210/220
Nitric Acid	5	210/200	210	160/120	160	160
Nitric Acid	10	140/175	200	AMB/—	150	120/140
Nitric Acid	20	—	140	NR	—	100/150
Nitric Acid	35	—	140	NR	AMB	—
Nitric Acid	40	NR/—	140	NR	NR	—
Nitric Acid	50	NR/—	140	NR	NR	NR
Nitric Acid	52.4	NR/—	110	NR	NR	NR
Nitric: Amchem 6-16†	16.6	—	65-95	—	65-95	—
Nitric Acid: Copper Salts	15:190 gpl	150/—	150	—	—	—
Nitric: Copper Salts	20:190 gpl	—	40-180	—	—	—
Nitric, 70%: Glacial Acetic: 49% Hydrofluoric[3]	5:2:1 @ 110°F	NR/—	NR	NR	—	—
Nitric, 70%: Glacial Acetic: 49% Hydrofluoric[3]	8:3:1 @ 100°F	NR/—	NR	NR	—	—
Nitric: Hydrochloric	10:10	—	200*	NR	200/—	200/—
Nitric: Hydrochloric Acids[3]	5:20	—	210/210/—	—	—	—
Nitric: Hydrochloric: Hydrofluoric[3]	10:77:13	—	100	—	—	—
Nitric: Hydrofluoric[3]	7.5:2.5	—	165	—	—	—
Nitric: Hydrofluoric[3]	15:5	—	165	—	—	—
Nitric: Hydrofluoric Acids[3]	12:24 @ 80°F	NR/—	NR	—	—	—
Nitric: Hydrofluoric Acids[3]	15:4 @ 190°F	—	—	—	NR	—
Nitric: Hydrofluoric Acids[3]	20:2-3	—	135	—	—	—
Nitric: Hydrofluoric Acids[3]	50:5 @ 120°F	NR/—	NR	NR	NR	NR/—
Nitric: Hydrofluoric: Chromic Acids[3]	2:3:6	—	80	—	NR	—
Nitric: Hydrofluoric Pickling Solution[3]	20:3.5	—	105	—	105	105/—
Nitric: Hydrofluoric Vapors[3]	35:5	—	200	—	—	—
Nitric Acid: Phosphoric	3:80	—	125	—	—	—
Nitric (34%): Phosphoric (85%)	4:7 by vol.	—	120	—	—	—
Nitric: Phosphoric: Sulfuric: Non-ionic Surfactant	20:11:5:0.1	—	—	—	80	80/—
Nitric: Sodium Dichromate	70:5 oz/gal @ 80	—	—	—	NR	—
Nitric: Sodium Dichromate: Molybdic Acid: Water @ 130-160°F	25:0.03:<0.1:75	—	—	—	—	NR/—
Nitric: Sulfuric @ 210°F	5:20	—	SAT/SAT/NR	NR	—	—
Nitric: Sulfuric: Copper Salts	9.5:17:112 gpl	—	40-180	—	—	—
Nitric: Sulfuric-Dinitro-Toluene Fumes	—	—	—	NR	—	—
Nitric: Sulfuric: HCl @ up to 225°F	10-20:10:6 molar	NR/—	—	NR	—	NR/—
Nitric: Sulfuric: Hydrochloric: Water	10:20:30:40	—	90	—	—	—
Nitric: Sulfuric: Hydrochloric	12:20:30	—	90	—	—	—
Nitric: Sulfuric: Na dichromate: $Cr_2(SO_4)_3$	3.8:7.8:25 gpl	—	40-180	—	—	—
Nitric: Sulfuric 50:50	30	—	180	—	—	—
Nitric: Sulfuric: Water	9:83:9	NR/—	80/NR/NR	NR	NR	NR/—
Nitric Acid Vapor	35%	—	200	—	—	160/180
Nitric Acid Vapor	10%	175/—	175	—	—	160/180
Nitric Acid Vapor	60%	95	—	—	—	160/180
Nitric Acid Vapor	24 @ 180°F	—	—	NR	—	—
Nitric Acid Vapor	48 @ 180°F	—	—	NR	—	—
Nitric Acid, Vapor & Condensate	5	—	180	—	—	—
Nitric Acid: Wetting Agent	2:½ oz/gal	—	80	—	—	—
Nitric-Ammonia Fumes	—	—	120	—	—	—
Nitric, Conc.; Sulfuric, Conc.	47:53 by vol. @ 100°F	NR/—	NR	NR	—	—
Nitric Oxide, Cl_2, HF Fumes[3]	Unknown	—	Hot	—	—	—
Nitric Oxide, Chlorine, Hydrofluoric Fumes[3]	Unknown, Hot	—	—	—	NR	—
Nitric, Red Fuming	100 @ 75°F	NR	NR	NR	NR	NR
Nitric, 70%: Sulfuric, 70% Pickling Acid	10.5:51	—	80*	—	80	80/—
Nitrobenzene	100	—	—	NR	NR	NR
Nitrogen	100	—	—	180/—	—	—
Nitrogen Fertilizer Solution	28	—	—	80[20]	—	—
Nitrogen, Liquid	100	-320/—		Hetron 31 SAT also, no veil		
Nitrogen Oxide/Methanol Fumes, @ 220°F	Unknown	—	—	—	NR	—
Nitrogen: Oxygen	50:50	—	85	—	—	—
N_2: CO_2: SO_2: O_2: H_2O Vapors	70:12:0.1:5:14 by vol	—	120	—	—	—

[20]AROPOL 7343 satisfactory

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES 980
Nitrogen: Oxygen: SO_2, droplets 80% Sulfuric	79:15:7	—	175	—	—	—
Nitromethane[3]	100	—	AMB	—	—	—
Nitromethane (tris, hydroxymethyl): Formaldehyde: Water, pH3	51:0.6:49	—	120*	—	—	120/—
Nitrophenol	100	—	—	NR	—	—
p-Nitrotoluene Sulfonic Acid	24	NR/—	200	—	—	—
Nitrous Acid	100	—	—	120/—	—	—
Nitrous Acid	10	AMB	AMB	120/—	—	—
Nonandioic Acid	Sat'd	—	AMB	—	—	—
Non-Condensable P&P Mill Gas	—	—	165	—	—	—
Nonionic Dispersant, Blend @ 125°F	100	—	SAT	LS/NR	SAT	—
Nonionic Surfactant, Alkanolamide	55 amide	—	120	—	120	—
Nonionic Surfactant, Alkyl Ether Amine Oxide	—	—	120	120	120	120/—
Nonyl Phenol	100	—	110*	110*/110	110	110/—
Nonyl Phenol, Ethoxylated	100	—	100	—	—	—
Nonylphenoxytriethoxyethanol Sulfate, Sodium Salt	28	—	100	—	100	—
Nuclear, Rad Waste	—	—	100	—	—	—
Nuclear Swimming Pool Reactor Liner	—	—	SAT	—	—	—
Nuclear Waste Ammonium Nitrate-Fluoride Solution[3]	—	—	100*	—	100	100/—
Nuclear Waste, Water, Low Level Ion exchange	—	—	AMB	—	—	—
Nut Oil, Ground	100	140/—	—	AMB	—	—
Oakite† Cleaner, pH 11-12 @ 165°F	—	—	—	—	LS/—	—
Oakite† Stripper SA†	Conc. @ 120°F	NR/—	NR	—	—	—
Octanoic Acid	Sat'd	—	140	160/100	160	180/200
O-dichlorobenzene	100	NR/—	—/LS120/NR	NR	NR	NR/100
Oil, Crude, B	—	—	—	AMB	—	—
Oil, Crude Storage Tank Bottoms	—	—	—	130/100	—	200/210
Oil, Furnace	—	—	—	AMB/—	—	—
Oil, Gas, Dirty, Refinery	—	—	—	AMB/—	—	—
Oil, Heating	—	—	—	AMB/—	—	—
Oil, Low Sulfur Crude	—	—	—	120/—	—	—
Oil, Medium Sulfur Crude	—	—	—	AMB/—	—	—
Oil, Mid-Continent Sweet	—	—	—	AMB/—	—	—
Oil, Oxidized Petroleum Heavy Bottoms, 7.8 lbs/gal with about 10% Acetic Acid	—	—	—	—	—	160-220/—
Oil, Refinery Waste Effluent	Unknown	—	AMB	—	—	—
Oil, Slop, Refinery	—	—	—	AMB/—	—	—
Oil, Sour Crude	—	—	210	180/150	200	210
Oil, Sour Crude, Wyoming	—	—	—	210/150	210/150	210
Oil, Sweet Crude	—	—	210	180/150	200	210
Oil, Waste, Various Ketones, Aromatics	Unknown	—	—	—	—	NR/—
Oil, Water Separation	—	AMB/—	AMB	AMB	AMB	—
Oil, West Texas Sour	—	—	—	AMB/—	—	—
Oil, West Texas Sweet	—	—	—	AMB/—	—	—
Oils: Animal	100	—	—	—	—	200
Mineral	100	—	—	—	—	200
Vegetable	100	—	—	—	—	200
Olefin (alpha) Sulfonate	100	—	120	—	—	—
Oleic Acid	100	200	200	180/130	200	200/210
Oleoparathion	3	140/—	—	—	—	—
Oleum (fuming sulfuric)	—	NR	NR	NR	NR	NR
Oligomeric Dispersant	100	130/—	130	130*	130	130*/—
Olin† 58981	—	—	122	—	—	—
Olive Oil	100	140/—	140	180/130	AMB	200/210
190D†: Vinylidene Chloride	98:2	—	AMB	—	—	—
OPM-1†	—	—	180	—	—	—
OPM-2†	—	—	180	—	—	—
Ore Smelting Furnace Gas, Wet, with dust: 40% Na, 23% Cd, 6% Pb, 21% B, 8% Zn and other Oxides to 400°F	—	—	SAT/SAT/NR	NR	—	NR/—
Organic Detergents	pH12 @ 75°F	—	—	NR	—	—
Organic Solvents + Aqueous HCl	Unknown @ 194°F	—	NR	—	—	—
Organotin, Quaternary Ammonium Salts, Amine Salts Blended	100	—	125	LS125/NR	125	—
Osmose Company Premix; and Fire Retardant Liquid Formulations	100; 50 & 16	—	—	82/—	—	—
Oxalic Acid	All	220	220	180/140	220/200	210/220
Oxidizing Gases	100	AMB	AMB	—	AMB	—
Oxygen: CO_2: SO_2: SO_3: H_2O, Traces Cl_2, N_2	21:1.5:0.9:0.2:5	—	200	—	—	—
Oxygen: Nitrogen	50:50	—	85	—	—	—
Oxygen: Nitrogen: SO_2; Droplets 80% Sulfuric	15:79:7	—	175	—	—	—
O_2: N_2: CO_2: SO_2: H_2O Vapors	5:70:12:0.1:14 by vol	—	120	—	—	—
Ozone	3	—	100	—	—	—

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Ozone/Cyanide Fumes	20 lbs/day @ 1% O_3	—	AMB	—	—	—
Ozone: Hydrogen	Unknown	—	*100/100/—	—	—	—
Ozone: Oxygen, Wet	1.5-2.5:O_2	—	140	—	—	—
Ozone Sewage Treatment	3	—	100	—	—	—
Ozone Treatment Condominium Waste	4 lbs/day @ 2% O_3	—	AMB	—	—	—
Palmitic Acid	Sat'd	140/160	—	160	220/200	210/220
Paper Machine	Fumes	AMB	—	—	—	—
Paper Mill Liquor	Unknown	—	—	180/120	—	—
Parathion, Wet	—	140/—	—	—	—	—
Parco 450/45†, pH 1, HF present[3]	—	—	78-120	—	—	—
Parco Cleaner† 550R	100	—	110	—	—	—
Pax Hyspeed†, Detergent	Sat'd	—	140	—	—	—
Peanut Oil	100	—	—	175/—	—	180/—
Peel Oil	100	—	—	120	—	—
Pep Set 1505†	100	—	AMB*	AMB*	AMB*	AMB/—
Pep Set 2590	100	—	AMB	AMB	AMB	AMB/—
Perchloric Acid	5	—	85/85/—	NR	—	180/—
Perchloric Acid	10	—	85/85/—	NR	—	150/—
Perchloric Acid	30	—	85/85/—	NR	—	80/—
Perchloric Acid	to 70	—	85*/85/—	NR	—	—
Perchloroethylene	100	AMB/120	100	NR	NR	100
Perchloroethylene, Vapor & Condensate	100	120	120	—	—	—
Petroleum Ether	100	AMB/—	—	—	—	—
Petroleum Oil & Waxes, Water Emulsion	1	—	140	—	—	—
Phenate Based Algaecide	100	—	125	125	125	—
Phenate Based Bactericide	100	—	125	125	125	—
Phenate Based Fungicide	100	—	125	125	125	—
Phenol	2	—	—	—	—	80/100
Phenol	5	—	180	NR	100/—	NR/80
Phenol	10	NR/—	100	NR	100/—	—
Phenol	85	NR/—	NR	NR	NR	NR/—
Phenol	100	NR/—	NR	NR	NR	NR
Phenol, Formalin, Sulfuric Fumes	Unknown @ 200°F	NR/—	—	—	—	—
Phenol, Fumes	—	—	80-110	NR	—	—
Phenol: HCl : Water	20:10:70	NR/—	NR	NR	NR	NR/—
Phenol Sulfonic Acid	Sat'd	—	—	—	—	NR
Phenolic Resin, Urea Modified (Durez† 24942)	pH 7-8	—	AMB	—	—	—
Phenolic Spent Caustic, Refinery	—	—	130	130/—	130	—
Phenolic Spent Caustic, Refinery, Neutralized to pH 5-6	—	—	130	130/—	130	—
Phenols, Some; Sulfates, H_2S, Water, Waste Liquor, pH 5-6	—	—	130	130/—	130	—
O-Phenylphenol: Sodium Xylene Sulfate: Isopropyl Alcohol: Potassium Ricinoleate: Inerts	6:10:10:6:67	—	100	—	—	100/—
Phosphate Mix (NaOH + H_3PO_4)[3]	—	—	—	—	—	170/—
Phosphate/Phosphoric Acid Waste Liquor, pH 1-3	5-10	—	200	—	—	—
Phosphate Rock Dust Scrubbing	Unknown	SAT/—	—	—	—	—
Phosphate Salts	25	AMB	AMB	AMB	—	AMB
Phosphonitrilic Chloride, Cl_2, HCl, Benzene, H_2O Vapors	—	—	120	—	—	—
Phosphoric Acid	85	220	250/250/200	180/150	220/200	210/220
Phosphoric Acid: Calcium Chloride	10:25	—	100	—	—	—
Phosphoric Acid, 28%, Some Fluorides, Ammonia; Reactor[3]	Fumes	—	to 250	—	—	—
Phosphoric: Chromic: Hydrofluoric[3]	40:7:2	—	100	—	NR	—
Phosphoric: Chromic: Hydrofluoric[3]	8.5:9.3:11	—	100	—	NR	—
Phosphoric: Fluorine: SiO_2	54:1.2:2	—	175	—	—	—
Phosphoric, Food Grade[11]	85	—	180	100*	100*/NR	—
Phosphoric: HCl, Sat. with Cl_2	15:9	—	220	—	—	—
Phosphoric: HCl, Sat. with Phosphorous	15:9	—	220	—	—	—
Phosphoric: Hydrochloric Acids	Unknown	—	SAT	—	—	—
Phosphoric: Hydrochloric: Butyl Ether	Unknown	—	SAT	—	—	—
Phosphoric: Hydrochloric: HF[3]	85:1:500 ppm	—	230/230/—	NR	—	—
Phosphoric: Hydrofluoric: Cr_2O_3[3]	50:2:7	—	100	—	—	—
Phosphoric: Hydrofluoric: Cr_2O_3[3]	8:11:9	—	100	—	—	—
Phosphoric: Hydroxyacetic: Sulfuric Acids[4]	51:29:20	—	243/243/—	—	—	—
Phosphoric, 30%: 70% Kerosene, 10% Isodecanol, 20% Organics	—	—	150	—	—	—
Phosphoric 85%: Kerosene: Xylene	35:33:33	—	100	—	—	—
Phosphoric Acid: N-Alkyl Dimethyl Benzyl Ammonium Chloride: Inerts	25:0.1:75	—	100	—	—	100/—

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON† 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES 980
Phosphoric: Nitric	80:4	—	125	—	—	—
Phosphoric (85%): Nitric (34%)	7.4 by vol.	—	120	—	—	—
Phosphoric: Nitric: Sulfuric: Non-ionic Surfactant	11:20:5:0.1	—	—	—	80*	80/—
Phosphoric: Nitric Vapor	95:5	200/—	200	—	—	—
Phosphoric Acid/Phosphate Waste Liquor, pH 1-3	5-10	—	200	—	—	—
Phosphoric Acid Plant Tailings	—	100/—	—	—	—	—
Phosphoric Acid with Polyvinyl Alcohol: Sodium Hydroxide, Alternately[3]	8:30	—	210-90	—	210-90	210/—
Phosphoric Acid-Sodium Phosphate Scrap Liquor, pH 1-3	—	—	200	—	—	—
Phosphoric Acid: Sulfuric Acid	20:10	—	160	—	—	—
Phosphoric, 85%: Sulfuric, 93% @ 160°F	50:50	NR	LS/SAT/—	NR	—	—
Phosphoric: Sulphuric: Fluoro Silicic, Gypsum Slurry Cooler	28:1.5:1.5	—	190	—	—	—
Phosphoric Acid: Sulfuric: Sodium Hydroxide: Trisodium Phosphate: Water	14:2:2:0.5:82	—	100	—	—	—
Phosphoric Acid: Sulfuric: Sodium Hydroxide: Trisodium Phosphate: Water	20:2.5:2:0.5:75	—	100	—	—	—
Phosphoric Acid (Super-phosphoric acid, 76% P_2O_5)	100	—	300/300/—	AMB/NR	220/200	210/220
Phosphoric Acid, Super	100	—	180	AMB/NR	220/200	210/220
Phosphoric Acid Traces of H_2SO_4 + Silica Tetrafluoride[3]	60	—	310/310/—	—	—	—
Phosphoric Acid, vapor and condensate	70	—	302/302/—	—	—	—
Phosphoric Acid, Wet Process[3]	Conc.	—	195	—	—	—
Phosphorous Oxychloride[6]	100	NR/—	80	80	NR	NR
Phosphorous Oxychloride, HCl, Cl_2, H_2O Vapors	—	AMB/—	AMB	—	—	—
Phosphorous Pentoxide: Fluorine (Trace)[3]	—	—	85	—	—	200/220
P_2O_5, Air, HF Fumes[3]	Unknown	—	315/315/—	—	—	—
Phosphorous Sesquisulfide	100	—	160	—	—	—
Phosphorous Trichloride[6]	100	NR/—	NR	AMB/NR	NR	NR
Phosphorous Trichloride	100 @ 140°F	NR/—	NR	NR	NR	NR
Phosphorous Trichloride, HCl, Cl_2, H_2O Vapors	100	—	160	—	—	—
Photographic Film Dryer	—	SAT/—	—	—	—	—
Photographic Processing Chemicals	—	—	80	—	—	—
Phthalic Acid	All	—	—	—	220/200	210/220
Phthalic Anhydride	Sat'd	100/150	100	150/100	200	210/220
Picric Acid	Sat'd	—	—	NR	—	—
Picric Acid, 10%	—	—/100	—	—	—	—
Picric Acid (alcoholic)	10	100/—	100	NR	100	100/200
Pigment Slurry: HCl: NaCl: Water	8:3:1:88	NR/—	203	—	200	—
Plus 5†	—	—	100	LS100/NR	100	100/—
Polyacrylamide, pH12	40	—	—/80°/—	—	80/—	—
Polychlorocyclohexane Sulfide	1	140	—	—	—	—
Polychlorophenate, Organosulfur Blend	100	—	125	125	125	—
Polychlorophenates, Alcohol, Amines Blended	100	—	125	125	125	—
Polychlorophenol, Methylene Bisthiocyanate Blend @ 125°F	100	—	—/LS/NR	SAT	SAT	—
Polycot† 2631	—	—	110	—	—	—
Polyelectrolyte, Anionic	100	130	130	130*	130	130*/—
Polyelectrolytes, Anionic, Blend @ 125°F	100	—	SAT	LS/NR	SAT	—
Polyester White Enamel, Water Reducible at 120°F (PPG Industries)	—	—	—/—/NR	NR[10]	SAT	SAT/—
Polyethylene, oxy Derivative, Surfactant	100	—	105	—	—	—
Polymer/Toluene Emulsion in Water with Alipal CO433†	—	NR/—	NR	—	NR	—
Polymethylene Polyphenyl Isocynate	100	—	—	120	NR	—
Polyphosphoric Acid	115	—	—	—	—	210/220
Polyvinyl Acetate Emulsion	—	100	100	120/80	150	210/—
Polyvinyl Alcohol	100	80/90	80	150/—	80	120/—
Polyvinyl Alcohol: Phosphoric Acid	92:8	—	90	—	—	—
Polyvinyl Chloride Latex with 35 parts DOP	—	—	110	—	—	120/—
Polyvinylidiene Chloride Latex	100	80/90	—	80/—	—	—
Polywet ND-2†	100	130/—	130	130*	130	130*/—
Potash Mine Fumes	—	90	—	—	—	—
Potash Slurry, 20% Clay: 20% Potash in Sat'd. Brine	40 Slurry @80°F	—	Hetron 197 SAT @ 12 fps	—	—	—
Potassium Aluminum Sulfate	Sat'd	150/160	180	180/130	180	210/220
Potassium Bicarbonate[3]	10	AMB	AMB	160/130	160	160
Potassium Bicarbonate[3]	Sat'd	—/90	—	160/—	140/AMB	150
Potassium Bromate	10	—	—	—	—	—
Potassium Bromide	Sat'd	—	—	160/130	—	160
Potassium Carbonate[3]	10	AMB	110	AMB/—	180/150	180

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON† 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Potassium Carbonate[3]	25	AMB	110	AMB/—	150	180
Potassium Carbonate[3]	Sat'd	NR/90	110	—	AMB	—
Potassium Chlorate	Sat'd @ 265°F	—	—	—	—	—
Potassium Chloride	All	200	250	180/150	220/200	210/220
Potassium Chloride: Cl_2, Br_2 Sat'd., pH 2-4	Sat'd	—	190	—	—	—
Potassium Chloride, Mercury Grade	Sat'd	—	180	—	—	—
Potassium Chloride: Potassium Hydroxide: Hypochlorite with Traces Chloropicrin @ 194°F	15:15:1	—	—	—	—	NR/—
Potassium Chloride, Wet Vapors	—	AMB/—	AMB	—	—	—
Potassium Cyanide[3]	Sat'd	—	—	NR	—	NR/—
Potassium Cyanide: K Hydroxide: Copper Cyanide[3]	3:2:8 oz/gal	—	175	—	—	—
Potassium Dichromate	All	200/—	200	180/—	200	210/220
Potassium Ferricyanide	Sat'd	—/200	—	180/150	220/180	210/220
Potassium Ferrocyanide	Sat'd	200	200	180/150	220/180	210/220
Potassium Fluoride[3]	Sat'd	—	150	—	150	150
Potassium Hydroxide[3]	10	NR/—	—	150/—	150/AMB	150
Potassium Hydroxide[3]	25	NR/—	—	—	150/AMB	150
Potassium Hydroxide[3]	45	NR/—	NR	NR	AMB	150
Potassium Hydroxide[3]	50	—	—	—	—	150
Potassium Hydroxide[3]	2 oz/gal	—	175	—	175/—	150
Potassium Hydroxide: Potassium Chloride: Hypochlorite with Traces of Chloropicrin @ 194°F	15:15:1	—	—	—	—	NR/—
Potassium Hydroxide: Potassium Cyanide: Copper Cyanide[3]	2:3:8 oz/gal	—	175	—	—	—
Potassium Nitrate	All	200	220	180/150	220/200	210/220
Potassium Oxalate	Sat'd	—	—	—	—	—
Potassium Permanganate	All	150	150	125/NR	200/150	210/220
Potassium Peroxide	Sat'd @ 80°F	—	—	—	—	—
Potassium Persulfate	All	AMB	AMB	AMB/—	200	210/220
Potassium Pyrophosphate	100	—	100*	—	100	100/—
Potassium Ricinoleate: O-Phenylphenol: Sodium Xylene Sulfate: Isopropylalcohol: Inerts	6:6:10:10:67	—	100	—	—	100/—
Potassium Sulfate	All	200	220	180/150	220/200	210/220
Power Plant Scrubber, Med. Sulfur Coal, pH 1.9-3.6	Liquor	—	150	—	—	—
Power Plant Scrubber, Med. Sulfur Coal, pH 1.9-3.6	Mist & Fumes	—	150	—	—	—
Premix Liquid (Osmose Co.)	100	—	—	82/—	—	—
Propenoic Acid See acrylic acid						
Propionic Acid	1	80/—	80	80	80	80
Propionic Acid	20	—	—	—	—	200/—
Propionic Acid	100	—	—	—	—	NR/—
Propionic Acid @ 120°F	80	NR/—	NR	NR	NR	NR/—
Propionyl Acid @ 120°F	80	NR/—	NR	LS*/NR	LS/NR	NR/—
Propionyl Chloride	100 @ 100°F	NR/—	NR	—	—	—
Propylene Glycol	All	100/170	180	170/150	200/180	210/220
Pulp, Bleached	—	—	190	—	—	—
Pulp and Paper Mill Bleach	Fumes	AMB/—	—	—	—	—
Pulp and Paper Mill Condensable Liquor, pH 9	—	—	130*	—	130	130*/—
Pulp and Paper Mill Digester	Fumes	AMB/—	—	—	—	—
Pulp and Paper Mill Recovery Boiler	Fumes	AMB/—	—	—	—	—
P & P Mill Waste, Acidic	—	—	150	AMB	AMB	AMB
Pulp Stock	Fumes	—	—	120*	—	—
Pulp Stock, Chlorinated, pH 4.5	—	—	190	—	—	—
PVC Latex with 35 parts DOP	—	—	110	—	—	—
Pyridine	100	NR	NR	NR	NR	NR
Quaternary Ammonium Compound, in Isopropanol, Cationic	—	120	120*	120*/120	120	120/—
Quaternary Ammonium, Dialkyl, Dimethyl Type: Aqueous Isopropanol	75:25	120/—	120*	120*/120	120	120/—
Quaternary Ammonium Salts, Organotin, Complex Amine Salt Solution @ 125°F	—	—	SAT	LS	SAT	—
Quaternary, Dicoco Dimethyl	75	120/—	120	120*/120	120	120/—
Quaternary, Dimethyl, Distearyl in Isopropanol	—	120/—	120*	120*/120	120	120/—
Quaternary, Dimethyl, Distearyl in "Neutral" Organic Solvent	—	190/—	190	190/150	190	190/—
Quaternary, Hexylene Glycol	—	120/—	120*	120*/120	120	120/—
Quaternary, Methosulfate Type	—	120/—	120*	120*/120	120	120/—
Quaternary Softener, Difatty Complex	—	120/—	120*	120*/120	120	120/—
R-2 Solutions	Sat'd	—	180	—	—	—
Rad Waste, Nuclear	—	—	100	—	—	—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON' 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Radiochemical Hoods, Glove Boxes	—	AMB/—	—	—	—	—
Raylene†[2]	50	—	150	—	—	—
Rayon Spin Bath	—	167/—	180	—	140/—	150/—
Rayon Spin Bath Evaporator/ Crystalizer to 160°F	—	—	—	—	—	NR/—
Rayon Spin Bath Fumes @ 195-203°F	—	NR/—	—/LS-S/—	—	—	—
Rayon Spinning Fumes	—	140/100	140	—	—	—
Recovery Boiler Blow-Down; Acetic: Sulfuric Sulfurous: Formic Acids: Acetone	—	NR/—	212	NR	212/200	NR/—
Recovery Boiler Flue Gas to 400°F	—	—	SAT/SAT/NR	NR	—	NR/—
Recovery Boiler (Kraft), no contact evap.; 50-100 ppm SO_2, 12-14% CO_2, 19% by vol. moisture, 37 fps to 400°F	—	—	SAT/SAT/NR	NR	—	NR/—
Recovery Boiler Stack Gases @ 300°F	—	—	SAT/SAT/NR	NR	—	NR/—
Red Liquor	Fumes	—	—/200/—	—	—	—
Reformer Charge	—	—	—	AMB/—	—	—
Rendering Fumes, Ozone, Chlorine	—	—	120	—	—	—
Rhodium Plating, phosphate	—	—	120	—	—	—
Richamide CDA†	100	—	120	—	120	—
Richonate 1850†	100	—	120*	—	120	—
RJ-4† Fuel	100	80/—	80*	80*	80	—
Rock Wool Slurry	Unknown	Hetron 197-3 with filler satisfactory for agitated tank. Ambient				
Salicylic Acid	Sat'd	—	—	—	150	160/—
Salt, Molten	Splash & Spills	750/—	750	—	—	—
Sand, Dry, 60-70 Mesh, 350 cfm	—	All NR with Abrasion Resistant Liner				
Sand, Slurry	4 lbs/gal @ 80°F	Hetron 31	Satisfactory	—	—	—
Sani-Fresh† Soap Solution	—	—	120	—	—	—
Scrubber, Med. Sulfur Coal, Particulate, pH 1.9-3.6, Cl-560-1200 ppm, 300,000 ACFM Gas	Liquor	—	150	—	—	—
Scrubber, Med. Sulfur Coal, Particulate, pH 1.9-3.6, Cl-560-1200 ppm, 300,000 ACFM Gas	Mist & Fumes	—	150	—	—	—
Scrubber Sludge; 30% Solids (90% Ca Sulfate-10% Ca Sulfate), 15% Fly Ash, pH 11	—	—	120	—	—	—
Scrubber Sludge; 30% Solids (90% Ca Sulfate-10% Ca Sulfate), 15% Fly Ash, pH5	—	—	120	—	—	—
SD-20†	—	—	100	100	100	100/—
Sea Water	—	—	180	180/150	180	210/—
Sea Water, Desalination, pH 7.5 @ 265°F	Normal	—	—/LS/NR	—	—	—
Sea Water, Desalination, pH 7.5	1.75 x Normal	—	180	—	—	—
Sea Water, Desalination, pH 7.5	2.75 x Normal	—	132	—	—	—
Selenious Acid	All	—	—	—	—	210/—
Septic System	—	AMB	AMB	AMB*	AMB	AMB
Sequestering Agents	100	—	125	125	125	—
Sewage, Anaerobic	—	85	85	85	—	—
Sewage, Municipal, Treated & Untreated	—	AMB	AMB	AMB*	AMB	AMB
Sewage Treatment	—	AMB	AMB	AMB*	AMB	AMB
Sewage Treatment Fumes	—	—/AMB	AMB	AMB	AMB	AMB
Sewage Treatment, Ozone, 3%	—	—	100	—	—	—
Sewer Gas; H_2S	—	AMB/—	AMB	AMB*	AMB	AMB
Shampoo, Carpet	—	—	100	LS100/NR	100	100/—
Shampoo, Liquid	100	—	120	—	—	—
Silicone Oils: Hydrochloric Acid	79:21	—	195	—	—	—
Silver Cyanide	Sat'd	—	—	—	—	210/—
Silver Nitrate	All	200	220	180/150	200	210/—
Silver Nitrate: Copper Chloride	33:15	—	80	—	—	—
Silver Plating Solution, 4% Silver; 7% Potassium and 5% Sodium Cyanides; 2% Potassium Carbonate[3]	—	—	NR	NR	200	200/—
Silver Refining Cells	—	—	SAT	—	—	—
Single Vessel Chlorine Dioxide Process (Hooker)[4]	—	Hetron 197 SAT throughout except for absorption of Cl_2 or ClO_2 in NaOH				
Skydrol 500†, Hydraulic Fluid	100	—	160	AMB	—	150/180
Slimicide, Organotin Amine Blend @ 125°F	100	—	SAT	LS/NR	SAT	—
Slimicide, Polychlorophenate-organosulfur blend	100	—	125	125	125	—
Slimicide, thiocyanate-poly-chlorophenol blend @ 125°F	100	—	—/LS/NR	SAT	SAT	—
Slurry, 20% Clay: 20% Potash in Sat'd. Brine	40 Slurry @ 80°F	—	Hetron 197 SAT @ 12 fps	—	—	—
Slurry, Coal/Water @ 80°F	10/90	Hetron 197-3 with abrasion resistant Filler Satisfactory at 7 fps				
Slurry, Lime	Sat'd	180/—	180	170/80	—	170
Slurry, Mineral or Rock Wool	Unknown	Hetron 197-3 with filler satisfactory for agitated tank. Ambient.				
Slurry, Sand/Water @ 80°F	4 lbs/gal	Hetron 31 Satisfactory				
Smelting Furnace Gas and Dust, Wet to 400°F	—	—	SAT/SAT/NR	—	—	—

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES HETRON† 92/99P	HETRON 72 197/197A	AROPOL 7240 7430 SERIES	HETRON 700/700C	HETRON 920 SERIES 980
Smoke, Particulate, Cooling and Washing with Water	—	100/—	100	—	—	—
Soap Plant Fumes	—	AMB/100	AMB	AMB	AMB	AMB/—
Soap Solution	Unknown	—	AMB	AMB	AMB	—
Soap: Sulfuric	—	—	—	—	215/—	—
Soap Tower Exhaust Fumes	—	—	160	—	—	—
Soda Ash; Sodium Carbonate Thickener Fumes	—	140/—	180	—	—	—
Sodium Acetate	100	200/150	200	150/—	200/150	210/220
Sodium Acid Sulfite	15	—	165	—	—	—
Sodium Alkyl Benzene Sulfonate	100	—	100	—	—	—
Sodium Alkyl Xanthate	All	—	—	—	—	150/—
Sodium Alkylaryl Sulfonate, pH 8	40	—	120*	—	120/AMB	120/—
Sodium Aluminate[3]	Sat'd	NR	NR	NR	150	160/—
Sodium Ammonium Phosphate	Unknown	—	200	—	—	—
Sodium Benzoate	Sat'd	176	176	176/—	—	210/220
Sodium Bicarbonate[3]	10	140/—	140	180/120	180/160	180/—
Sodium Bicarbonate[3]	Sat'd	140	140	160/—	160/140	150/—
Sodium Bichromate	—	—/90	—	—	—	—
Sodium Bichromate: Sulfuric: Sugar Reaction Product, pH 2.6	—	—	140	—	—	—
Sodium Bisulfate	All	200	200	180/150	200	210/220
Sodium Bisulfide[3]	15	—	160	—	140	140/—
Sodium Bisulfide[3]	65	—	160	—	—	—
Sodium Bisulfide[3]	45	—	160	—	140	140/—
Sodium Bisulfide: NaOH[3]	15:15	—	—	NR	140	140/—
Sodium Bisulfite	Sat'd	200	200	180/90	200	210/220
Sodium Bisulfite: Sodium Sulfate: Sodium Sulfite	15:15:15	—	165	—	—	—
Sodium Bisulfite/Sulfite	50/50 Sat'd	—	150	—	—	—
Sodium Borate	Sat'd	170	170	180/140	220/140	210/220
Sodium Bromide	All	220	250	180/150	—	210/220
Sodium Carbonate	2	120/—	160/160/—	150/—	180/160	180/—
Sodium Carbonate[3]	10	120/—	160/160/—	160/NR	180/160	180/—
Sodium Carbonate[3] @ 200°F	10	—	LS	—	—	
Sodium Carbonate[3]	25	AMB/—	AMB	AMB	180/160	160/—
Sodium Carbonate[3]	32	—	—	AMB/—	160	160/—
Sodium Carbonate[3]	Sat'd	180/AMB	AMB	—	160	160/—
Sodium Carbonate; Soda Ash Thickener Fumes	—	140/—	180	—	—	—
Sodium Carbonate, Vapor & Condensate	10	180	180	—	—	—
Sodium Chlorate	90	—	200*	130	200	210/220
Sodium Chlorate	Sat'd	—/90	200	NR	200	210/220
Sodium Chlorate, Sodium Chloride	3.2M:3.4M	—	180	—	—	—
Sodium Chlorate: Sodium Chloride with 350 ppm Cr, 10 ppm Ca, 10,000 Amps	340:200 gpl	—	—	—	150	—
Sodium Chlorate: Sulfuric: Chlorine Dioxide: Methyl Alcohol[4]	120:450 gpl:Sat'd:Trace	—	145	—	—	—
Sodium Chlorate, Sulfuric, Methanol, Sodium Sulfate	—	—	125	—	—	—
Sodium Chloride	Sat'd	200	250	180/150	200	210/220
Sodium Chloride: Calcium Chloride: Magnesium Chloride	12:10:2	—	150	—	—	—
Sodium Chloride, Cl_2 Sat'd., pH 2	300-310 gpl	—	212	—	212/200	—
Sodium Chloride, Cl_2 Sat'd., pH 2.5	Sat'd	—	170	—	—	—
Sodium Chloride: ClO_2[4]	23:35	—	120	—	—	—
Sodium Chloride, Dechlorinated: pH 2-3: Free Chlorine (Traces)	Sat'd	—	200	—	—	NR*/—
Sodium Chloride: HCl	Sat'd:5	—	—	—	—	210/—
Sodium Chloride, Mercury Grade	Sat'd	—	180	—	—	—
Sodium Chloride, pH 3	Sat'd	—	210*	—	—	210/—
Sodium Chloride, pH 3, Cl_2 Sat'd	Sat'd	—	210	NR	LS	—
Sodium Chloride, pH 3.5	Sat'd	—	165	—	—	—
Sodium Chloride, pH 10.5, Cl_2 Sat'd	Sat'd	NR/—	190	—	—	—
Sodium Chloride, pH 11, some Cl_2	Sat'd	—	165	—	—	—
Sodium Chloride, Sat'd. Chlorine	Sat'd	—	220	NR	—	—
Sodium Chloride: Sodium Chlorate	3.4M:3.2M	—	180	—	—	—
Sodium Chloride: Sodium Chlorate with 350 ppm CR, 10 ppm Ca, 10,000 Amps	200:340 gpl	—	—	—	150	—
Sodium Chloride: Sodium Nitrate: Sulfuric	8:8:20	—	180	—	—	—
Sodium Chloride: Sulfuric Acid	8:12	—	212	—	—	—
Sodium Chloride: Sulfuric, Chlorine + ClO_2	23:35	—	120	—	—	—
Sodium Chloride, Vapor & Condensate	Sat'd	180	180	—	—	—
Sodium Chloride, Wet NaOH, Chute	100-150 tons/day	—	AMB	—	—	—
Sodium Chlorite	2	—	212	—	—	210/220
Sodium Chlorite	25	175	175	—	—	210/220

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON† 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Sodium Chlorite	Sat'd	—	150	NR	150	210/220
Sodium Chromate	Sat'd	—	180	—	200/180	210/220
Sodium Cumene Sulfonate	43	—	120	—	—	—
Sodium Cyanide[3]	Sat'd	—/100	LS160/LS160/NR	100/—	180	210/—
Sodium Cyanide[3]	50	—	—/LS150/NR	—	—	210/—
Sodium Cyanide[3]	10	—	—/LS120/NR	120/—	—	210/—
Sodium Dichromate	Sat'd	90/—	—	120	210/200	210/—
Sodium Dichromate: Acetic Acid	30:70	—	160	—	—	—
Sodium Di-phosphate	Sat'd	—	—	180/—	—	—
Sodium Dodecylbenzene Sulfonate, pH 8	40	—	120*	—	120	—
Sodium Ethoxysulfate	100	—	120*	—	120	—
Sodium Ferricyanide	Sat'd	220	250	180/150	220/200	210/220
Sodium Ferrocyanide	Sat'd	—/220	180	180/150	220/200	210/220
Sodium Fluoride[3]	All	—	—	—	—	180
Sodium Fluorosilicate[3]	All	—	—	—	—	150/—
Sodium Hexametaphosphate	Sat'd	—	150*	—	150	150*/—
Sodium Hydrogen Phosphate	Unknown	—	200	—	—	—
Sodium Hydrosulfide[3]	15-65	—	160	—	—	—
Sodium Hydrosulfide[3]	45	—	160	—	140	140/—
Sodium Hydrosulfide: NaOH[3]	15:15	—	—	NR	140	140/—
Sodium Hydroxide[3]	0.5	—	155	100/—	—	—
Sodium Hydroxide[3]	5%@140°F-33%80°F-66%	NR/—	LS/LS/NR	NR	—	—
Sodium Hydroxide[3]	1	140/180	140	LS125/NR	—	—
Sodium Hydroxide[3]	5	NR/180	LSAMB	120/NR	LS200/120	150
Sodium Hydroxide[3]	10	NR/—	LSAMB	NR	212/150	150
Sodium Hydroxide[3]	15	NR/—	NR	NR	212/150	120
Sodium Hydroxide[3]	25	NR/—	NR	NR	212/150	120
Sodium Hydroxide[3]	50	NR/—	NR	NR	212/150	180
Sodium Hydroxide: CCl_4: Aluminum Chloride	Unknown @ 160°F	—	—	—	NR	—
Sodium Hydroxide: Cresylic Acid	5:12	—	—	—	—	180/—
Sodium Hydroxide: Ethylene Diamine: Diethylene Triamine: Water[3]	10:10:10:70	—	—	—	NR	—
Sodium Hydroxide: Gluconic Acid	30:1.6	—	80	—	—	—
Sodium Hydroxide (10% exposure time): H_2SO_4 Paste (90% exposure time), Sulfide Reduction Process[3]	5:20	—	150	—	—	—
Sodium Hydroxide, Intermittent Service[3]	15	—	140	—	—	—
Sodium Hydroxide: NaHS[3]	15:15	—	—	NR	140	140/
Sodium Hydroxide Neutralization of Acidic Organics	@ 160°F	—	—	—	NR	—
Sodium Hydroxide Neutralization of Acidic Toluene, Naphtha	@ 160°F	—	—	—	NR	—
Sodium Hydroxide Scrubbing Cl_2 Blow Gas	20	—	—	NR	120	100
Sodium Hydroxide Scrubbing Cl_2, ClO_2[4]	5	—	100	NR	120	120
Sodium Hydroxide: Sodium Thiosulfate & Sulfide[3]	30:2	NR/—	NR	NR	—	—
Sodium Hydroxide Vapor & Condensate[3]	5	180	180	—	—	—
Sodium Hypochlorite[3, 4, 5, 7]	5¼	125/NR	125	120	125	150
Sodium Hypochlorite[3, 4, 5, 7]	10	100/NR	120	LS/NR	120	150
Sodium Hypochlorite[3, 4, 5, 7]	15	NR	110	NR	120	150
Sodium Hypochlorite[3, 4, 5, 7]	2	125/—	125	—	125	150
Sodium Hypochlorite Reactor, 10% Excess Cl_2	15	—	—	—	—	100
Sodium Hypochlorite Reactor, 10% Excess NaOH[3]	15	—	—	—	—	120
Sodium Hypochlorite Vapors	5¼	—	—	—	—	150
Sodium Lauryl Sulfate	100	—	100	—	100	180
Sodium: Magnesium: Calcium Chloride Solution	12:2:10	—	150	—	—	—
Sodium meta-arsenite	50	—	130	—	—	—
Sodium Methacrylate, pH 10 - 10.5	25	—	180	—	—	—
Sodium Monophosphate	Sat'd	—/150	—	180/150	—	210/220
Sodium Nitrate	Sat'd	220	250	180/150	220/180	210/220
Sodium Nitrite	Sat'd	180/—	180	180/150	220/180	210/220
Sodium Nitrite: Sodium Chloride: Sulfuric	8:8:20	—	180	—	—	—
Sodium Persulfate	20	—	—	—	—	120/—
Sodium Phosphate, Mono, pH 1-3	5-10	—	200	—	—	—
Sodium Phosphate-Phosphoric Acid Scrap Liquor, pH 1-3	—	—	200	—	—	—
Sodium Polyacrylate, pH 9 - 10.5	25	—	180	—	180/—	150
Sodium Silicate[3]	6	—	160	90/NR	160*	210/220
Sodium Silicate, pH 12[2, 3]	—	—	200	NR	200*	—
Sodium Sulfate	All	AMB/180	AMB	175/150	220/200	210/220
Sodium Sulfate: Boric Acid with 0.25% Sulfuric, 0.03% H_2O_2, 100 ppm Iron, 3000 ppm Chloride, Temperature Cycled[16]	25:15	—	—/206/206	—	—/206	206*/—

[16]*HETRON 197 and 700 series resins appear to be unsuitable under cyclic conditions with some crazing but are resistant under static conditions*

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Sodium Sulfate: Carbonate: Bicarbonate: Fluoride Fumes; Electrostatic Precipitator	3:0.5:0.1:0.1	—	185*	—	185	185/—
Sodium Sulfate: Sodium Sulfite: Sodium Bisulfite	15:15:15	—	165	—	—	—
Sodium Sulfate: Sulfuric, CS_2 Saturated	5:3	—	140*/140/—	—	—	—
Sodium Sulfhydrate[3]	15	—	160	—	140	140/—
Sodium Sulfhydrate[3]	65	—	160	NR	—	—
Sodium Sulfhydrate[3]	45	—	160	NR	140	140/—
Sodium Sulfhydrate: NaOH[3]	15:15	—	—	NR	140	140/—
Sodium Sulfide[3]	10	AMB/—	140	80/NR	120	210/220
Sodium Sulfide[3]	Sat'd	NR/90	NR	NR	120	210/220
Sodium Sulfide: Sulfur[3]	21:1.5 @ 180°F	NR/—	NR	NR	—	—
Sodium Sulfite	All	200/—	220	AMB	200	210/220
Sodium Sulfite/Bisulfite	50/50 Sat'd	—	150	—	—	—
Sodium Sulfite: Sodium Bisulfite: Sodium Sulfate	15:15:15	—	165	—	—	—
Sodium Sulfate: Sulfuric, H_2S and CS_2 (traces)	20:10	—	125	—	—	—
Sodium Tetraborate	Sat'd	—/180	180	180/150	—	200/—
Sodium Tetrachlorophenate	13	—	AMB	—	—	—
Sodium Thiocyanate	All	—	—	—	—	150/—
Sodium Thiosulfate	All	—/90	—	AMB	AMB	120/—
Sodium Tripolyphosphate	Sat'd	—/125	125	125/80	200	210/—
Sodium Xylene Sulfate: Isopropyl Alcohol: O-Phenyl Phenol: Potassium Ricinoleate: Inerts	10:10:6:6:67	—	100	—	—	100/—
Sodium Xylene Sulfonate	40	—	150	90/NR	—	210/220
Sodium Xylene Sulfonate: Lauric/Myristic Monoethanolamide Solution	—	—	120*	—	120	120/—
Sodium Xylene Sulfonate: NaSulfate	40:2	NR/—	150	—	—	—
Softener B†	—	190/—	190	190/150	190	190/—
Soil, Acid, Bambridge, Ga.	—	AMB/—	AMB	AMB	AMB	AMB
Soil, Alkaline, Roswell, N.M.	—	AMB/—	AMB	AMB	AMB	AMB
Soil, Clay	—	AMB/—	AMB	AMB	AMB	AMB
Soil Fumigant	Dilute	NR/—	NR	NR	—	—
Sorbitol	—	—/180	—	—	—	150
Sour Crude Oil	100	—	210	180/150	200	210
Sour Crude Oil, Wyoming	—	—	—	210/150	210/150	210
Soya Oil	100	—	—	180/130	—	180/—
Soya Oil: NaOH: Soya Soap, 75% Time Sulfuric: Fatty Acid: Soya Oil: Gums, 25% Time	10:5:30 20:40:10	—	—	—	220/—	—
Soya Oil: Sulfuric Acid to 300°F	90:10	—	SAT/SAT/NR	—	—	—
Soybean Oil, Epoxydized†	100	—	125	—	—	—
SP-181† Oil Treating Chemical	—	—	—	80/—	—	—
Spent Acid, 2% Excess Sulfuric, pH 1	—	—	200	—	200	NR/—
Spent Acid: Sulfuric: Lignin: Crude Tall Oil, pH 3	29:1:60:10	—	200	—	200	NR/—
Stack Gas Scrubbing, Ammonia Process	—	—	125	—	—	—
Stackfas Mastic (T)	—	—	100	—	—	—
Stainless Steel Pickle; Sulfamic: Ferric Sulfate	6:0.1 oz/gal	—	160	—	—	—
Stannic Chloride	All	AMB/180	AMB	180/100	180/150	180/—
Stannous Chloride	All	200	250	180/100	220/200	210/—
Stannous Fluoride: Hydrofluoric Acid[3]	50:20 @ 220°F	NR/—	—	—	—	—
Starch	—	—	180	—	—	—
Starch, Digested, Neutralizer	—	—	250/250/—	—	—	—
Starch Hydrolyzer	—	—	290/290/—	—	—	—
Steam, Hydrogen Chloride[3]	Unknown @ 225°F	—	—	—	NR	—
Steam, small amount NH_3, H_3PO_4 and Fluorine[3]	—	—	140	—	—	—
Steam, Steam Condensate; Buried Pipe @ 240°F	—	—	NR	—	—	—
Steam, trace amount NH_3[3]	—	—	212	—	—	—
Steam with 0.05% Sulfuric	Fumes	—	—/to 300/—	—	—	—
Stearic Acid	All	200	250	180/150	200	210/220
Steel & Iron Cleaning Bath	—	—	180	—	—	—
Steel Pickleline (HCl) Exhaust	30	—	215 to AMB	—	—	—
Stop Baths, Photographic	—	—	80	—	—	—
Stove Oil	—	—	—	175/—	—	—
Styrene	100	NR	NR	NR	NR	NR/—
Styrene, Acrylic Emulsions, DW-875†, U-3400†, U-7001†	—	—	80	—	—	—
Succinonitrile	All	—	—	—	—	100/—
Sugar, Beet, Liquor	—	—	—	—	—	180/—
Sugar, Cane Liquor	All	—	—	—	—	180

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES HETRON 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Sugar Solution*	60	—	—	AMB	—	210
Sulfamic Acid	Sat'd	—/160	160	160/100	180/150	210/—
Sulfanilic Acid	All	—	—	—	—	210/—
Sulfate: Ferrous Sulfate	15:16	—	—	—	150	—
Sulfate Recovery Boiler Gases	—	—	300/300/—	—	—	—
Sulfate Salts, Sulfuric	24:10	—	135	—	—	—
Sulfated Detergents	0-50	200/—	200	180/100	200/—	210/220
Sulfide Anolyte ($NiSO_4$, $NiCl_2$, H_3BO_3 @ pH 1.5) for electro refining process	—	—	170	—	—	—
Sulfide Reduction Process Sulfuric Acid Paste (90% exposure time): NaOH (10% exposure time)	20:5	—	150	—	—	—
Sulfidic Spent Caustic, Petrochemical	—	—	130	130/—	130	—
Sulfidic Spent Caustic, Petrochemical, Neutralized to pH 5-6	—	—	130	130/—	130	—
Sulfite Liquors	—	160	160	160/120	—	210/220
Sulfite, Spent Liquor, Calcium Base Mill, pH 1.5-2 (trace formic & acetic)	@ 212°F	—	—	—	NR	—
5-Sulfo-isophthalic Acid, Na Salt	25	—	100*	—	100	—
Sulfonate, Alpha Olefin	100	—	120	—	—	—
Sulfonated Aliphatics, HCl, H_2S, Butanol	—	—	140	—	—	—
Sulfonated Detergents Neutralization Fumes	—	—	190*	—	190	210/220
Sulfonated Detergents: Sodium Hydroxide: Sodium Tripolyphosphate: Hypochlorite: Bisulfite Fumes	—	—	190*	—	190	210/220
Sulfonic Acid, Alkyl Benzene	100	—	100	—	—	—
Sulfonic Acid, p-nitrotoluene	24	NR/—	200	—	—	—
Sulfonyl Chloride	100 @ 75°F	—	—	NR	NR	NR
Sulfonyl Chloride, Aromatic	100	—	80	NR	NR	—
4-Sulfophthalic Acid	25	—	120	—	—	—
4-Sulfophthalic Acid: Sulfuric Acid	50:1.6	—	90	LS90/NR	—	—
Sulfur	—	—/200	—	—	—	—
Sulfur Burner Gas Cooler, Wet to 350°F	—	—	SAT/SAT/NR	NR	—	NR/—
Sulfur Burner Gas, Wet to 350°F	—	—	SAT/SAT/NR	NR	—	NR/—
Sulfur Chloride	100	NR/—	NR	NR	NR	NR
Sulfur Chloride	Vapor @ 80°F	—	—	NR	—	NR/—
Sulfur: CuO: $PbSO_4$: FeO: $ZnSO_4$: $Bi_2(SO_4)_3$ Dust	25:18:25:10:8:3	—	200	—	—	—
Sulfur Dichloride	Vapor @ 80°F	—	—	NR	—	NR/—
Sulfur Dichloride	100	NR/—	NR	NR	NR	—
Sulfur Dioxide, Ammonia Scrubber Process	—	—	115	—	—	—
SO_2: Ammonia, Vapor	0.06:0.02 by vol	—	120	—	—	—
Sulfur Dioxide Burner Gas, Cooler, Wet to 350°F	—	—	SAT/SAT/NR	NR	—	NR/—
Sulfur Dioxide Burner Gas, Wet to 350°F	—	—	SAT/SAT/NR	NR	—	NR/—
SO_2: CO_2: N_2: O_2: H_2O Vapors	0.1:12:70:5:14 by vol	—	120	—	—	—
Sulfur Dioxide, Dry or Wet	100	200/—	250	180/150	220/—	210/250
Sulfur Dioxide, HF, H_2S, F, H_2SO_4*	Water Sat'd	—	170	—	—	—
Sulfur Dioxide; Oxygen: Nitrogen, droplets 80% Sulfuric	7:15:79	—	175	—	—	—
Sulfur Dioxide Pulp Mill	Fumes	—	—/to400/—	—	—	—
SO_2 Removal by Citrex† or Citrate Process	—	—	140	—	—	—
SO_2 Removal; Fossil Fuel; Limestone Injection Mist after Scrubber, pH 2-12	—	—	140	—	—	—
Sulfur Dioxide Sat'd. H_2O: trace HF, H_2SO_4, H_2S, F*	—	—	170	—	—	—
SO_2: SO_3 Fumes	Unknown	—	—	—	—	150/—
SO_2: SO_3 Fumes, Water Spray	—	—	—	—	—	120/—
SO_2: SO_3: HCl: H_2SO_4: Caustic: H_2O Fumes	—	—	190*	—	190	—
Sulfur Dioxide: SO_3, Wet @ 140°F	76:24	—	—/LS/NR	—	—	—
Sulfur Dioxide, Trace Sulfur Trioxide	2	250/—	250	—	—	—
SO_2 Vaporization	100	—	140	—	—	—
Sulfur Dioxide, Wet; Wet; CO_2, N_2, O_2, Dust to 350°F	8-10	—	SAT/SAT/NR	NR	—	NR/—
Sulfur Fungicide	—	—	—	180/—	—	—
Sulfur-Humid Air, Fumes	—	200/—	200	—	—	—
Sulfur and Machine Oil Fumes	—	—	HOT	—	—	—
Sulfur, Molten @ 250-280°F	100	—	—/SAT/NR	NR	SAT/NR	NR/—
Sulfur, Molten (H_2S, SO_2, H_2O, SO_3 in ppm) @ 260-300°F	100	—	—/SAT/NR	NR	—	NR/—
Sulfur, Molten, Vapors	100	—	300/300/—	—	—	—
Sulfur Trioxide, Dry	100	AMB/—	AMB	NR	—	210/220
Sulfur Trioxide: SO_2, Wet @ 140°F	24:76	—	—/LS/NR	—	—	—
Sulfur Trioxide, Wet	100	AMB/—	AMB	NR	—	NR/—

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON† 92 99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Sulfur, Wettable, Fungicide	8	140 —	140	—	—	—
Sulfuric Acid	25	200	250/250/200	180/120	225/200	210/220
Sulfuric Acid	50	200	200	150/NR	220/200	210/220
Sulfuric Acid	50 @ 250°F	NR —	LS/LS/NR	NR	LS/NR	NR/—
Sulfuric Acid	70	150	190*	NR	190/160	160/—
Sulfuric Acid	75	100/—	175/175/NR	NR	AMB	120/—
Sulfuric Acid	80	—	150	NR	NR	NR
Sulfuric Acid	93	NR	NR	NR	NR	NR
Sulfuric: Ammonium Bisulfate: Surfactant	30:6:10	—	110	—	—	—
Sulfuric Acid: Ammonium Sulfate: Manganese, pH 9	30:125:13 gpl	—	—/100*/100	—	100/—	—
Sulfuric: Anodizing Solution	—	—	AMB	—	—	—
Sulfuric: Benzene Sulfonic Acid: Water	7:88:5	—	140	—	—	—
Sulfuric: Chlorate, Methanol, Sodium Sulfite	Unknown	—	125	—	—	—
Sulfuric: Chlorine Saturated	80	—	80	NR	NR	NR/80
Sulfuric: Chromic	53:53 oz/gal	—	140	—	NR	—
Sulfuric: Chromic	16:3 @ 155°F	—	—	—	NR	NR/—
Sulfuric: Chromic Acid	20:20	—	180	NR	NR	—
Sulfuric: Chromic Acids	16:12.5	—	225	NR	NR	—
Sulfuric: Chromic Acids[4]	32:20	—	90	NR	—	—
Sulfuric: 2% Chromic Oxide	80	NR —	165	—	—	—
Sulfuric (10.5N): ClO_2	—	—	120*	—	120	—
Sulfuric, Conc.: Nitric, Conc.	53:47 by vol @ 100°F	NR —	NR	NR	—	—
Sulfuric: Contaminated with Maganese Sulfate and Oxide	10	—	212	—	NR	—
Sulfuric: Copper Salts	21:31 gpl	—	150	—	—	—
Sulfuric: Copper Salts	33:31 gpl	—	180	—	—	—
Sulfuric: Copper Sulfate	28:12	—	120	120*/—	120	120*/—
Sulfuric: Copper Sulfate	18:5	—	150	—	—	—
Sulfuric: Copper Sulfate	200:50 gpl	—	150	—	—	—
Sulfuric: Cu: Fe: Zn Slurry/Thickener	10%:80:10:5 gpl	—	180	—	—	—
Sulfuric: 1% Dodecyl Benzene Sulfonic Acid	78	NR —	150	—	—	—
Sulfuric Evaporation	to 70	—	185	NR	—	NR/—
Sulfuric: FeO·TiO_2 Ore, Steam-Air Agitated @ 220°F	10-20:30-40	NR[14]/—	—	—	—	—
Sulfuric: Ferric Sulfate: Cupric Sulfate	20:10:10	—	180	—	—	—
Sulfuric Acid Fume Scrubber	33	—	194	—	—	—
Sulfuric Fumes in Steam	0.05	—	—/to 300/—	—	—	—
Sulfuric: HCl	45:15	—	140	—	—	—
Sulfuric: Heavy Polymer, Trace Iron and Hydrocarbons	60	—	80	—	—	—
Sulfuric: Hydrochloric Acids	30:1	—	180	—	—	—
Sulfuric: Hydrochloric: Antimony Trioxide	35:15:5	—	100	—	—	—
Sulfuric, 28% by Wt.: Hydrofluoric, 20% by Wt.: Hydrochloric, 50% by Vol.: Sodium Dichromate, 3% by Wt.[3]	—	—	120	—	—	—
Sulfuric: Hydrogen Iodide	25 gpl:66 gpl	—	158	—	—	—
Sulfuric: Hydroxylamine Acid Sulfate	70:Sat'd	—	125	—	—	—
Sulfuric: Hydroxylammonium Acid Sulfate	10:86-90	—	180	—	—	—
Sulfuric: Ilmenite Ore, Steam-Air Agitation @ 220°F	10-20:30-40	NR[14]—	—	—	—	—
Sulfuric: Lignin: Crude Tall Oil, pH3	30:60:10	—	200	—	200	NR/—
Sulfuric: Manganese: Ammonium Sulfates, pH_2	40:13:135 gpl	125*/—	125	125*	—	—
Sulfuric: Manganese Sulfate	10:90	—	100	—	—	—
Sulfuric: Manganese Sulfate	28:50 gpl	—	203	—	—	—
Sulfuric: 50%: MEK, 100%	90:10	80/—	80*	80*/—	80	80*/—
Sulfuric: Metal Sulfate Salts	10:24	—	135	—	—	—
Sulfuric: Na, Mg, Zn Sulfates	10:24	—	135	—	—	—
Sulfuric: Na Sulfate	35:23	—	180	—	—	—
Sulfuric: Na Sulfate-Sat'd. with Cl_2	35:23	—	130	—	—	—
Sulfuric (10.6N), Na_2SO_4, 0.06 gpl $NaClO_3$, 0.2 gpl NaCl	—	—	130	—	—	NR/—
Sulfuric: Nitric Acid 50:50	30	—	180	—	NR	—
Sulfuric: Nitric Acids	58:28 @ 160°F	NR/—	—	—	—	—
Sulfuric: Nitric Acids	58:28	AMB/—	AMB	—	—	—
Sulfuric: Nitric Acids @ 180-200°F	38:0.5	NR/—	—	—	—	—
Sulfuric: Nitric Acids @ 210°F	20:5	—	SAT/SAT/NR	NR	—	—
Sulfuric: Nitric: Copper Salts	17:9.5:112 gpl	—	180	—	—	—
Sulfuric: Nitric: Dinitro-Toluene Fumes	—	—	—	NR	—	—
Sulfuric: Nitric: HCl @ up to 225°F	10:10-20:6 molar	NR/—	—	NR	—	NR/—
Sulfuric: Nitric: Hydrochloric	20:10:30	—	90	—	—	—
Sulfuric: Nitric: Na dichromate: $Cr_2(SO_4)_3$	7.8:3.8:25 gpl	—	40-180	—	—	—
Sulfuric: Nitric: Phosphoric: Non-ionic Surfactant	5:20:11.0.1	—	—	—	80*	80/—

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCEN-TRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON† 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Sulfuric, 70%: Nitric, 70% Pickling Acid	51:10.5	—	80*	—	80	80/—
Sulfuric: Nitric: Water	83:9:9	NR/—	80/80/NR	NR	NR	NR/—
Sulfuric: Organic (Alkyl Benzene)[2]	75:2	—	160	—	—	—
Sulfuric Acid Paste (90% exposure time): NaOH (10% exposure time), Sulfide Reduction Process	20:5	—	150	—	—	—
Sulfuric, 93%: Phosphoric, 85% @ 160°F	50:50	NR/—	LS/SAT/—	NR	—	—
Sulfuric: Phosphoric Acid	10:20	—	160	—	—	—
Sulfuric: Phosphoric: Hydroxyacetic Acids[4]	20:51:29	—	243/243/—	—	—	—
Sulfuric: Phosphoric Acid: Sodium Hydroxide: Trisodium Phosphate: Water	2:14:2:0.5:82	—	100	—	—	—
Sulfuric: Phosphoric Acid: Sodium Hydroxide: Trisodium Phosphate: Water	2.5:20:2:0.5:75	—	100	—	—	—
Sulfuric Acid, pickle liq. tank covers	25	—	200	—	—	—
Sulfuric: Soap	Unknown	—	—	—	215/200	—
Sulfuric: Sodium Chlorate: Chlorine Dioxide: Methyl Alcohol[4]	450:120gpl:Sat'd:Trace	—	145	—	—	—
Sulfuric: Sodium Chloride	12:8	—	212	—	—	—
Sulfuric: Sodium Chloride, Chlorine and ClO_2	35:23	—	120	—	—	—
Sulfuric: Sodium Chloride: Sodium Chlorate: Cl_2: ClO_2: Steam	4N:1M:1M:Sat'd	—	180	—	—	—
Sulfuric: Sodium Dichromate	30:3	—	150	—	NR	—
Sulfuric: Sodium Dichromate	30:5 oz/gal	—	180	—	NR	—
Sulfuric: Sodium Dichromate	32:4	—	160	—	NR	—
Sulfuric: Sodium Dichromate	42:5 oz/gal	—	160	—	NR	—
Sulfuric: Sodium Dichromate: Chromic Sulfate	9:52 gpl:Sat'd	—	80	—	—	—
Sulfuric: Sodium Dichromate Over Steam Coils	22-26:3.5-5	—	—	NR	SAT	—
Sulfuric: Sodium Nitrate: Sodium Chloride	20:8:8	—	180	—	—	—
Sulfuric: Sodium Sulfate, H_2S and CS_2	10:20	—	125	—	—	—
Sulfuric: Soya Oil to 300°F	10:90	—	SAT/SAT/NR	—	—	—
Sulfuric: Sulfate Salts	10:24	—	135	—	—	—
Sulfuric: 4-Sulfo-phthalic Acid	1.6:50	—	100	LS100/NR	—	—
Sulfuric: Trace Dichlorides	30	—	166	—	—	NR/—
Sulfuric: Trace Dichlorides @ 166°F	76	—	—/LS/NR	NR	—	NR/—
Sulfuric: Trace Nitrogen & Nitrobenzene	30 @ 160°F	—	—	—	NR	—
Sulfuric: Trace Organics	30	—	166	—	—	—
Sulfuric: Trace Organics	47 @ 166°F	—	—	—	—	NR/—
Sulfuric: Trace Organics	62 @ 166°F	—	—	—	—	NR/—
Sulfuric: Trace Organics	72 @ 166°F	—	—	—	NR	NR/—
Sulfuric: Trace Organics	76	—	166	—	NR	NR/—
Sulfuric: Trace Organics	80 @ 166°F	—	—	—	NR	NR/—
Sulfuric Acid Vapor	80	140	140	—	—	—
Sulfuric Acid Vapor	50	140	140	120	—	—
Sulfuric Acid Vapor	98 @ 180°F	NR/—	NR	NR	NR	NR
Sulfuric Acid Vapor	15-20	—	220	180/150	—	180
Sulfuric Acid Vapor with Trace Nitric	65-70	—	to 200	—	—	NR/—
Sulfuric Acid, Waste, with up to 16% Dinitro Butyl Phenol @ 150°F	25	NR/—	—	—/NR	—	—
Sulfuric Acid, Waste, Leaching, pH 2-5	—	—	—	AMB	—	—
Sulfuric Acid Waste with Metal Salts	177 gpl	—	—	—	—/90	—
Sulfuric Acid, waste pickle liq.	—	—	200	NR	—	LS200/—
Sulfuric Acid: Water: HAS (Hydroxylammonium Acid Sulfate)[4]	60:20:20	—	100	—	—	—
Sulfuric Acid: Water: HAS (Hydroxylammonium Acid Sulfate)[4]	75:14:11	—	100	—	—	—
Sulfuric: 10-20%: Xylene Derivative: T-Amine: Alkaline Metal Salt	—	—	100	100/NR	NR	100*/—
Sulfuric: Zinc Sulfate: Sodium Sulfate	1.5-5:3:5	—	—	—	—	205/—
Sulfuric: Zinc Sulfate: Sodium Sulfate	5-10:1-8:10-20	—	—	—	—	95/—
Sulfuric 1.5-4% Zn Sulfate 1-3% Na Sulfate 3-8%, CS_2, Amines, Sat'd. with H_2S	—	185/—	185	—	—	—
Sulfuric 5-10%, Zn Sulfate 1-8%, Na Sulfate 8-25% Sat'd. with H_2S, Trace Amines	—	95-200/—	95-200	—	—	—
Sulfurous Acid	10	AMB	150	NR	AMB	100/—
Sulfurous Acid	Sat'd	—	150	NR	—	100/—
Sulfuryl Chloride	99 @ 120°F	NR/—	NR	NR	NR	NR
Sulfuryl Chloride	100 @ 75°F	NR/—	NR	NR	NR	NR
Sulphide Anolyte, Nickel Plating Tank pH 1.5	—	—	150	—	—	—
Super Phosphoric Acid	76% P_2O_5	—	300/300/—	AMB/NR	220/200	210/220
Super Phosphoric Acid	100	—	180	AMB/NR	220/200	210/220
Surfactants, Alkanolamide	100	—	120	—	120	—
Surfactants, Amide Type	100	—	120	—	120	—
Surfactant, Anionic	58	—	120*	—	120	—
Surfactants, Linear Primary Alcohol Type	100	—	120*	—	120	—

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Surfactants, Linear Primary Alcohol Type-Ethanol	100	—	120*	—	120	—
Surfactant, Nonionic, Alkyl Ether Amine Oxide	—	—	120	120	120	120/1
Surfactant, Nonionic, Tergitol 15-S-9†	100	—	100	—	—	—
Surfactant, Nonyl Phenoxytriethoxy Ethanol Type	28	—	100	—	100	—
Surfactant, Polyethylene, oxy Derivative	100	—	105	—	—	—
Sweet Crude Oil	—	—	210	180/150	200	210/230
Sweet Oil	100	140/—	140	—	—	—
Sweetwater	—	—	—	—	—	180
35D†: Acrylonitrile	98:2	—	AMB	—	—	—
Tall Oil	—	—	—	—	—	150/—
Tall Oil, Crude, 1.5% Spent Acid: Lignin, pH 4.3	—	—	200	—	200	NR/—
Tall Oil, 2% Spent Acid, pH1, Lignin	—	—	200	—	200	NR/—
Tall Oil: Sulfuric: Lignin, pH3	10:30:60	—	200	—	200	NR/—
Tannic Acid	Sat'd	200	250	180/150	220/200	210/—
Tanning Leather, Drums	—	—	SAT	—	—	—
Tar Camphor	100	80/—	80	—	—	—
Tartaric Acid	Sat'd	220	250	180/150	220/200	210/—
"Teller" Scrubber, Wet Process P_2O_5 Plant[3]	—	—	95	—	—	—
Telone†, Fumigant[4]	Conc.	—	NR	—	—	—
Terephthalic Acid: HCl: Dimethyl Formamide: Water	14:28:7:51	—	100	—	—	—
Tergitol 15-S-9†	100	—	100	—	—	—
Tetrachlorocyclopentane Saturated with Cl_2 and Trace HCl, CCl_4, Dicyclopentadiene and Hexachlorocyclopentane	100	—	120-160	—	—	—
Tetrachloroethylene	100	AMB/NR	100	NR	NR	80/100
1, 1, 2, 2-Tetrachlorethylene	100	NR/—	—/LS120/NR	NR	NR	NR/—
Tetrachlorophenol, Sodium Salt	13	—	AMB	—	—	—
Tetrachloropyridine	100	—	120*	—	120	120/—
Tetrakis (Hydroxymethyl) Phosphonium Chloride	100	—	170*/170/NR	—	—	—
Tetrakis (Hydroxymethyl) Phosphonium Chloride, HCl, H_2O Vapors	—	AMB/—	AMB	—	—	—
Tetrapotassium Pyrophosphate	60	125	125	90/NR	130	100/—
Tetrasodium Ethylenediamine Tetracetate[3]	All	—	—	—	—	150/—
Tetrasodium Pyrophosphate	5	—/125	125	125/—	220/200	150/—
Tetrasodium Pyrophosphate	Sat'd @ 75°F	—/125	—	90/NR	—	100/—
Textone† Bleach	—	—	—	—	—	210/220
Thermolin RF-230†	Pure	—	95	—	—	—
Thermolin RF-230†	Impure	—	95	—	—	—
Thioglycol, Mono	100	—	65-80	—	—	—
Thioglycolic Acid	10	—	—	—	—	100/—
Thionyl Chloride	100	NR/—	NR	NR	NR	NR
Thionyl Chloride, Vapor	100	NR/—	150/150/NR	NR	—	—
Thiosorbic Lime	Sat'd	—	150	—	—	—
Tin Fluoborate Plating Bath, 18% Stannous Fluobrate; 7% Tin, 9% Fluoboric Acid; 2% Boric Acid[3]	—	—	200	—	200	200/—
Tin, Molten, 700°F, Fumes	—	SAT/—	SAT	—	—	—
Tinofix QF†	50	—	AMB*	AMB*/—	—	—
Titanium Sulfate Reduction Process	—	—	80	—	—	—
Tobias Acid	All	—	—	—	—	210/—
Toilet Tanks, Aircraft	—	—	AMB	—	—	—
Toluene	100	AMB	AMB*/AMB/NR	AMB/—	NR	LS,AMB/100
Toluene @ 120°F	100	NR/—	NR	NR	NR	NR/—
Toluene Diisocyanate	Sat'd	—/NR	150	NR	AMB	80/—
Toluene Sulfonic Acid	65	—	100	—	100	210/—
Toluene Sulfonic Acid	100	—	—	—	—	210/—
Toluene, Vapor	100	—	200	—	—	—
Toluene, Vapor & Condensate	100	120/—	120	—	—	—
Toluene, Vapor & Reflux	100	—	230/230/—	—	—	—
Toluene: Xylene: Aromatic: Aliphatic	86:3:5:6	—	90/—/—	90/—	—	—
Tolyl Chloride (o)	100 @ 200°F	NR/—	NR	—	—	—
Toxaphene: Xylene	90:10	—	122	—	—	—
Transformer Oil	100	—	AMB	AMB	AMB	210/—
Transmission Fluid, Automatic	100	—	—	AMB/—	—	—
Tributyl Phosphate	100	—	—	NR	—	—
Tributyl Phosphate: Aromatic Solvent	35:65	—	AMB*	—	—	—
Trichloroacetaldehyde	100 @ 100°F	NR/—	NR	—	NR	NR
Trichloroacetic Acid	0-50	200/—	200	AMB/—	180	210/—
Trichloroacetic Acid	50	AMB	AMB	LS180/NR	180	210/—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Trichloroacetonitrile, Trace Acetonitrile and HCl	100	—	85	—	—	—
Trichlorobenzene	100	NR/—	NR	NR	—	NR/—
Trichlorobenzene Vapors Wet with HCl	—	—	*212/212/—	—	—	—
1, 1, 1-Trichloroethane	100	NR/—	80	NR	NR	80/—
1, 1, 2-Trichloroethane	100	—	80/NR/NR	—	—	—
Trichloroethylene*	100	NR/—	AMB	NR	NR	NR/—
1, 1, 2-Trichloroethylene	100 @ 120°F	NR/—	NR	NR	NR	NR/—
Trichloroethylene, 50%	—	—/175	—	—	—	—
Trichloroethylene: Chlorinated Organics: Hydrochloric (32%)	14:0.9:85.1 @ 104°F	NR/—	NR	—	—	—
Trichloroethylene Fumes; 22% HCl; 10% Cl_2; 9% O_2; 6% CO; 4% H_2	—	175/—	—	—	—	—
Trichloroethylene, HCl, Cl_2, H_2O Vapors	—	120/—	120	—	—	—
Trichloromethane	100 @ 80°F	NR/—	NR	NR	NR	NR/—
Trichloromonofluoromethane	100	—	—	—	—	80/—
Trichlorophenol	100 @ 175°F	NR/—	NR	NR	NR	NR/—
Tricresyl Phosphate	100	—	—	—	—	80/120
Tridecyl Benzene Sulfonate-Detergent Base	—	—	120	—	120	210*/—
Triethanol Ammonium Lauryl Sulfate	100	—	80	NR	80	—
Triethanolamine Linear Alkylate Sulfonate	60	—	100	—	—	—
Triethylamine	100	—	—	—	—	150/—
Triethylamine Hydrochloride	Sat'd @ 75°F	—	—	NR	—	—
Triethanolamine	100	—	—	—	—	150/—
Triethylene Glycol	100	—	180	—	—	—
Trifluorovinyl Chloride, Oils and Greases	100	AMB/—	AMB	—	—	—
Trihydroxybenzoic Acid	Sat'd	—	80	—	—	—
Trimethyl Borate in Methyl Alcohol*	98	—	150	—	—	—
Trimethyl Carbinol	100	—	100	—	—	—
Trimethylamine Hydrochloride	100	—	130	130/—	130	130/—
Trimethylamine Hydrochloride, pH 3-4	100	—	130	—	—	—
Trimethylamine: HCl	100:37	—	130	—	—	—
Trimethylamine HCl: Ethylene Oxide Reaction	—	—	NR	—	180	—
Triphenyl Phosphite	100	—/90	122	90/NR	—	100/—
Tris (Hydroxymethyl) Nitromethane: Formaldehyde: Water, pH3	51:0.6:49	—	120*	—	—	120/—
Trisodium Phosphate	25	—	150	—	180	210/—
Trisodium Phosphate	Sat'd	AMB/—	AMB	NR	AMB	210/—
Tuna Oil	100	—	—	160/120	—	160/—
Turpentine: Chlorine	99+:0.3 @ 320°F	NR/—	NR	NR	—	NR/—
Turpentine, crude sulfate @ 100°F	—	LS/—	LS	SAT/NR	LS	SAT*/—
Turpentine: Methyl Alcohol	to 48:to 85 @ 150°F	—	—	—	—	NR/—
Turpentine, Pure Gum	100	—/90	120	AMB/—	AMB	AMB/100
U-3400† and U-7000†, Styrene Acrylic Emulsions	—	—	80	—	—	—
Ultraformer Feed, Refinery	—	—	—	AMB/—	—	—
Ultraformer Feed/Xylene	—	—	AMB/—/—	—	—	—
Ultraformer Heavy Feed, Refinery	—	—	—	AMB/—	—	—
Ultrawet† 60K Biodegradable Detergent	100	—	150	—	—	—
Ultrawet 45DS Biodegradable Detergent	100	—	130	—	—	—
Ultrawet 60L Biodegradable Detergent	100	—	100	—	—	—
Underground, Clay Soil	—	AMB/—	AMB	AMB	AMB	AMB
URAN Fertilizer-Ammonium Nitrate Composition; 44.3% Ammonium Nitrate, 35.4% Urea, 20.3% Water	—	—	120	—	100	—
Uranium Extraction	—	—	SAT	—	—	—
Uranium Fluoride, KOH, HF, KF, K_2O, K_2UO_4, Cl_2, KCl, KOCl, $KClO_3$, $KClO_4$, CO_2, K_2CO_3, $KHCO_3$, H_2CO_3, UO_2CO_3, F_2, ClF_3, DF_2	—	—	—	—	100	100*/—
Uranium SX Units	—	—	SAT	—	SAT	SAT
Urea	Sat'd	—/90	160	150/90	160/AMB	180/—
Urea: Ammonium Chloride: Ammonium Nitrate	38:2.5:20	—	AMB	—	—	—
Urea: Ammonium Nitrate: Water	20:30:50	—	—	—	—	120/—
Urea: Ammonium Nitrate: Water	35:44:20	—	120	—	—	—
Urea: Ammonium Nitrate: Water	40:10:50	—	—	—	—	120/—
Urea-Formaldehyde Resin	100	—	80	—	—	—
Urea Modified Phenolic Resin (Durez† 24942)	pH 7-8	—	AMB	—	—	—
Urotropine	28	80/—	80	—	—	—
Vanasol @ 80°F	1	—	—/SAT/NR	SAT/—	SAT	SAT/—
Variquat† K-300	—	120/—	120*	120*/120	120	120/—
Varisoft† 222-90	—	120/—	120*	120*/120	120	120/—
Varox 185E†	—	—	120	120	120	120/—
Varsol† @ 200°F	100	NR/—	SAT/SAT/—	SAT/NR	SAT/NR	SAT/—
Veneer Drying Fumes	—	—	to 300/300/—	—	—	—

†See list of trademarks and product names.

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES				
		HETRON[*] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Vegetable Oils[*]	—	—	—	180/—	—	—
Vidden D† Fumigant[*]	Conc.	—	NR	—	—	—
Vinegar	100	AMB/—	AMB	180/150	AMB	210/220
Vinyl Acetate	100 @ 75°F	—	—	NR	NR	NR/—
Vinyl Toluene	100	—	80[*]	NR	NR	80/—
Vinyl Trichloride	100 @ 80°F	—	NR	—	—	—
Vivo-Zyne†	100	—	—	100[*]	100	—
Wash Solution, pH 13.6[3]	—	NR/—	NR	—	150	—
Washer Hoods, Ducts, Chlorination, ClO_2, and Brown Stock	—	—	SAT	—	—	—
Waste Oils, Gear, Cutting, etc., Treated with Lime and 93% H_2SO_4	—	NR/—	NR	NR	—	—
Waste, Organic, H_2O, HCl, Cl_2 Vapors	—	—	175	—	—	—
Waste Water Treatment	—	—/100	—	—	—	—
Water: Acid: Organic contaminated	96.5:2:1.5	—	150/150/NR	150/NR	NR	NR/—
Water, City (10-60 psi)	100	180/—	180	180/150	—	180/220
Water, Condensate, pH 7.3-8.2; with NH_4, NO_3, SO_4, B, Cl, O_2, H_2S	—	—	—	125/—	—	—
Water, Condensate, Buffered	—	—	100	—	—	—
Water, Condensate, Trace Amounts Mercaptan, H_2S, Turpentine, Acetone	@ 150°F	—	—	—	—	NR/—
Water, Condensate, Zero Hardness, pH 8.5-9.5 @ 200-210°F	100	—	SAT/SAT[*]/—	—	—	LS/—
Water, Contaminated with Aromatic Solvents, Salts, Hydrocarbon Resins, Organics; Slightly Acid to Basic	—	100/—	100	—	—	—
Water, Cooling[17], ph 5.5-7	—	—	180	—	—	—
Water, Cooling, 20 ppm Chromate	—	—	180[*]	180	—	180
Water, Cooling Tower	—	AMB/—	120	120	—	120
Water, Deionized[9, 3]	100	—	180	180/90	180/140	210/220
Water, Deionized, High Purity 1.5 μmho/cm.	100	—	—	AMB[19]/NR[19]	—	—
Water, Demineralized[3]	100	100/—	212/212/180	180/120	—	210/220
Water, Distilled[3]	100	160/—	210/210/180	160/140	200/140	210/220
Water, Drinking[*]	—	NR/—	NR	AMB[25]/—	AMB/—	AMB/—
Water: Ethylene Glycol @ 212°F	50:50	—	—	—	700 NR as molding cpd.	—
Water, Geothermal	—	—	—	125/—	—	—
Water, Geyser, Condensate	—	—	—	125/—	—	—
Water, Ground, Organic (1.310 ppm) Contaminated[24], Untreated, pH 5.7	—	—	110	—	—	—
Water, Irrigation	—	AMB/—	AMB	AMB[*]	AMB	AMB
Water, Light, FC195†	100	160/—	160	—	—	—
Water, Light, FC203†	100	NR/—	120	120[*]	120	NR/—
Water-Oil Separation	—	AMB/—	AMB	AMB	—	—
Water: Organic: acid contaminated @ 150°F	96.5:1.5:2	—	SAT/SAT/NR	SAT/NR	NR	NR/—
Water: pH3, pH7, or pH 10	—	—	125	—	—	—
Water, pH 5 to 9 (1-13 at times) with HCl; Cl_2, Benzoic Acid; Benzoyl, Benzal, Benzyl Chlorides Present	—	—	120	—	—	—
Water, 13,000 ppm acetic acid	—	—	150	150[*]	150	—
Water, 8,000 ppm chlorobenzene	—	—	150[*]	150[*]/120	150	—
Water, 100 ppm methylene chloride	—	—	150[*]	150	150	—
Water, 3,000 ppm 150-octyl alcohol	—	—	150[*]	150	150	—
Water, 50 ppm Phenol	—	—	AMB	—	—	—
Water, 500 ppm sodium chloride	—	—	150[*]	150	150	—
Water Sat'd. with 1.5-2.5% Ozone in Oxygen	—	—	140	—	—	—
Water, Sea	—	—	180	180/150	180	210/—
Water, Sea, desalination pH 7.5	1.7 x Normal	—	180	—	—	—
Water, Sea, desalination pH 7.5	2.75 x Normal	—	132	—	—	—
Water, Sea, desalination pH 7.5 @ 265°F	Normal	—	—/LS/NR	—	—	—
Water, Steam Condensate[3]	100	200/—	212[*]	180/150	—	180/—
Water, Steam Condensate, Steam; Buried Pipe @ up to 240°F	—	NR	NR	NR	—	—
Water: Sulfuric: Acetic: Methylene Chloride: Octyl Alcohol: Sodium Chloride: Chlorobenzene	48:0.3:1.3:0.01:0.3:0.5:0.8	—	150/150/NR	150/NR	NR	NR/—
Water, Tap	—	180	180	180/150	180	180
Water Treatment, Dye Plant, pH 2-3	—	—	180	—	—	—
Water Treatment, Softening and Coagulating	—	AMB/—	AMB	AMB	—	—
Water, Vapor & Condensate[3]	—	180/—	212	—	—	—

[17]*Dissolved solids, 1574-2183 ppm: PO_4, 0.25 ppm; total PO_4, 1.3 ppm; Cu, 0.7 ppm; Zn, 3.4 ppm; Fe, 1.8 ppm; $CaCO_3$, 450 ppm max.; Chromate, hexa, 18-22 ppm, Cl_2 residual, 0.20-.45 ppm; NaCl, 527-702 ppm.*

[19]*No change in water at 0.1 ft.² laminate/gal. as in 20-30,000 gal. tank.*

[19]*AROPOL 7430 satisfactory.*

[24]*Such as methylene chloride, 50 ppm; chloroform, 2; trichloroethylene & trichloroethane, 14; alcohols, 700; MEK & MIBK, 200; Benzenes, 105; Acetone, 50; Phenol, 2 etc.*

[25]*AROPOL 7242 satisfactory.*

†See list of trademarks and product names

(continued)

TABLE 1.54: POLYESTER AND VINYL ESTER RESINS—ASHLAND (continued)

CHEMICAL ENVIRONMENT	CONCENTRATION %	SERVICE TEMPERATURE, °F FOR RESIN TYPES: HETRON[1] 92/99P	HETRON 72/197/197A	AROPOL 7240/7430 SERIES	HETRON 700/700C	HETRON 920 SERIES/980
Water, Waste with Pine Oil, Kerosene, Methoxychlor, Melathion, Xylene, Detergents, Chlorophyll, Surface Active Agents and Other Oils	Unknown	—	80	80/—	80	80
Water, Waste, With Solids, Oil, Grease	—	AMB—	AMB	AMB'	AMB	AMB
Water, Waste, Trickling Filters	—	AMB'/—	AMB	AMB'	AMB	AMB
Water, White	—	—	AMB	—	—	—
Wax, Chlorinated	100	—	—	—	—	180/200
Weed Killers	@ 80°F	—	—	NR	—	—
Whey	—	—	—	175/—	—	—
Whiskey	—	—	—	—	—	80/—
White Liquor (Pulp Mill)	—	—	—	—	180	150/—
White Water	—	—	AMB	—	—	—
White Water, Splash & Spills	—	110/—	110	—	—	—
Wine Fermentation[9]	—	—	—	AMB[25]/—	—	—
Wine Storage[9]	—	—	—	AMB[20]/—	—	—
Winery Waste	—	—	—	AMB	—	—
Wire Pickling Fumes	—	—	140	—	—	—
Xylene	100	—/90	150/100/—	90/NR	AMB	NR/100
Xylene @ 120°F	100	NR/—	SAT/NR/NR	NR	NR	NR/—
Xylene: Adogen† 381	75:25	—	100	—	—	—
Xylene: Camphene, Chlorinated 68%	10:90	—	122	—	—	—
Xylene Derivative: T-Amine: Alkaline Metal Salt: 10-20% Sulfuric Acid	—	—	100	100/NR	NR	100'/—
Xylene: DXE; Trace H_2SO_4; Flake Caustic	50:50 @ 185°	NR/—	NR	NR	—	—
Xylene: Kerosene: 85% Phosphoric	33:33:35	—	100	—	—	—
Xylene: Toxaphene	10:90	—	122	—	—	—
Xylene/Ultraformer Feed	—	—	AMB/—/—	—	—	—
Zimmite†, Mud Remover	1-2	100/—	100	—	—	—
Zinc Casting Fumes	—	—	300/300/—	—	—	—
Zinc Chloride @ 310°F	70	—	SAT/SAT/—	—	—	—
Zinc Chloride	Sat'd	200	265	180/150	220/200	210/—
Zinc Chloride Plating Bath; Zinc Chloride: Sodium Chloride: Ammonium Chloride, pH 4.8-5.2	18:31:3 oz/gal	—	AMB	—	—	—
Zinc Cyanide Plating Bath, 9% Zinc and 4% Sodium Cyanides 9% Sodium Hydroxide[3]	—	NR/90	NR	—	180	160/—
Zinc Dimethyldithiocarbanate	3.5	140/—	—	—	—	—
Zinc Electrolytic Cells	—	—	140	—	—	—
Zinc Fluoborate[3]	50	—	—	—	—	210/—
Zinc Fluoborate Plating Bath, 49% Zinc Fluoborate; 5% Ammonium Chloride; 6% Ammonium Fluoborate[3]	—	—	200	—	200	200/—
Zinc Hydrosulfite	Sat'd	160	160	—	—	—
Zinc, Nickel Hydrophosphate, HF and Fluosilicic[3]	Sat'd	—	80	—	—	—
Zinc Nitrate	Sat'd	—/180	180	180/150	180	210/—
Zinc Phosphate	Unknown	—	200	—	—	—
Zinc Smelter Fumes	—	—	SAT	NR	—	—
Zinc Sulfate	All	200	250	180/150	220/200	210/—
Zinc Sulfite	Sat'd	—/150	—	150/100	—	180/—

†See list of trademarks and product names

[1]*HETRON 99P for fume service only*
[2]*Good test results after short exposure*
[3]*Synthetic surfacing veil recommended for maximum resistance*
[4]*Benzoyl Peroxide - Dimethyl aniline cure system recommended to assure satisfactory service*
[5]*Post-cure recommended*
[6]*Solution may discolor*
[7]*Nonthixotropic resins preferable*
[8]*Unsatisfactory as lining*
[9]*Acceptable as to odor and taste for AROPOL 7242 type resin. Steamed 4 hours with atmospheric steam prior to exposure*
[10]*Three 3 hour exposures to 30% nitric at 100°F to simulate cleaning*
[11]*No discoloration occurs at 5 ft²/gal. acid with AROPOL 7242 and HETRON 700 type construction if surfaces are acid or steam cleaned*
[12]*"C" veil only*
[13]*AROPOL 7240 only*
[14]*Appears to be erosion/corrosion*
[15]*AROPOL 7240 SAT at 120°F*
[16]*HETRON 197 and 700 series resins appear to be unsuitable under cyclic conditions with some crazing but are resistant under static conditions.*
[17]*Dissolved solids, 1574-2183 ppm: PO_4, 0.25 ppm; total PO_4, 1.3 ppm; Cu, 0.7 ppm; Zn, 3.4 ppm; Fe, 1.8 ppm; $CaCo_3$ 450 ppm max.; Chromate, hexa, 18-22 ppm. Cl_2 residual, 0.2-0.45 ppm; NaCl, 527-702 ppm.*
[18]*No change in water at 0.1 ft.² laminate/gal. as in 20-30,000 gal. tank.*
[19]*AROPOL 7530 satisfactory.*
[20]*AROPOL 7343 satisfactory.*
[21]*Vol. % SO_2, 0.25; SO_3, 0.03; CO_2, 12.5; N_2, 74.6; O_2, 4.9; H_2O, 7.8; fly ash, 5.0 grams ft³; velocity 60 fps.*
[22]*Vol. % SO_2, 0.25; SO_3, 0.003; CO_2, 12.5; N_2, 74.6; O_2, 4.9; H_2O, 7.8; fly ash, 1.2 grams ft³; velocity 8 fps.*
[23]*0.12% SO_2/5% O_2/12% CO_2/70% N_2/13.4% H_2O; 5 grams/ft³ of 1-2% H_2SO_4, 2-3000 ppm HCl, 10-20 ppm HF, rust water.*
[24]*Such as methylene chloride, 50 ppm; chloroform, 2; trichloroethylene & trichloroethane, 14; alcohols, 700; MEK & MIBK, 200; Benzenes, 105; Acetone, 50; Phenol, 2 etc.*
[25]*AROPOL 7242 satisfactory.*

TABLE 1.55: POLYPROPYLENE AND POLYVINYLIDENE FLUORIDE LINED PIPING SYSTEMS—RESISTOFLEX

Chemical Resistance Ratings for RESISTOFLEX-PP (Polypropylene) and FLUOROFLEX-K (KYNAR)

Chemical	MAXIMUM USE TEMPERATURE (°F) Poly-propylene	PVDF (Kynar)	Chemical	MAXIMUM USE TEMPERATURE (°F) Poly-propylene	PVDF (Kynar)
Acetic Acid (Glacial)	70	70	Brine	225	275
Acetic Acid (50%)	225	212	Bromic Acid	NR	230†
Acetic Anhydride	75	NR	Bromine (Dry)	NR	170
Acetone (10%)	120†	120	Bromine (Liquid)	NR	170
Acetone (50%)	120†	NR	Bromine Water (25%)	NR	212†
Acetonitrile	70	120	Butadiene		250
Acetophenone	NR	NR	Butyl Acetate	NR	75
Acetylchloride	120	120†	Butyl Acrylate	NR	75
Acrylonitrile	100	70	n-Butyl Alcohol	70†	275
Allyl Chloride	NR	212	sec-Butyl Alcohol	70†	275
Aluminum Ammonium Sulfate (Alum)	225	275	tert-Butyl Alcohol	70†	275
Aluminum Chloride*	225	275	n-Butylamine		NR
Aluminum Fluoride	225	275	sec-Butylamine		70
Aluminum Hydroxide	225	275	tert-Butylamine		70
Aluminum Nitrate	225	275	Butylene		275
Aluminum Potassium Sulfate	225	275	Butyl Bromide	NR	275
Ammonia (Dry Gas)	140	NR	Butyl Chloride	NR	275
Ammonia Aqua (30%)	150	212†	Butylphenol		212†
Ammonium Bifluoride	225	275	Butyric Acid	225	230†
Ammonium Carbonate	225	275	n-Butyl Mercaptan		275
Ammonium Chloride	225	275	Calcium Bisulfate	225	275
Ammonium Fluoride (25%)	225	275	Calcium Bisulfide	225	275
Ammonium Hydroxide	225	212	Calcium Carbonate	225	275
Ammonium Nitrate	225	275	Calcium Chlorate	225	
Ammonium Phosphate	225	275	Calcium Chloride	225	275
Ammonium Sulfate	225	275	Calcium Hydroxide	225	275
Amyl Acetate	NR	125	Calcium Hypochlorite (20%)	120	275
Amyl Alcohol	70	275	Calcium Hypochlorite (94%)		275
Amyl Chloride	NR	275	Calcium Nitrate	225	275
Aniline	140†	120	Calcium Sulfate	225	275
Antimony Trichloride	120	70†	Caprylic Acid		150
Aqua Regia	NR	70†	Carbon Dioxide (Wet)	150†	275
Arsenic Acid	70†	275	Carbon Dioxide (Dry)	150†	275
Barium Carbonate	225	275	Carbon Disulfide	NR	70†
Barium Chloride	225	275	Carbon Tetrachloride	NR	275
Barium Hydroxide	225	275	Castor Oil	120†	275
Barium Sulfide	225	275	Cellosolve	70†	275
Benzaldehyde	70†	125	Chlorine Liquid	NR	212
Benzene	NR	170	Chlorine (5% in CCl_4)	NR	212†
Benzene Sulfonic Acid	70	120	Chlorine Water (Saturated)	NR	212†
Benzoic Acid	150†	230	Chlorine Gas (Wet or Dry)	NR	212
Benzyl Alcohol	160†	275	Chlorine Dioxide (15%)	NR	212
Benzyl Chloride	70†	275	Chloroacetic Acid (50%)	NR	212†
Black Liquor		275	Chlorobenzene	NR	170
Borax	225	275	Chloroform	NR	212
Boric Acid	225	275	Chlorosulfonic Acid	NR	NR

Chemical	MAXIMUM USE TEMPERATURE (°F) Poly-propylene	PVDF (Kynar)	Chemical	MAXIMUM USE TEMPERATURE (°F) Poly-propylene	PVDF (Kynar)
Chromic Acid (31% with 0.3% H_2SO_4)	160	170	Ethylene Diamine		NR
Chromyl Chloride		120†	Ethylene Dichloride (EDC)	NR	275
Citric Acid	140†	275	Ethylene Glycol	225	275
Coal Gas		212†	Ethylene Oxide	NR	212
Cocoanut Oil	70	275	Fatty Acids	140	275
Copper Chloride	140	275	Ferric Chloride (50%)	225	275
Copper Cyanide	140	275	Ferric Nitrate	225	275
Copper Fluoride	140	275	Ferric Sulfate	225	275
Copper Nitrate	140	275	Ferrous Chloride	225	275
Copper Sulfate	140	275	Ferrous Nitrate	225	275
Corn Oil	120	275	Ferrous Sulfate	225	275
Cottonseed Oil	140	275	Formaldehyde (37%)	140	120†
Cresol	70	150	Formic Acid	140†	250†
Cresylic Acid		150	Fuel Oil	NR	275
Crotonaldehyde		120	Furane		NR
Crude Oil		275	Furfural	NR	NR
Cyclohexane	NR	275	Gallic Acid		70
Cyclohexanol	70	150	Gas—Manufactured		275
Cyclohexanone	NR	70	Gas—Natural		275
Dextrin	150†	230†	Gasoline—Leaded	NR	275
Diacetone Alcohol	120†	70	Gasoline—Unleaded	NR	275
Diesel Fuels		275	Gasoline—Sour	NR	275
Diethylamine	120†	70	Glucose	225	275
Diethyl Cellosolve		275	Glycerine	225	275
Diethyl Ether	NR	70	Glycol	150†	275
Diethylene Triamine		120	Glycolic Acid	150†	70
Diglycolic Acid	70	70†	Heptane	NR	275
Diisobutyl Ketone		212†	Hexane	75	275
Diisobutylene		275	Hydriodic Acid (48%)	140	275
Dimethyl Amine	120†	NR	Hydrobromic Acid (50%)	150	275
Dimethyl Formamide	225	NR	Hydrochloric Acid (2%)	225	275
Dimethylaniline		70	Hydrochloric Acid (10%)	185	275
Dimethyl Phthalate	NR	70	Hydrochloric Acid (20%)	175	275
p-Dioxane	NR	NR	Hydrochloric Acid Conc. (36%)	150	275
Distilled Water	225	275	Hydrocyanic Acid	140†	275
Epichlorohydrin	120†	NR	Hydrofluoric Acid (35%)	120†	250
Esters		70	Hydrofluoric Acid (70%)	100	212
Ether	NR	120	Hydrofluoric Acid (100%)	70	212
Ethyl Acetate	NR	NR	Hydrofluosilicic Acid	140	275
Ethyl-aceto Acetate		70	Hydrogen	140†	275
Ethyl Acrylate	NR	70	Hydrogen Chloride (Dry)	140	275
Ethyl Alcohol	175	275	Hydrogen Cyanide		275
Ethyl Chloride	NR	275	Hydrogen Peroxide (30%)	70	212
Ethylene Bromide	NR	230	Hydrogen Peroxide (90%)	70	75†
Ethylene Chloride	NR	230	Hydrogen Phosphide		120†
Ethylene Chlorohydrin	70	70	Hydrogen Sulfide (Dry)	140	275

(continued)

TABLE 1.55: POLYPROPYLENE AND POLYVINYLIDENE FLUORIDE LINED PIPING SYSTEMS—RESISTOFLEX (continued)

Chemical	Maximum Use Temperature (°F) Polypropylene	PVDF (Kynar)
Hydrogen Sulfide (Wet)	140†	275
Hypochlorous Acid		275
Iodine (Dry)	NR	150†
Iodine (Liquid)		170
Iodine (Wet)	70†	150†
Iodoform		212†
Jet Fuel — JP4 and JP5	NR	212
Kerosene	NR	275
Ketones	70	NR
Lactic Acid (20%)	140	125†
Lactic Acid (80%)		125
Lard Oil	70	275
Lauric Acid	150	230†
Lauryl Chloride		250†
Lead Acetate	225	275
Lemon Oil	NR	250†
Linoleic Acid		250†
Linseed Oil	140	275
Lubricating Oil	70	275
Magnesium Carbonate	225	275
Magnesium Chloride	225	275
Magnesium Hydroxide	225	275
Magnesium Nitrate	225	275
Magnesium Sulfate	225	275
Maleic Acid	140	250†
Malic Acid	NR	250†
Mercaptan, n-Butyl		275
Mercuric Chloride (40%)	140	250†
Mercuric Chloride		250†
Mercuric Cyanide	225	250†
Mercuric Nitrate	150†	275
Mercury	225	275
Methane	70†	275
Methane Sulphonic Acid (50%)		212†
Methyl Alcohol	140	275
Methyl Bromide	NR	275
Methyl Cellosolve	75†	275
Methyl Chloride	NR	150
Methyl Chloroform		120†
Methyl Ethyl Ketone	70	NR
Methyl Sulfuric Acid	120	120
Methylene Chloride	70	NR
Methyl-isobutyl Ketone	NR	70
Milk	225	212†
Mineral Oil	70	275
Monoethanolamine		NR

Chemical	Maximum Use Temperature (°F) Polypropylene	PVDF (Kynar)
Monochlorobenzene		150
Morpholine		NR
Naphtha	70	275
Naphthalene	225	212
Nickel Chloride	225	275
Nickel Nitrate	225	275
Nickel Sulfate	225	275
Nicotine		70
Nicotinic Acid		250†
Nitric Acid (2%)	225	175
Nitric Acid (10%)	150	170
Nitric Acid (30%)	100	130
Nitric Acid (50%)	70	120
Nitric Acid — Conc. (70%)	NR	120
Nitric Acid — Fuming (90%)	NR	NR
Nitric Acid — Sulfuric Acid 50:50	NR	120
Nitrobenzene	120	70
Nitrogen Dioxide	70	170
Nitromethane	140	120†
Nitrous Acid	NR	212†
Octane	NR	275
Octene		275
Oleic Acid	70	250†
Oleum (Fuming Sulfuric Acid)	NR	NR
Oxalic Acid	70	120
Oxygen Gas	225	275
Ozone	NR	230
Palmitic Acid	225	275
Perchlorethylene	NR	275
Perchloric Acid (10%)	70†	212†
Perchloric Acid (72%)	70†	120†
Phenol (10%)	150	170
Phenol (100%)	140	120
Phenylhydrazine		120†
Phosgene (Gas & Liquid)	NR	
Phosphoric Acid (30%)	225	275
Phosphoric Acid (52%)	225	250
Phosphoric Acid (85%)	140	230
Phosphorus	75†	
Phosphorus Pentoxide		212†
Phosphorus Trichloride		212†
Phthalic Acid (Ortho)	70†	212
Picric Acid	140	70†
Polyvinyl Acetate	75	275
Potassium Bromide	225	275
Potassium Carbonate	225	275

Chemical	Maximum Use Temperature (°F) Polypropylene	PVDF (Kynar)
Potassium Chlorate	225	275
Potassium Chloride	225	275
Potassium Cyanide	225	275
Potassium Dichromate	225	275
Potassium Ferrocyanide	225	275
Potassium Hydroxide	225	212†
Potassium Nitrate	225	275
Potassium Permanganate (20%)	140	250
Potassium Permanganate		250
Potassium Sulfate	225	275
Potassium Sulfide	225	275
Propane		275
Propyl Alcohol	140†	120
Propylene Oxide		NR
Pyridine	120†	NR
Pyrogallol		120†
Refrigerants 11, 12 & 22		212†
Salicyl-aldehyde		120
Salicylic Acid	120	212
Sea Water	225	275
Silver Cyanide	225	275
Silver Nitrate	225	275
Sodium Acetate	225	275
Sodium Benzoate	225	275
Sodium Bicarbonate	225	275
Sodium Bisulfate	225	275
Sodium Bisulfite	225	275
Sodium Bromide	225	275
Sodium Carbonate	225	275
Sodium Chlorate	225	275
Sodium Chloride	225	275
Sodium Cyanide	225	275
Sodium Fluoride	225	275
Sodium Hydroxide (10%)	225	120
Sodium Hydroxide (50%)**	225	NR
Sodium Hypochlorite (17%)***	150	212
Sodium Hypochlorite (20%)***	150	
Sodium Nitrate	225	275
Sodium Nitrite	225	275
Sodium Peroxide	225	275
Sodium Phosphate	225	275
Sodium Silicate	225	275
Sodium Sulfate	225	275
Sodium Sulfide	225	275
Sodium Sulfite	225	275
Sodium Thiosulfate	150†	275

Chemical	Maximum Use Temperature (°F) Polypropylene	PVDF (Kynar)
Sour Crude Oil		275
Stannic Chloride	225	275
Stannous Chloride	225	275
Stearic Acid	120†	275
Stoddard's Solvent		250†
Sulfur	140	250†
Sulfur Chloride	NR	70†
Sulfur Dichloride		70†
Sulfur Dioxide	70	170
Sulfur Trioxide	NR	NR
Sulfuric Acid (5%)	225	250
Sulfuric Acid (10%)	225	230
Sulfuric Acid (30%)	200	230
Sulfuric Acid (50%) (60%)	175	230
Sulfuric Acid (78%)	150	170
Sulfuric Acid (93%)	140	150
Sulfuric Acid (96%)	125	130
Sulfuric Acid (98%)	70	120
Sulfuric Acid — Fuming (Oleum)	NR	NR
Sulfurous Acid	150†	212†
Tall Oil		275
Tannic Acid	225	230†
Tartaric Acid	150	250†
Tetraethyl Lead		275
Tetrahydrofuran	NR	NR
Tetramethyl Ammonium Hydroxide (50%)		212†
Toluene	NR	170
Tributyl Phosphate	NR	70
Trichloroacetic Acid (10%)	140	75†
Trichloroacetic Acid		75
Trichloroethylene	NR	275
Triethylamine	NR	120
Trisodium Phosphate	150†	275
Turpentine	NR	275
UDMH-Hydrazine (50-50)		70
Urea (50%)	225	250†
Varsol	NR	250†
Vinyl Acetate	NR	250†
Water	225	275
White Acid (Ammonium Difluoride & HCl)		250†
Xylene	NR	212†
Zinc Chloride	225	275
Zinc Nitrate	225	275
Zinc Sulfate	225	275

Resistoflex piping products lined with TFE (PTFE), PFA, and FEP resins are chemically inert to all of the above chemicals

† Maximum temperature at publication — consult factory for use at higher temperatures

* Not recommended in anhydrous condition as in "Friedel-Crafts" and alkylation type reactions

** Not recommended in processes where mercury amalgam is formed

*** Polypropylene is not recommended where free chlorine is present as a residual reactant from the formation of sodium hypochlorite or from decomposition

NR Not recommended — severely affected

TABLE 1.56: ACETAL, NYLON AND POLYESTER RESINS—DU PONT

DELRIN Acetal Resins

Acid Resistance	Resists weak acids (pH 4). Not recommended in strong acids.
Basic Resistance	Resists weak bases (pH 9). Not recommended for strong alkalies.
Solvent Resistance	Excellent resistance to a wide variety of solvents, ethers, oil, greases, gasoline and other petroleum hydrocarbons.

ZYTEL Nylon Resins

Acid Resistance	Limited. Attacked by strong acids. General order of resistance 612>66> copolymers or 6.
Base Resistance	Excellent at room temperature. Attacked by strong bases at elevated temperatures.
Solvent Resistance	Generally excellent. Some absorption by such polar solvents as water, alcohols, and certain halogenated hydrocarbons causing plasticization and dimension changes.

RYNITE Polyester Resin

Acid Resistance	Good at room temperature. Attacked by strong and weak acids at elevated temperatures.
Base Resistance	Good at room temperature. Attacked by strong and weak bases at elevated temperatures.
Solvent Resistance	Excellent resistance to a wide variety of fluids such as gasoline, motor oil, transmission fluid, hydrocarbons and organic solvents. Some absorption by ketones and esters causes plasticization and small dimensional changes.

TABLE 1.57: EPOXY, FLUOROPOLYMER AND POLYETHYLENE RESINS–DURIRON

DURCO NON-METALLICS

Durco Designation	Durco Symbol	Description	Max. Service Temperature
DURCON 6	DU6	Silica filled epoxy	215° F (102° C)
DURCON 700	D700	Glass fiber reinforced epoxy	225° F (107° C)
Durco TFE	TFE	Tetrafluoroethylene polymer	400° F* (204° C)
Durco PFA	PFA	Perfluoroalkoxy polymer	400° F (204° C)
Durcothene	UMPE	Ultra high molecular weight polyethylene	200° F (93° C)

*Most Durco equipment totally lined with TFE is limited to 300° F (149° C).

	Durcon 6	Durcon 700	TFE – PFA	Durcothene
Acetate solvents	E	E	E	G
Acetic acid, all strengths	G	G	E	G
Acetic anhydride	G	G	E	G
Alum (slurry)	G	G	S	E
Aluminum chloride	E	E	E	E
Aluminum sulfate & H_2SO_4	G	S	E	E
Ammonium chloride	E	E	E	E
Ammonium fluoride	P	P	E	E
Ammonium hydroxide	S	G	E	E
Ammonium nitrate	E	G	E	E
Ammonium phosphate	E	G	E	E
Ammonium sulfate	E	E	E	E
Ammonium sulfate & H_2SO_4	G	S	E	G
Aniline dyes	S	S	E	G
Aniline hydrochloride	G	–	E	–
Anodizing solutions	G	S	E	S
Antimony trichloride	E	E	E	E
Arsenic acid	G	G	E	E
Barium chloride	E	E	E	E
Barium nitrate	E	G	E	E
Barium sulfate	E	E	E	E
Benzoic acid	G	G	E	–
Black liquor (slurry)	G	G	P	E
Boric acid	G	G	E	E
Brine, acid	E	E	E	E
Brine, alkaline	S	G	E	E
Bromine, dry	G	P	E	S
Bromine, wet	S	P	E	S
Cadmium sulfate	E	E	E	E
Calcium bisulfate	E	E	E	E
Calcium bisulfite & H_2SO_4	G	S	E	E
Calcium chloride	E	E	E	E
Calcium hydroxide (lime)	S	G	G	E
Calcium hypochlorite	S	P	E	G
Calcium phosphate	E	G	E	E
Carbon disulfide	E	E	E	E
Carbonic acid	E	E	E	E
Carbon tetrachloride	E	E	E	S
Cellulose acetate	E	E	E	E
Chloroacetic acid	G	P	E	S
Chlorinated water	S	P	E	S
Chlorine dioxide	G	P	E	S
Chlorine gas, wet	S	P	E	S
Chromic acid	S	S	E	G
Citric acid	G	G	E	E
Copper nitrate	E	G	E	E
Copper silver nitrate	G	G	E	E
Copper sulfate	E	E	E	E
Copper sulfate + 10% H_2SO_4	G	P	E	E
Cupric chloride	E	E	E	E
Cuprous chloride	E	E	E	E
Ethylene dichloride	E	P	E	P
Fatty acids	E	G	E	E
Ferric chloride	E	E	E	E
Ferric ferro-cyanide	E	E	E	E
Ferric nitrate	G	G	E	E
Ferric sulfate	E	E	E	E
Ferric sulfate + 10% H_2SO_4	E	P	E	E
Ferrous sulfate	E	E	E	E
Ferrous sulfate + 10% H_2SO_4	E	P	E	E
Formaldehyde	E	S	E	E
Formic acid	G	G	E	E
Glycerin, crude	G	S	E	–
HCL waste pickle liquor	E	E	G	E
Hydrochloric acid< 150°F (66°C)	E	E	E	E
Hydrochloric acid> 150°F (66°C)	E	E	E	E
Hydrofluoric acid	P	P	E	E
Hydrofluosilicic acid	P	P	E	E
Hydrogen peroxide	G	S	E	S
Hypochlorite bleach	S	P	E	G
Iodine, dry	G	P	E	–
Lactic acid	G	G	E	E
Lead acetate	E	E	E	E

(continued)

TABLE 1.57: EPOXY, FLUOROPOLYMER AND POLYETHYLENE RESINS—DURIRON (continued)

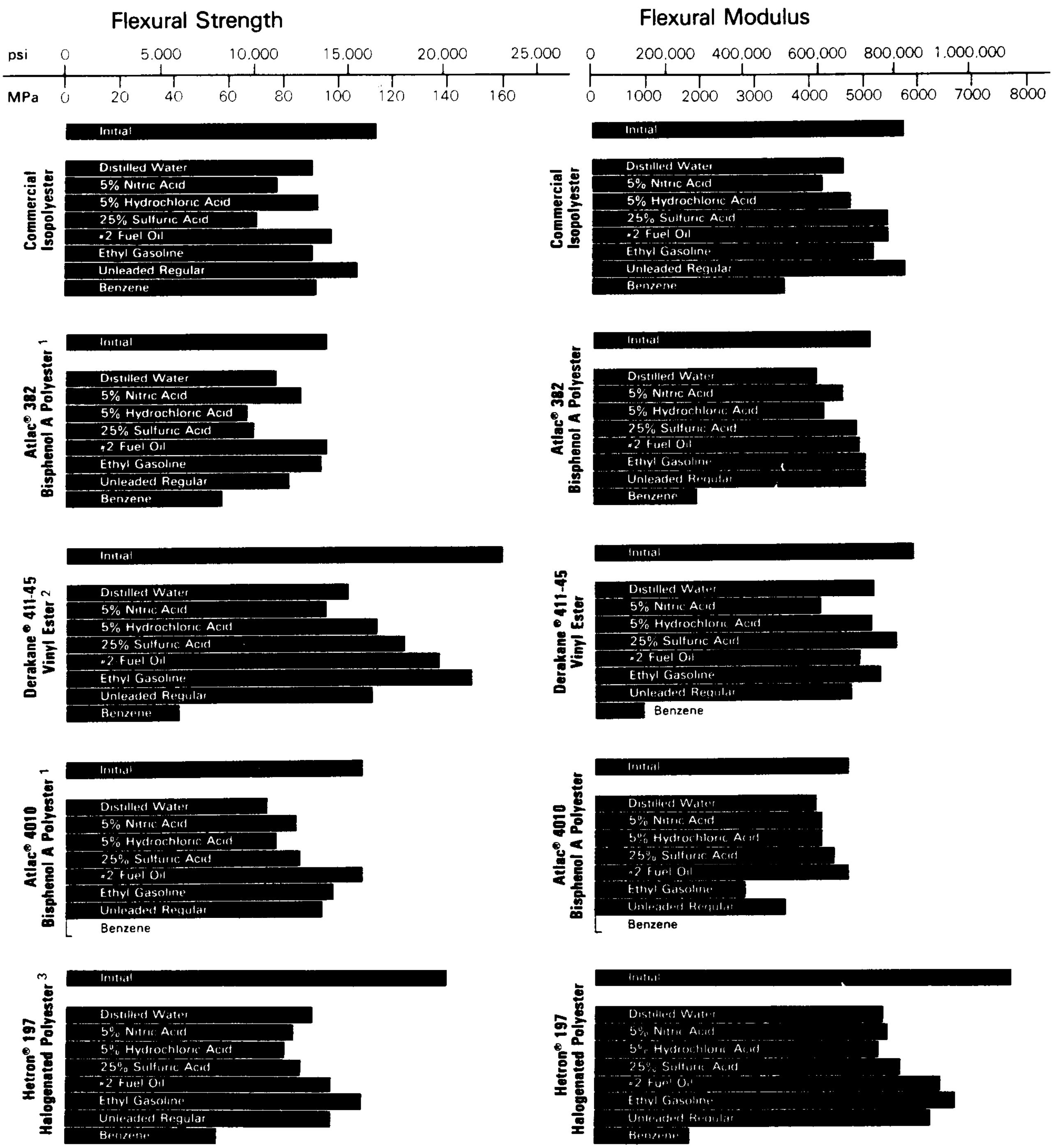
	Durcon 6	Durcon 700	TFE – PFA	Durcothene
Lead nitrate	G	G	E	E
Lead sulfide	E	E	E	E
Lithophone	G	G	E	E
Magnesium chloride	E	E	E	E
Magnesium sulfate	E	E	E	E
Maleic acid	G	G	E	E
Malic acid	G	G	E	E
Manganese chloride	E	E	E	E
Mercuric chloride	E	E	E	E
Mercuric nitrate	G	G	E	E
Mercuric sulfate	E	E	E	E
Mercurous sulfate	E	E	E	E
Metal plating solutions	G	G	E	E
Mine water	E	E	E	E
Mixed acid	S	P	E	S
Nickel chloride	E	E	E	E
Nickel ammonium sulfate	E	E	E	E
Nitric acid, all strengths	G	S	E	S
Nitric acid + 3% - 5% HF	P	P	E	G
Nitrobenzene	S	–	E	P
Oleic acid	G	G	E	G
Oleum	P	P	E	P
Oxalic acid	G	G	E	G
Phenol	E	P	E	P
Phosphoric acid + 2% H_2SO_4.1% HF	S	P	E	E
Phosphoric acid, all strengths	G	S	E	E
Picric acid	G	G	E	E
Phthalic acid	G	G	E	E
Potassium bisulfate	E	E	E	E
Potassium chloride	E	E	E	E
Potassium hydroxide	S	G	E	E
Potassium iodide	G	G	E	E
Potassium nitrate	E	G	E	E
Potassium sulfate	E	E	E	E
Pyridine sulfate	E	E	E	E
Sea water	E	E	E	E
Sodium bicarbonate	E	E	E	E
Sodium bisulfate	E	E	E	E
Sodium bisulfite	E	E	E	E
Sodium chlorate	E	E	E	E
Sodium chloride	E	E	E	E
Sodium dichromate	S	S	E	G
Sodium ferricyanide	G	–	E	E
Sodium hydroxide	S	G	E	E
Sodium hydroxide, fused	P	S	E	E
Sodium hypochlorite	S	P	E	S
Sodium nitrate	E	G	E	E
Sodium perchlorate	G	S	E	E
Sodium phosphate	E	G	E	E
Sodium sulfate	E	E	E	E
Sodium sulfide	E	E	E	E
Sodium sulfite	E	E	E	E
Sodium thiosulfate	E	E	E	E
Stannic chloride	E	E	E	E
Stannous chloride	E	E	E	E
Stearic acid	G	G	E	G
Sulfite liquors	G	S	E	E
Sulfite liquors & H_2SO_4	G	P	E	E
Sulfur	–	–	E	–
Sulfur chloride	–	–	E	–
Sulfur dioxide	G	S	E	E
Sulfuric acid, sat. with SO_2	S	S	E	G
Sulfuric acid, up to 100° F (38°C)	G	S	E	G
Sulfuric acid, 5% to boiling	G	P	E	E
Sulfuric acid, 60-100%, 176°F (80°C)	S	P	E	P
Sulfurous acid	G	S	E	E
Sugar solutions	E	E	E	E
Tannic acid	E	G	E	E
Tar and ammonia	S	S	E	E
Tartaric acid	G	G	E	E
Titanic sulfate	E	E	E	E
Toluene	G	G	E	P
Zinc chloride	E	E	E	E
Zinc sulfate	E	E	E	E

E = Excellent – Virtually unattacked under all conditions. G = Good – Generally acceptable with a few limitations. S = Satisfactory – Suitable under some conditions; not recommended for remainder. Consult The Duriron Company, Inc. for details. P = Poor – Unsuitable under all conditions.

TABLE 1.58: ISOPOLYESTER, HALOGENATED AND BISPHENOL A POLYESTERS, AND VINYL ESTER RESINS—AMOCO CHEMICALS

Comparison of commercial corrosion resistant resins after one year immersion

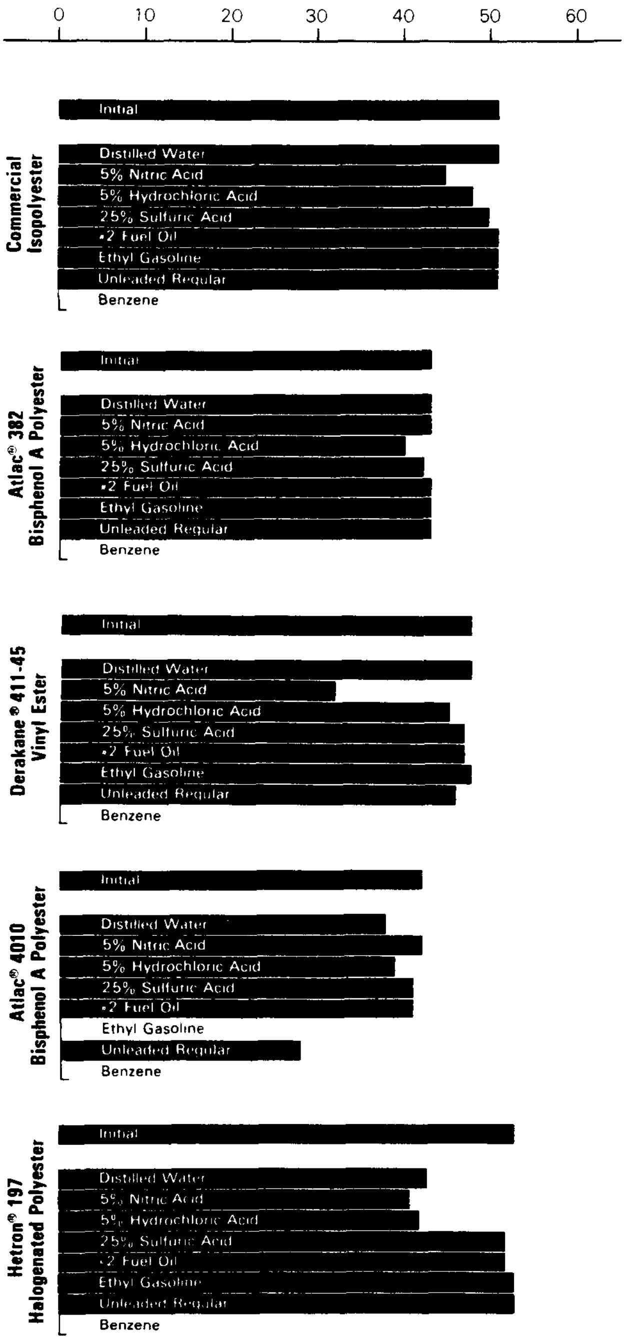
The lengths of the bars reflect the tested performance of the resins after one year in the indicated environments. The Composite Ratings are the ten year performances projected from the 1, 3, 6 and 12 month evaluations. All laminates were made according to ASTM Method C581 with a glass fiber content of 25±2%. To assure high quality, the ATLAC-based laminates were supplied by ICI United States. The other laminates were fabricated in the laboratory.



(continued)

TABLE 1.58: ISOPOLYESTER, HALOGENATED AND BISPHENOL A POLYESTERS, AND VINYL ESTER RESINS—AMOCO CHEMICALS (continued)

Barcol Hardness



Composite Ratings

Commercial Isopolyester

H_2O at 71°C	excellent
5% HNO_3 at 71°C	good
5% HCl at 71°C	good
25% H_2SO_4 at 71°C	good
#2 Fuel Oil at 23°C	excellent
Ethyl Gasoline at 23°C	excellent
Unleaded Regular at 23°C	excellent
Benzene at 23°C/time to failure	1 year

Atlac® 382 Bisphenol A Polyester

H_2O at 71°C	good
5% HNO_3 at 71°C	excellent
5% HCl at 71°C	good
25% H_2SO_4 at 71°C	good
#2 Fuel Oil at 23°C	excellent
Ethyl Gasoline at 23°C	excellent
Unleaded Regular at 23°C	excellent
Benzene at 23°C/time to failure	3 months

Derakane® 411-45 Vinyl Ester

H_2O at 71°C	good
5% HNO_3 at 71°C	acceptable
5% HCl at 71°C	excellent
25% H_2SO_4 at 71°C	excellent
#2 Fuel Oil at 23°C	excellent
Ethyl Gasoline at 23°C	excellent
Unleaded Regular at 23°C	good
Benzene at 23°C/time to failure	6 months

Atlac® 4010 Bisphenol A Polyester

H_2O at 71°C	good
5% HNO_3 at 71°C	excellent
5% HCl at 71°C	good
25% H_2SO_4 at 71°C	excellent
#2 Fuel Oil at 23°C	excellent
Ethyl Gasoline at 23°C	failure
Unleaded Regular at 23°C	acceptable
Benzene at 23°C/time to failure	1 month

Hetron® 197 Halogenated Polyester

H_2O at 71°C	acceptable
5% HNO_3 at 71°C	good
5% HCl at 71°C	acceptable
25% H_2SO_4 at 71°C	good
#2 Fuel Oil at 23°C	excellent
Ethyl Gasoline at 23°C	excellent
Unleaded Regular at 23°C	good
Benzene at 23°C/time to failure	6 months

1. ICI United States 2. Dow Chemical Company 3. Hooker Chemical Corporation

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO

The data shows results under Test Procedure ASTM D543, "Resistance of Plastics to Chemical Reagents." This method requires molded two-inch diameter disc specimens to be placed in a separate container and totally immersed for 168 hours (seven days) at 73.2°F. Appearance, weight and dimensional changes are noted as evidence of chemical attack. To obtain information on chemical resistance at elevated temperatures, these immersion studies were repeated at 50°C (122°F) and the results are set forth under the column "Heat Reduces Resistance."

The rating of certain reagents is followed by the designation (†). This designation indicates that the reagent was applied to a bar specimen which was then placed in a bending jig and held under constant 2% outer fiber strain at 23°C (73°F) for 72 hours.

TEST CLASSIFICATIONS

"R" — Resistant. No visual change was observed in the plastic for the duration of the test.

"MR" — Moderately Resistant. Some visual change (discoloration, crazing, checking) occurred.

"X" — Not Resistant. The plastic was severely crazed, or was softened, or was dissolved by the end of the test.

Chemical Resistance of Lustrex and Lustran Plastics

	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
Group	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Acids					
Acetic 1-5%	R	Yes	R	No	R
Acetic 25%	MR*	Yes	R	No	R
Acetic 50%	MR	Yes	R	Yes	R
Acetic Glacial 100%	X	—	X	—	X
Benzoic	R*	Yes	R	No	R
Boric	R	Yes	R	No	R
Butyric	—	—	—	—	X
Carbolic 50%	MR*	Yes	X	—	—
Carbolic 100%	X	—	X	—	X
Chromic 20%	R**	Yes	R	No	R
Chromic Sulfuric Acid Mixture	—	—	X	—	—
Citric 10%	R	Yes	R	No	R
Citric 20%	MR*	Yes	R	No	R
Dehydroacetic 1%	—	—	R	Yes	—
Dehydroacetic 25%	—	—	R	Yes	—
2-Ethylbutyric	—	—	—	—	R
Formic 90%	MR	Yes	X	—	—
Gallic	R	No	R	No	—
Hydrochloric 10%	R	Yes	R	No	R
Hydrochloric 38%	MR	Yes	R	Yes	R
Hydrofluoric 1%	MR**	No	—	—	—
Hydrofluoric 25%	—	—	—	—	R
Hydrofluoric 48%	X	—	—	—	X
Lactic 10%	MR	No	R	No	—
Malic 10%	R*	Yes	R	No	—
Nitric 20%, 70%	MR	Yes	R	Yes	R
Nitric, conc.	X	—	X	—	X
Octanoic	—	—	—	—	R
Oleic 100%	MR	Yes	R	Yes	R
Oxalic 10%	R*	Yes	R	No	—
Palmitic	MR	No	R	No	—

	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
Group	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Acids					
Phosphoric 1%-50%	R*	Yes	R	Yes	R
Propionic	—	—	—	—	X
Pyrogallic	R**	—	—	—	—
Red Oil (Oleic Acid)	—	—	R	Yes	R
Salicylic, saturated	R*	Yes	R	No	—
Stearic	R	Yes	R	Yes	—
Sulfur (Colloidal elemental)	R	—	—	—	—
Sulfuric 10%—50%	MR*	Yes	R	No	R
Sulfuric, concentrated	X	—	X	—	X
Tannic 1%	X	—	R	No	—
Tannic Jelly	X	—	—	—	—
Tannic, saturated	MR*	Yes	R	No	—
Tartaric	R*	Yes	R	No	—
Uric	—	—	—	—	R
Alcohols					
Allyl	MR*	Yes	X	—	X
n-Amyl	R*	Yes	R	Yes	R
Benzoyl	X	—	—	—	—
Benzyl	—	—	—	—	X
Butoxyethanol	—	—	R	—	R
n-Butyl	R*	Yes	R	Yes	R
Sec.-Butyl	—	—	MR	Yes	—
Tert.-Butyl	—	—	R	No	—
Cetyl	—	—	R	No	—
Cyclohexanol	R	Yes	R	Yes	R
Decyl	—	—	—	—	R
Diacetone	—	—	X	—	—
2-Ethoxyethanol	—	—	—	—	X
Ethyl (denatured)	R**	Yes	—	—	X
Ethyl Formula 30	MR	Yes	R	Yes	—
Ethyl 95%	MR**	Yes	—	—	—

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO (continued)

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Alcohols					
Ethyl 2B Absolute	R	Yes	X	—	X
Ethyl 2B-95	X	—	R	Yes	—
Furfuryl	X	—	X	—	X
n-Heptyl	R*	X	R	Yes	—
Hexyl	MR	Yes	—	—	—
n-Hexyl	R	Yes	R	Yes	—
Isobutyl	R*	Yes	R	Yes	R
Isopropyl	R*	Yes	R	Yes	R
Lauryl	R	No	R	No	—
Methyl	MR	Yes	X	—	X
Methylamyl	R	Yes	—	—	—
Nonyl	R	No	R	—	—
n-Octyl	R	No	R	No	—
2-Phenoxyethanol	—	—	—	—	X
Phenylethyl	X	—	X	—	X
Propyl	R	Yes	R	Yes	—
Sec-Butyl	MR*	—	MR	Yes	—
Tetrahydrofurfuryl	X	—	X	—	—
Undecyl	MR	—	—	—	—
Aldehydes					
Acetaldehyde	X	—	X	—	X
Amyl Cinnamaldehyde	X	—	—	—	—
Benzaldehyde (undiluted)	X	—	X	—	X
Cinnamaldehyde	—	—	—	—	X
Formaldehyde (30%)	X	—	R	Yes	R
Methylal (conc. Formaldehyde)	—	—	—	—	X
Salicylaldehyde	—	—	—	—	X
Alkalies					
Ammonia (aqueous)	R	Yes	R	—	R
Ammonia Hydroxide (conc.)	R	Yes	R	No	R
Alkalies					
Calcium Hydroxide (Saturated soln.)	—	—	R	No	—
Potassium Hydroxide 1-5%	MR	Yes	R	No	R
Potassium Hydroxide 10%	R	Yes	R	No	R
Potassium Hydroxide 30%	R	Yes	R	No	R
Potassium Hydroxide, sat.	MR	Yes	R	No	R
Sodium Hydroxide 1%-50%	MR	No	R	No	R
Sodium Hydroxide, sat.	R	No	R	No	—
Amines, Amids					
Acetamide	R	Yes	—	—	—
Aniline	X	—	X	—	X
Cyclohexylamine	—	—	—	—	X
Dibutylamine	—	—	—	—	X
Diethanolamine	R	No	—	—	R
Diethylamine	—	—	—	—	R
Dimethylformamide	X	—	X	—	—
Diphenylamine	X	—	X	—	—
Diethylenetramine	MR	Yes	—	—	—
Diephenylenimine (Carbazole)	—	—	R	No	—
Ethylenediamine	MR	—	—	—	—
Isopropylamine	—	—	—	—	X
Pentylamine	—	—	—	—	X
Trichopropanolamine	—	—	R	No	—
Triethylenetetramine	MR**	—	—	—	—
Cosmetics					
Lanolin	R*	Yes	R	No	—
Perfume Alcohol 5DA40	MR**	—	—	—	—
Cycloparaffins					
Cyclohexane	—	—	R	—	R
Methylcyclohexane	X	—	R	No	—

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO (continued)

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Esters					
Amyl Acetate	X	—	X	—	X
n-Amyl Phthalate	X	—	X	—	X
Benzyl Acetate	X	—	X	—	X
n-Butyl Acetate	X	—	X	—	X
Butyl Butyrate	—	—	—	—	X
n-Butyl Phthalate	X	—	—	—	—
Cellosolve (Ethylene Glycol Monoethyl Ether)	—	—	X	—	X
Dibutyl Phthalate	X	—	X	—	X
Dibutyl Sebacate	X	—	—	—	—
Diethyl Phthalate	X	—	X	—	X
Dimethyl Phthalate	X	—	—	—	—
Ethyl Acetate 90%	X	—	X	—	X
Ethyl Benzoate	X	—	X	—	X
Ethyl Lactate	X	—	X	—	—
Ethyl Acetoacetate	—	—	—	—	X
Ethyl Benzoate	X	—	X	—	—
Ethyl Chloroacetate	—	—	—	—	X
Ethyl Lactate	X	—	X	—	—
Ethyl Salicylate	—	—	—	—	X
Isoamyl Acetate	—	—	—	—	X
Isopropyl Acetate	X	—	—	—	—
Methyl Acetate	X	—	—	—	—
Methyl Benzoate	—	—	—	—	X
Methyl Laurate	—	—	—	—	X
Foods					
Alcohol (Bourbon)	—	—	R	—	R
Almond Oil	—	—	R	No	—
Bacon Fat	MR	—	—	—	—
Beef Gravy	R**	Yes	R	No	R
Beer (Over 3.2% alcohol)	R		R†	—	R
Beet Juice	—	—	R	—	R

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Foods					
Black Pepper (fresh)	X	—	R†	—	—
Butter	R	No	R	No	R
Carrot Juice	R	Yes	R	No	—
Catsup	R	Yes	R	No	R
Celery Salt	—	—	R†	No	—
Cherries (processed)	R**	Yes	—	—	—
Chicken Gravy (conc.)	R**	Yes	—	—	—
Chicken Soup (conc.) MBT	X	Yes	R	No	R
Cinnamon, pwd.	R**	Yes	R†	—	—
Clove Oil	—	—	X	—	—
Coca-Cola	R	Yes	R	—	R
Coca-Cola Extract	R	Yes	R	—	R
Cocoa Butter	MR**	No	—	—	—
Coconut Oil	MR	Yes	R	No	—
Cod Liver Oil	MR	Yes	R	No	R
Coffee					
Cream/Sucaryl	—	—	R	No	R
Cream/Sugar	—	—	R	No	R
Dry Powder	R	Yes	R	No	R
Liquid	MR*	No	R	No	R
Paste	MR*	No	R	No	R
Corn Oil	MR	No	R	No	R
Crisco	MR	—	R	No	R
Fountain Syrups					
Cherry, Chocolate,	R**	Yes	R	—	—
Orange, Root Beer,	R**	Yes	R	—	—
Strawberry, Vanilla	R**	Yes	R	—	—
Garlic Salt	—	—	R†	—	—
Gin	MR	—	—	—	—
Ginger Ale	R	No	R	—	R
Ginger Ale Extract	R	No	—	—	—
Grapefruit Juice	MR*	—	R	—	R
Grape Juice	—	—	R	—	—

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO (continued)

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Foods					
Honey	R	No	R	No	R
Horseradish	MR	No	—	—	R
Horseradish Mustard (Curtis)	R	Yes	—	—	—
Lard	R	No	R	No	R
Lean Beef	MR	—	—	—	—
Lemon Emulsion Flavoring	X	—	—	—	—
Lemon Juice, Fresh	MR	—	R	No	R
Lemon Oil and Peel	X	—	X	—	—
Licorice Powder	R**	No	—	—	—
Lime Emulsion Flavoring	X	—	—	—	—
Margarine	R*	Yes	R	No	R
Mayonnaise	MR**	—	R	—	R
Mazola Oil	R	—	R	—	R
Milk	MR	—	R	—	R
Milk Paste	R*	No	R	—	R
Milk, powdered	R	No	R	—	R
Mincemeat	X	—	—	—	—
Mustard	MR	No	R	—	R
Nutmeg Oil	—	—	X	—	—
Oil-Cooking	—	—	R	—	R
Olives	—	—	R	No	—
Onion Flakes	—	—	R†	—	—
Onion Salt	—	—	R†	—	—
Orange Emulsion Flavoring	X	—	—	—	—
Orange Juice, conc.	R**	Yes	R	—	—
Orange Juice, liquid	MR	—	R	—	R
Orange Oil & Peel	X	—	R	—	—
Oregano	—	—	R†	—	—
Paprika	—	—	R†	—	—
Parsley Flakes	—	—	R†	—	—

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Foods					
Peanut Butter (low oil cont.)	R	No	—	—	—
Peanut Butter	MR	—	R	No	—
Peanut Oil	MR	No	X	—	—
Pepper (Ground Black)	—	—	R	—	—
Pepsi-Cola	R	Yes	—	—	—
Pepsi-Cola Extract	R	Yes	—	—	—
Pineapple Juice, fresh	MR	—	R	—	—
Root Beer	R	No	—	—	R
Root Beer Extract	R	No	—	—	—
Rum	MR	—	—	—	—
Rye Whiskey	MR	—	—	—	—
Saponified Oil	MR	—	—	—	—
Sassafras Oil	—	—	X	—	—
Sausage Fat	MR	—	—	—	—
Sesame Oil	MR	—	—	—	—
Shrimp	MR	No	—	—	—
Soybean Oil	R	Yes	R	No	—
Spices Allspice (Jamaica, Whole), Anise Seed, Basil (Sweet), Bay Leaves, Caraway Seed, Celery Seed, Cinnamon (Stick), Coriander (Whole), Cumin Seed, Dill Seed, Fennel Seed (Whole), Marjoram, Mustard (Mayonnaise), Oregano, Parsley (Shredded), Black Pepper (Whole), Cayenne Pepper	R	No	—	—	—

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO (continued)

Group	LUSTREX* POLYSTYRENE		LUSTRAN* SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Foods					
Spices (Red), Peppers (Sweet Bell, Pickling (Mixed), Poppy Seeds, Poultry Seasoning, Rosemary, Sage, Savory (Summer), Spearmint, Thyme	R	No	—	—	—
Spices Cloves (Whole), Pumpkin Pie Spice	R**	Yes	—	—	—
Spices Chili Powder, Cream of tartar Curry Powder, Paprika	MR	No	—	—	—
Syrup (Maple)	—	—	—	—	R
Syrup (Simple Sugar)	—	—	—	—	R
Tea, Powder	R**	Yes	R	No	—
Tomato Juice	R	Yes	R	No	R
Vanilla	MR	—	R	Yes	—
Vanilla Extract	R**	No	—	—	R
Vinegar	MR	No	R	No	R
Wesson Oil	MR**	—	—	—	—
Whiskey	MR**	—	—	—	—
Worcestershire Sauce	R**	No	—	—	—
Glycols					
Diethylene Glycol	R	No	R	No	R
Ethylene Glycol	R	No	R	—	R
Polyethylene Glycol Distearate	—	—	R	—	—
Polyethylene Glycol Monolaurate	—	—	R	—	—
Propylene Glycol	R*	No	R	No	R
Triethylene Glycol	R**	No	R	No	R

Group	LUSTREX* POLYSTYRENE		LUSTRAN* SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Hydrocarbons, Aliphatic					
Butane	—	—	R	—	R
Gasoline					
Ethyl	X	—	R	Yes	X
Regular	X	—	R	No	X
White	X	—	R	No	X
n-Heptane	X	—	R	No	R
Hexane	X	—	—	—	X
Kerosene	X	—	R	No	R
Pentane	—	—	—	—	X
Pentene	—	—	—	—	X
Propane, gas, liquid	X	—	—	—	—
Hydrocarbons, Aromatic					
Benzene	X	—	X	—	X
Ethylbenzene	X	—	X	—	X
α-Methylnaphthalene	—	—	—	—	X
Nitrobenzene	—	—	—	—	X
Toluene	X	—	X	—	X
Toluene 75%, Mineral Oil 25%	—	—	X	—	—
Xylene	X	—	X	—	X
Hydrocarbons, Halogenated					
g-Benzene Hexachloride (Lindane)	X	—	X	—	X
Benzyl Chloride	—	—	—	—	X
Bromobutane	—	—	—	—	X
Bromoethane	—	—	—	—	X
Bromohexane	—	—	—	—	X
Butyryl Chloride	—	—	—	—	X
Carbon Tetrachloride	X	—	MR	—	MR
Chlordane	X	—	X	—	X
o-Chlorobenzaldehyde	—	—	—	—	X
Chlorobenzene	—	—	—	—	X
Chlorobutane	—	—	—	—	X

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO (continued)

Group	LUSTREX® POLYSTYRENE 73°F	LUSTREX® POLYSTYRENE Heat Reduces Resistance	LUSTRAN® SAN 73°F	LUSTRAN® SAN Heat Reduces Resistance	LUSTRAN ABS 73°F
Hydrocarbons, Halogenated					
Chloro Ethanol	—	—	—	—	X
Chloroform	—	—	X	—	X
α-Chloronaphthalene	—	—	—	—	X
Chloropropane	—	—	—	—	X
o-Dichlorobenzene	X	—	X	—	X
P-Dichlorobenzene	—	—	X	—	X
Diethylene Chloride	—	—	X	—	X
Ethyl Chloride (gas & liquid)	X	—	—	—	—
Ethylene Chloride	—	—	—	—	R
Ethylene Dichloride	X	—	X	—	X
Hexachlorobenzene	—	—	R	No	—
Methyl Chloride	X	—	—	—	—
Methylene Chloride	X	—	X	—	—
Monochlorobenzene	X	—	X	—	—
Naphtha	X	—	R	Yes	R
Naphthalene	X	—	R	Yes	
Octanoyl Chloride	—	—	—	—	X
Parachloride	X	—	—	—	—
Paradichlorobenzene	X	—	X	—	—
Perchloroethylene	X	—	R	Yes	X
Phthaloyl Chloride	—	—	—	—	X
Propylene Dichloride	X	—	X	—	—
Tetrachloroethane	X	—	X	—	—
Tetrachloroethylene	X	—	X	—	X
Trichlorobenzene	—	—	X	—	—
Trichloroethane	X	—	—	—	—
Trichloroethylene	X	—	X	—	X
Trichloropropene	—	—	—	—	X
Ketones & Ethers					
Acetone	X	—	X	—	X
Acetophenone	X	—	X	—	X
Ketones & Ethers					
Benzyl Ether	—	—	—	—	X
Butyl Ether	—	—	—	—	X
Cyclohexanone	X	—	X	—	X
Diacetone	MR*	Yes	—	—	—
Dibutyl Ether	X	—	—	—	—
Diethyl Ether	X	—	X	—	X
Diethylketone	X	—	X	—	X
2, 6-Dimethyl-4-Heptanone	—	—	—	—	X
Hexyl Ether	—	—	—	—	X
Methylacetophenone	—	—	—	—	X
Methyl Ethyl Ketone	X	—	X	—	X
Methyl Isobutyl Ketone	X	—	X	—	X
Methyl Isopropyl Ketone	X	—	—	—	—
Methyl Propyl Ketone	X	—	—	—	—
Pharmaceuticals					
Acetophenetidin	R**	No	—	—	—
Adrenalin Hydrochloride	R**	Yes	—	—	—
Adrenalin in Oil	R**	No	—	—	—
Aspirin, pwd.	R	No	—	—	—
Atrabrine	R**	—	—	—	—
Benzoic and Salicylic Acid Ointment	R	Yes	—	—	—
Caffeine, sat.	R**	Yes	R	No	R
Camphor	MR**	—	MR	—	MR
Ephedrine Hydrochloride	MR	—	—	—	—
Ephedrine Sulfate	R	Yes	—	—	—
Gum Acacia, pwd.	R	Yes	—	—	—
Gum Tragacanth	R	Yes	—	—	—
Iodine 83%	—	—	X	—	—
Iodine (Tincture U.S.P.)	—	—	—	—	X
Mentholatum	R	—	—	—	—
Menthol Crystals	X	—	—	—	—

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS–MONSANTO (continued)

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Pharmaceuticals					
Mercurochrome	MR	Yes	—	—	R
Mercury Ointment, Ammoniated	MR**	No	—	—	—
Merthiolate, tincture	MR**	Yes	—	—	—
Novocain (2% and 4%)	R	No	—	—	—
Pectin, sat.	R	Yes	—	—	—
Penicillin G	R	No	—	—	—
Petroleum Jelly	R	Yes	R	—	R
Petroleum Jelly, carbolated	MR		R		R
Quinine	R	Yes	—	—	—
Strychnine	R*	No	—	—	—
Sulfadiazine	MR**	Yes	—	—	—
Sulfur Ointment	R**	No	—	—	—
Thymol	X	—	—	—	—
Witch Hazel, distilled	R**	Yes	—	—	—
Zinc Oxide Ointment	R**	No	—	—	—
Salts					
Aluminum Chloride, sat.	R	No	R	Yes	R
Aluminum Sulfate, sat.	R*	Yes	R	No	R
Ammonium Bifluoride, sat.	R**	Yes	—	—	—
Ammonium Molybdate	R	No	—	—	—
Ammonium Salt, insecticide	MR**	—	—	—	—
Ammonium Thiocyanate	MR	Yes	R	No	—
Ammonium Thioglycolate	R**	No	—	—	—
Atropine Sulfate	R	No	R	No	—
Barium Bromide	R	No	—	—	—
Barium Carbonate	R	No	R	No	R
Barium Chloride	R	No	R	No	R
Borax, sat.	R*	Yes	R	No	R
Cadmium Bromide	R	No	—	—	—

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Salts					
Cadmium Stearate	—	—	R	No	—
Calcium Bromide	R	No	—	—	—
Calcium Chloride	R	No	R	No	R
Calcium Hypochloride, sat.	MR	Yes	—	—	—
Calcium Hypochlorite, pwd.	R	Yes	R	No	R
Calcium Oxide	R	No	R	No	R
Calcium Sulfate 25% Sol.	—	—	R	—	R
Cesium Bromide	R	No	—	—	—
Copper Oxide	R	No	R	No	R
Copper Sulphate	MR	No	R	—	R
Cupric Chloride 25%	—	—	R	—	R
Cupric Sulfate 25%	—	—	R	—	R
Cuprous Oxide	R	No	R	No	R
Diphenyl Oxide	X	—	—	—	—
Ethylene Oxide	X	—	—	—	—
Ferric Ammonium Sulfate	R*	Yes	-	—	—
Ferric Chloride	R*	Yes	R	No	R
Ferrous Chloride, sat.	R**	Yes	R	No	R
Ferrous Sulfate 25%	—	—	R	—	R
Ferrous Sulfite	MR	No	—	—	—
Hydrogen Sulfide	X	—	—	—	—
Hydroquinone, sat.	R*	Yes	R	Yes	—
Hydroquinone, 4%, sat.	MR	—	—	—	—
Lead Acetate	R*	No	—	—	—
Lead Arsenate	MR**	—	—	—	—
Lead Nitrate	R*	Yes	R	—	—
Magnesium Bromide	R	No	—	—	—
Magnesium Carbonate	R*	No	R	No	—
Mercuric Chloride 5%, pwd.	R*	Yes	R	No	—
Mercuric Chloride, sat.	MR*	Yes	R	No	—

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO (continued)

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Salts					
Potassium Aluminum Sulfate, sat.	R	Yes	R	No	—
Potassium Bicarbonate	—	—	—	—	R
Potassium Bisulfate, sat.	MR**	No	R	No	—
Potassium Bromate	R	No	—	—	—
Potassium Bromide 3%	MR**	—	R	No	—
Potassium Chloride	—	—	—	—	R
Potassium Chrome Alum.	R**	Yes	—	—	—
Potassium Ferricyanide	R*	Yes	R	No	—
Potassium Iodide, sat.	R*	Yes	R	No	—
Potassium Permanganate, sat.	MR*	No	R	Yes	R
Potassium Sulfate	R	No	R	No	—
Potassium Sulfide	R	No	R	No	—
Red Copper Oxide	MR	—	—	—	R
Selenium Monochloride	X	—	—	—	—
Silver Nitrate, sat.	R	Yes	R	Yes	—
Sodium Acetate, sat.	R**	Yes	R	No	—
Sodium Benzoate	R*	No	R	No	—
Sodium Bicarbonate	R*	No	R	No	R
Sodium Bichromate	MR*	—	—	—	—
Sodium Bisulfite, sat.	MR*	No	R	No	R
Sodium Borate, pwd.	R*	Yes	R	No	—
Sodium Bromide, sat.	R	Yes	R	No	—
Sodium Carbonate, sat.	R	Yes	R	No	R
Sodium Carbonate 2%-7%	MR*	No	R	No	R
Sodium Chloride, sat.	R	No	R	No	R
Sodium Chloride, 10%-20%	MR	No	R	No	R
Sodium Fluoride, pwd.	MR	No	R	No	—
Sodium Hypochlorite 12%	R*	No	R	No	—
Sodium Nitrate	—	—	R	No	—

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Salts					
Sodium Perborate, pwd.	R*	Yes	R	No	—
Sodium Petraborate (Borax)	R	Yes	—	—	—
Sodium Sulfate	—	—	R	No	R
Sodium Sulfide, pwd.	R	Yes	—	—	—
Sodium Sulfite	—	—	R	No	—
Sodium Thiosulfate, sat.	R*	No	R	No	—
Stannic Chloride, solution	R	—	—	—	—
Strontium Bromide	R	No	—	—	—
Titanium Tetrachloride	X	—	—	—	—
Trisodium Phosphate	—	—	R	No	—
Zinc Bromide	R	No	—	—	—
Zinc Carbonate	R**	Yes	R	No	—
Zinc Chloride 50°	R*	No	R	No	—
Zinc Oxide	R	No	—	—	—
Zinc Oxide, pwd.	R*	No	R	No	—
Zinc Stearate, pwd.	R*	No	R	No	—
Zinc Sulfacarbolate	R**	Yes	—	—	—
Zinc Sulfate, sat.	R**	No	R	No	—
Miscellaneous					
Acetic Anhydride	X	—	X	—	X
Acetonitrile	X	—	X	—	X
Ajax with Ammonia	—	—	R	—	R
Amidol (Photog.), sat.	R	No	—	—	—
Ammonium Carbonate	—	—	R	No	R
Amyl Mercaptan	X	—	—	—	—
Anethym Oil	X	—	—	—	—
Anise Seed Oil	X	—*	X	—	X
Baby Shampoo (Johnson & Johnson)	—	—	R†	—	R
Benzedrine	R	—	—	—	—
Benzoic Resin	MR**	No	—	—	—

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO (continued)

Group	LUSTREX® POLYSTYRENE		LUSTRAN® SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Miscellaneous					
Benzonitrile	—	—	—	—	X
Benzyl Benzoate	—	—	—	—	X
Bluing	—	—	—	—	R
Brake Fluid	—	—	MR††	—	—
Bromine Liquid	X	—	—	—	X
Butanethiol	—	—	—	—	X
Butyl Carbitol	—	—	X	—	—
Butyl Cellosolve	X	—	—	—	—
Butyric Anh.	—	—	—	—	X
Carbazole	R	No	—	—	—
Carbitol	R**	Yes	—	—	—
Carbonated Water	MR**	Yes	—	—	—
Carbon Dioxide	—	—	R	—	R
Carbon Disulfide	—	—	X	—	—
Carnauba Wax	R	No	R	No	R
Cassia Oil	X	—	—	—	—
Castor Oil	MR	No	R	No	—
Cedar Wood Oil	X	—	R	No	—
Cellophane	R	No	—	—	—
Cellulose Acetate	X	—	—	—	—
Cellulose Nitrate (sheet)	R**	—	—	—	—
Chlorine, (sat., water)	X	—	—	—	—
Cineol	—	—	—	—	X
Citraconic Anhydride	—	—	—	—	X
Citronella Oil	X	—	X	—	—
Cleaning Solution Sulfuric Acid & Potassium Bichromate	MR*	—	—	—	—
Clorox	MR**	—	R	No	R
Colloidal Sulfur	MR**	—	R	No	R
Cottonseed Oil	MR	Yes	R	No	R
Cresolic Compounds	MR*	—	—	—	X
Miscellaneous					
P-Cymene	—	—	—	—	X
DDT	X	—	R	Yes	—
Decahydronaphthalene	—	—	R	No	—
Detergents	R†	—	R†	—	R†
Detergent — Joy (5%)	—	—	R	No	R
Dexoxyn	MR**	—	—	—	—
Diethyl Carbonate	—	—	—	—	X
NN-Diethyl-M-Toluidine	—	—	—	—	X
Dimethyl Sulfate	—	—	—	—	X
N,N-Dimethylaniline	—	—	—	—	X
Dioxane	—	—	X	—	X
Distilled Water	R	Yes	R	No	R
Dow Corning Fluid 4	R	No	—	—	—
Dow Corning Fluid 200	R	No	—	—	—
Dowtherm A	X	—	—	—	—
Dry Cell Solution MnO_2 and NH_4Cl	R	—	—	—	—
Elon (Photog.) 3%, sat.	MR**	No	—	—	—
Ethylcellulose	MR	—	—	—	—
N-Ethylaniline	—	—	—	—	X
Eugenol	X	—	—	—	—
Flit, insecticide	MR	Yes	—	—	—
Freon II	—	—	X	—	X
Freon 12:22	X	—	R	—	R
Glass Wax	X	—	—	—	—
Glucose 30%	R*	Yes	R	No	R
Glycerin	R*	No	R	No	R
Glycine, pwd.	R	No	R	No	R
Glycol Ether (Cellosolve)	X	—	X	—	X
Grease (Lubricating)	—	—	MR††	—	—
Havoline Motor Oil	—	—	R	—	—
Hexachlorophene	—	—	—	—	R

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO (continued)

Group	LUSTREX* POLYSTYRENE		LUSTRAN* SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Miscellaneous					
Higgins India Ink	X	—	—	—	—
Hydrogen Peroxide 3%	R*	Yes	R	No	R
Hydrogen Peroxide 30%	R*	Yes	—	—	—
Iodine 3%	MR	No	R	No	—
Iodine 7% in Alcohol	MR	—	—	—	—
Ipana Tooth Paste	R	No	—	—	—
Isobutyronitrile	—	—	—	—	X
Ivory Soap	—	—	R	—	—
Lactose, sat.	R**	Yes	—	—	—
Lestoil	—	—	R	—	—
dl-Leucine	—	—	R	—	—
Light Process Oil	—	—	—	—	R
Lighter Fluid (Naptha)	—	—	R††	—	R
Lime Water	R	—	—	—	—
Linseed Oil (boiled)	X	—	R	No	—
Linseed Oil (raw)	MR**	No	R	No	R
Liquid Wrench	—	—	—	—	R
2, 4-Lutidine	—	—	—	—	X
Mesityl Oxide	—	—	—	—	X
Metallic Mercury	MR**	—	—	—	—
Metallic Sodium	R**	—	—	—	—
dl-Methionine (powder)	—	—	R	—	—
2-Methoxyethanol	—	—	—	—	X
Methyl Butyl Carbinol	R*	Yes	—	—	—
Methyl Ethyl Silicone	R	—	X	—	—
Methyl Eugenol	X	—	—	—	—
Methyl Salicylate	X	—	X	—	—
Mineral Oil	R	No	R	—	R
Mineral Spirits	—	—	R	—	R
Morpholine	—	—	X	—	—
Moth Flakes	MR**	Yes	—	—	R

Group	LUSTREX* POLYSTYRENE		LUSTRAN* SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Miscellaneous					
Motor Oil-Essolube, Tydol	MR**	No	R	—	R
Motor Oil-Sunoco	X	—	—	—	—
Mr. Clean	—	—	R	—	—
Napnthalene Base Gear Oil-Telechron	R**	—	—	—	—
Nitroglycerin	R**	—	X	—	X
Nitromethane	—	—	—	—	X
m-Nitrotoluene	—	—	—	—	X
Nitrous Oxide	R**	Yes	—	—	—
Nujol	R	—	R	—	R
Oil of					
Anise Seed	X	—	X	—	X
Clove	X	—	—	—	—
Lilac (Artificial)	X	—	—	—	—
Nutmeg	X	—	X	—	—
Peppermint, Roses	X	—	—	—	—
Rose Geranium,	X	—	—	—	—
Sandalwood Sassafras,	X	—	—	—	—
Spearmint, Sweet	X	—	—	—	—
Almond, Wintergreen	X	—	—	—	—
Oil-Light Machine	—	—	R	—	R
Olive Oil	MR**	No	R	No	—
Ozone (abs. of light)	R*	—	—	—	—
Palm Oil	MR	No	R	No	—
Paraffin	MR**	Yes	R	No	R
Paraffin Oil	R	No	—	—	—
Para Oil	MR**	—	—	—	—
Pentasol	R	Yes	—	—	—
Phenol 5%	MR**	Yes	X	—	X
Phenylacetonitrile	—	—	—	—	X
Phosphorous, White	MR*	No	—	—	—

(continued)

TABLE 1.59: POLYSTYRENE, SAN AND ABS PLASTICS—MONSANTO (continued)

Group	LUSTREX* POLYSTYRENE		LUSTRAN* SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Miscellaneous					
Pine Needle Oil	X	—	X	—	—
Pine Oil	X	—	X	—	—
Piperidine	—	—	—	—	X
Propadrine, 1:1000	MR**	—	—	—	—
1, 2 Propylene Oxide	X	—	X	—	—
Protargol 2%	R**	Yes	—	—	—
Pyrethrum Extract	MR**	—	—	—	—
Raid Ant and Roach Killer	—	—	X	—	—
Resorcinol Crystals	R	No	X	—	—
Resorcinol 5%	R	Yes	—	—	—
Rotenone Resinoid	MR	—	—	—	—
Rubber (white & black)	R**	—	—	—	—
Shampoo	—	—	R††	—	—
Shoe Polish	—	—	—	—	R
Skelly Solvent	X	—	R	No	—
Sobicide, insecticide	X	—	—	—	—
Spearmint Oil	—	—	X	—	—
Spermaceti	MR	No	—	—	—
Stanisol	X	—	—	—	—
Stoddard Solvents (White Spirits)	X	—	R	No	R
Sucrose 30%	R**	Yes	—	—	—
Sulfur Dioxide (Moist)	—	—	—	—	X
Tenite	R	—	—	—	—
Tetrahydrofuran	X	—	X	—	—
Tetralin	X	—	X	—	—
Texaco Motor Oil	—	—	R	—	—
3-In-One Oil	X	—	—	—	—
Thionyl Chloride	X	—	—	—	—
Tobacco Tars	R	—	—	—	—
Triethanolamine	R*	No	R	No	R

Group	LUSTREX* POLYSTYRENE		LUSTRAN* SAN		LUSTRAN ABS
	73°F	Heat Reduces Resistance	73°F	Heat Reduces Resistance	73°F
Miscellaneous					
Turkey Red Oil	R	No	R	No	—
Turpentine	MR*	Yes	MR	Yes	—
Typewriter Oil	R	No	—	—	—
Urine	MR	Yes	—	—	—
Varsol No. 2	X	—	—	—	—
Water Glass	R**	Yes	—	—	—
Water Paints (Children's)	R	No	—	—	—
Water Soluble Oil	MR	No	R	No	—
Wax Pencil	R**	—	—	—	—
Weed Killer (2, 4-D)	R**	Yes	—	—	—
White Iodine	R	—	—	—	—
White Wax	R**	Yes	R	—	—

*Impact materials less resistant.
**Impact materials not tested.
†Tested under 2% constant strain.
††Composition may vary, each formulation should be checked individually.

TABLE 1.60: POLYVINYL CHLORIDE, POLYPROPYLENE AND POLYETHYLENE FABRICATIONS—ATLAS

KEY

C 80°F.

H Up to the temperature limitation of the material. In cases where chemical boils below this limitation, resistance is intended to be shown up to the boiling point.

R RECOMMENDED

C CONDITIONAL. may be suitable but consult Atlas before using.

N NOT RECOMMENDED

RIGID PLASTIC FABRICATIONS

	PVC (Type I)		PVC (Type II)		POLYPROPYLENE (Homopolymer)		POLYETHYLENE (Linear)	
	C	H	C	H	C	H	C	H
Acetaldehyde	N	N	N	N	C	N	C	N
Acetic acid, up to 10%	R	R	R	C	R	R	R	R
Acetic acid, glacial	R	N	R	N	R	C	R	C
Alum	R	R	R	R	R	R	R	R
Aluminum Chloride	R	R	R	R	R	R	R	R
Aluminum Nitrate	R	R	R	R	R	R	R	R
Aluminum Sulfate	R	R	R	R	R	R	R	C
Ammonium Chloride	R	R	R	R	R	R	R	R
Ammonium Hydroxide	R	R	R	R	R	R	R	R
Ammonium Nitrate	R	R	R	R	R	R	R	R
Ammonium Sulfate	R	R	R	R	R	R	R	R
Amyl Acetate	N	N	N	N	N	N	N	N
Amyl Alcohol	R	R	R	R	R	C	R	C
Aniline	N	N	N	N	R	R	R	N
Aqua Regia	R	R	C	N	N	N	N	N
Barium Chloride	R	R	R	R	R	R	R	R
Barium Hydroxide	R	R	R	R	R	R	R	R
Barium Nitrate	R	R	R	R	R	R	R	R
Barium Sulfide	R	C	R	C	R	R	R	R
Benzene	N	N	N	N	C	N	C	N
Benzene sulfonic acid, 10%	R	R	R	R	N	N	N	N
Benzoic acid	R	R	R	R	R	R	R	R
Boric acid	R	R	R	R	R	R	R	R
Bromine water	R	R	C	N	N	N	N	N
Butyl Acetate	N	N	N	N	N	N	N	N
Butyl Alcohol	R	R	R	N	R	R	R	C
Butyric acid	R	N	C	N	R	C	R	C
Cadmium Chloride	R	R	R	R	R	R	R	R
Cadmium Nitrate	R	R	R	R	R	R	R	R
Cadmium Sulfate	R	R	R	R	R	R	R	R
Calcium Bisulfite	R	R	R	R	R	R	R	R
Calcium Chloride	R	R	R	R	R	R	R	R
Calcium Hydroxide	R	R	R	R	R	R	R	R
Calcium Nitrate	R	R	R	R	R	R	R	R
Carbon Disulfide	N	N	N	N	C	N	N	N
Carbon Tetrachloride	R	N	N	N	C	C	N	N
Chlorine Dioxide, water solution	R	R	R	R	N	N	N	N
Chlorine gas, dry	C	N	C	N	C	N	N	N
Chlorine gas, wet	N	N	N	N	N	N	N	N
Chlorine water	R	R	R	R	N	N	N	N
Chloroacetic acid	R	C	R	C	C	N	C	N
Chlorobenzene	N	N	N	N	C	N	C	N
Chloroform	N	N	N	N	C	N	C	N
Chromic acid, up to 5%	R	R	R	R	R	N	R	C
Chromic acid, 10%	R	R	R	R	R	N	R	N
Chromic acid, 20%	R	R	R	R	R	N	R	N
Chromic acid, 50% and over	R	C	N	N	N	N	N	N
Citric acid	R	R	R	R	R	R	R	R
Copper Chloride	R	R	R	R	R	R	R	R
Copper Nitrate	R	R	R	R	R	R	R	R
Copper Sulfates	R	R	R	R	R	R	R	R
Dichloroacetic acid	C	N	C	N	N	N	N	N
Dichlorobenzene	N	N	N	N	N	N	N	N
Diethyl ether	N	N	N	N	C	N	C	N
Ethyl Acetate	N	N	N	N	N	N	N	N
Ethyl Alcohol	R	R	R	R	R	R	R	C
Ethyl Sulfate	R	C	R	C	C	N	C	N
Ethylene Chloride	N	N	N	N	N	N	N	N
Ethylene Glycol	R	R	R	R	R	R	R	R
Fluosilicic acid	R	R	R	R	R	R	R	R
Formaldehyde	R	R	R	R	R	C	R	C
Formic acid	R	N	R	N	R	R	R	R
Gasoline	R	R	R	C	R	C	R	C
Glycerine	R	R	R	R	R	R	R	C
Gold Cyanide	R	R	R	R	R	R	R	R
Hexane	R	C	N	N	R	C	R	C
Hydrobromic acid, 20%	R	R	R	R	R	R	R	R
Hydrochloric acid	R	R	R	R	R	R	R	R
Hydrocyanic acid, 10%	R	R	R	R	R	R	R	R
Hydrofluoric acid, 30-50%	R	N	R	N	R	R	R	R
Hydrofluosilicic acid	R	R	R	R	R	R	R	R
Hydrogen Peroxide, 50%	R	R	R	R	R	C	R	C
Hydrogen Sulfide gas, dry	R	R	R	R	R	R	R	R
Hydrogen Sulfide gas, wet	R	R	R	R	R	R	R	R
Iron Chlorides	R	R	R	R	R	C	R	C
Iron Nitrates	R	R	R	R	R	R	R	R

(continued)

TABLE 1.60: POLYVINYL CHLORIDE, POLYPROPYLENE AND POLYETHYLENE FABRICATIONS—ATLAS (continued)

	PVC (Type I)		PVC (Type II)		POLYPROPYLENE (Homopolymer)		POLYETHYLENE (Linear)	
	C	H	C	H	C	H	C	H
Iron Sulfates	R	R	R	R	R	R	R	R
Isopropyl Ether	N	N	N	N	C	N	C	N
Kerosene	R	R	R	R	C	N	C	N
Lactic acid, 25%	R	R	R	R	R	R	R	R
Lead Acetate	R	R	R	R	R	R	R	R
Lead Nitrate	R	R	R	R	R	R	R	R
Linseed Oil	R	R	R	R	R	C	R	C
Magnesium Chloride	R	R	R	R	R	R	R	R
Magnesium Hydroxide	R	R	R	R	R	R	R	R
Magnesium Nitrate	R	R	R	R	R	R	R	R
Magnesium Sulfate	R	R	R	R	R	R	R	R
Maleic acid	R	R	R	C	R	R	R	R
Mercuric Acetate	R	R	R	R	R	R	R	R
Methyl Acetate	N	N	N	N	N	N	N	N
Methyl Alcohol	R	R	R	R	R	R	R	R
Methyl Ethyl Ketone	N	N	N	N	R	C	R	C
Methyl Sulfate	R	C	R	C	C	N	C	N
Mineral Oil	R	C	R	C	R	C	R	C
Mineral Spirits	R	N	N	N	R	C	R	C
Muriatic acid	R	R	R	R	R	R	R	R
Nickel Chloride	R	R	R	R	R	R	R	R
Nickel Nitrate	R	R	R	R	R	R	R	R
Nickel Sulfate	R	R	R	R	R	R	R	R
Nirtic acid, up to 5%	R	R	R	R	R	R	R	C
Nitric acid, 20%	R	R	R	C	R	R	R	C
Nitric acid, 40%	R	R	R	N	R	C	C	N
Nitric acid, 50% and over	C	N	N	N	C	N	N	N
Nitrobenzene	N	N	N	N	C	N	C	N
Oleic acid	R	R	R	R	R	C	R	C
Oxalic acid	R	R	R	R	R	C	R	C
Perchloric acid, 10%	R	R	R	R	C	N	C	N
Phenol	R	N	N	N	R	C	C	N
Phosphoric acid	R	R	R	R	R	C	R	C
Phosphorous acid	R	R	R	R	R	R	R	R
Phosphorous Trichloride	N	N	N	N	C	N	C	N
Phthalic acid	R	R	R	R	R	R	R	R
Picric acid	N	N	N	N	C	N	C	N
Potassium Bicarbonate	R	R	R	R	R	R	R	R
Potassium Carbonate	R	R	R	R	R	R	R	R
Potassium Chloride	R	R	R	R	R	R	R	R
Potassium Cyanide	R	R	R	R	R	R	R	R
Potassium Ferricyanide	R	R	R	R	R	R	R	R
Potassium Ferrocyanide	R	R	R	R	R	R	R	R
Potassium Hydroxide, up to 30%	R	R	R	R	R	R	R	R
Potassium Hydroxide, 30% and over	R	R	R	R	R	R	R	R

	PVC (Type I)		PVC (Type II)		POLYPROPYLENE (Homopolymer)		POLYETHYLENE (Linear)	
	C	H	C	H	C	H	C	H
Potassium Nitrate	R	R	R	R	R	R	R	R
Potassium Sulfate	R	R	R	R	R	R	R	R
Pyridine	N	N	N	N	R	N	R	N
Rochelle salt	R	R	R	R	R	R	R	R
Salicylic acid	R	R	R	R	R	R	R	R
Silver Nitrate	R	R	R	R	R	R	R	R
Sodium Acetate	R	R	R	R	R	R	R	R
Sodium Bicarbonate	R	R	R	R	R	R	R	R
Sodium Carbonate	R	R	R	R	R	R	R	R
Sodium Chloride	R	R	R	R	R	R	R	R
Sodium Cyanide	R	R	R	R	R	R	R	R
Sodium Hydroxide, up to 30%	R	R	R	R	R	R	R	R
Sodium Hydroxide, 30% and over	R	R	R	R	R	R	R	R
Sodium Hypochlorite, up to 3%	R	R	R	R	R	C	R	C
Sodium Hypochlorite, 15% and over	R	R	R	C	R	C	R	C
Sodium Nitrate	R	R	R	R	R	R	R	R
Sodium Sulfate	R	R	R	R	R	R	R	R
Sodium Sulfide	R	R	R	R	R	R	R	R
Sodium Sulfite	R	R	R	R	R	R	R	R
Sodium Thiosulfate	R	R	R	R	R	C	R	C
Soya Oil	R	C	R	C	R	C	R	C
Stearic acid	R	R	R	R	R	R	R	R
Sulfur Dioxide gas, dry	R	R	R	R	R	C	R	C
Sulfur Dioxide gas, wet	R	N	N	N	C	N	C	N
Sulfur Trioxide gas, dry	R	R	R	R	C	N	C	N
Sulfur Trioxide gas, wet	R	R	R	R	C	N	C	N
Sulfuric acid, up to 50%	R	R	R	R	R	C	R	C
Sulfuric acid, 80%	R	R	R	N	C	C	C	N
Sulfuric acid, 93%	R	C	R	N	C	N	N	N
Sulfuric acid, over 93%	N	N	N	N	C	N	N	N
Sulfuric acid, fuming	N	N	N	N	N	N	N	N
Sulfurous acid	R	R	R	R	R	R	R	R
Tannic acid	R	R	R	R	R	R	R	R
Tartaric acid	R	R	R	R	R	C	R	C
Tin Chloride	R	R	R	R	R	C	R	C
Tin Sulfate	R	R	R	R	R	R	R	R
Toluene	N	N	N	N	C	N	C	N
Trichloroethylene	N	N	N	N	C	N	C	N
Trisodium Phosphate	R	R	R	R	R	R	R	R
Tung Oil	R	R	R	R	R	C	R	C
Urea	R	R	R	R	R	R	R	R
Xylene	N	N	N	N	C	N	C	N
Zinc Chloride	R	R	R	R	R	R	R	R
Zinc Nitrate	R	R	R	R	R	R	R	R
Zinc Sulfate	R	R	R	R	R	R	R	R

TABLE 1.61: VINYL, SILICONE AND FLUOROELASTOMER TUBING—BARNANT

MASTERFLEX Tubing Compatibility Tables

Legend:
X = Satisfactory
C = Use only after testing
N = Not satisfactory
T = TYGON (vinyl) tubing
S = Silicone tubing
V = VITON (fluoroelastomer) tubing
— = No data available

Fluid to be pumped	Tubing T	Tubing S	Tubing V
Acetaldehyde	N	X	N
Acetates (low mol wt)	N	C	N
Acetic acid (less than 5%)	X	X	X
Acetic acid (more than 5%)	X	X	C
Acetic anhydride	C	N	N
Aceto nitrile	—	C	—
Acetone	N	C	N
Acetyl bromide	N	—	—
Acetyl chloride	N	—	—
Air	X	X	X
Alcohols	X	X	X
Aliphatic hydrocarbons	X	C	N
Aluminum chloride	X	C	X
Aluminum sulphate	X	X	X
Alums	X	—	X
Ammonia (gas, liquid)	X	X	N
Ammonium acetate	X	—	—
Ammonium carbonate	X	—	—
Ammonium chloride	X	—	X
Ammonium hydroxide	X	X	X
Ammonium nitrate	X	C	—
Ammonium phosphate	X	X	—
Ammonium sulfate	X	X	X
Amyl acetate	N	N	N
Amyl alcohol	X	N	X
Amyl chloride	C	N	X
Aniline	N	N	C
Aniline hydrochloride	N	N	X
Antimony salts	X	—	C
Aqua regia (75% hydrochloric, 25% nitric acid)	N	—	C
Aromatic hydrocarbons	N	C	X
Arsenic salts	X	—	X
Barium salts	X	X	X
Benzaldehyde	N	N	N
Benzene	C	N	X
Benzenesulfonic acid	C	—	X
Benzoic acid	X	C	X
Benzyl alcohol	X	—	X
Bleaching liquors	X	C	X
Boric acid	X	X	X
Bromine	X	N	X
Butane	C	N	X
Butyl acetate	N	—	N
Butyl alcohol (Butanol)	X	C	X
Butyric acid	N	—	C
Calcium oxide (diluted)	—	X	X
Calcium salts	X	C	X
Carbon bisulfide	N	—	X
Carbon dioxide	X	C	X
Carbon tetrachloride	C	N	X
Chloracetic acid	N	—	N
Chlorine (wet)	X	N	X
Chlorine (dry)	X	N	N
Chlorobenzene	N	—	X
Chlorobromomethane	—	N	X
Chloroform	C	N	X
Chlorosulfonic acid	C	N	N
Chromic acid	X	N	X
Chromium salts	X	—	—
Copper salts	X	X	X
Cresol	N	X	X
Cyclohexane	—	N	X
Cyclohexanone	N	N	X
Diacetone alcohol	—	N	N
Dimethyl formamide	—	C	N
Essential oils	X	—	—
Ethers	C	N	C
Ethyl acetate	N	C	N
Ethyl alcohol (Ethanol)	C	C	X
Ethyl bromide	N	—	X
Ethyl chloride	N	N	X
Ethylamine	N	—	N
Ethylene chlorohydrin	N	N	X
Ethylene dichloride	N	N	X
Ethylene glycol	X	X	X
Ethylene oxide	—	N	N
Fatty acids	X	C	X
Ferric chloride	X	C	X
Ferric sulfate	X	C	X
Ferrous chloride	X	C	X
Ferrous sulfate	X	C	X
Fluoborate salts	X	—	—
Fluoboric acid	X	—	—
Fluo-silicic acid	X	—	—
Formaldehyde	X	C	N
Formic acid	X	C	N
Freon	N	N	C
Gasoline (non-aromatic)	N	N	X
Gasoline (high aromaticity)	N	N	X
Glucose	X	X	X
Glue	X	—	X
Glycerine	X	X	X
Hydriodic acid	X	—	X
Hydro-bromic acid	X	N	X
Hydrochloric acid	X	N	X
Hydrochloric acid (med conc)	X	N	X
Hydrochloric acid (conc)	X	N	X
Hydrocyanic acid	X	N	X
Hydrofluoric acid	X	N	X
Hydrogen peroxide (dil)	X	X	X
Hydrogen peroxide (conc)	N	X	C
Hydrogen sulfide	X	N	N
Hypochlorous acid	X	—	X
Iodine solutions	X	—	X
Kerosene	N	N	X
Ketones	N	N	N
Lacquer solvents	N	N	N
Lactic acid	X	—	X
Lead acetate	X	N	N
Linseed oil	X	X	X
Lithium hydroxide (5%)	—	N	X
Magnesium chloride	X	X	X
Magnesium sulfate	X	—	X
Malic acid	X	X	X
Manganese salts	X	X	X
Mercury salts	X	—	X
Methane	—	N	X
Methyl chloride	—	C	X
Mixed acid (40% sulphuric, 15% nitric)	C	—	X
Molybdenum disulfide	—	C	—
Monoethanolamine	—	C	—
Naphtha	C	N	X
Natural gas	X	X	X
Nickel salts	X	X	X
Nitric acid (diluted)	X	C	X
Nitric acid (med conc)	X	N	X
Nitric acid (conc)	C	N	C
Nitrobenzene	N	N	X
Nitrogen oxides	X	C	C
Nitrous acid	X	—	C
Oils, animal	N	C	X
Oils, mineral	N	C	X
Oils, vegetable	C	X	X
Oleic acid	C	N	C
Oxalic acid	X	C	X
Oxygen (gas)	X	X	—
Perchloric acid	N	N	X
Perchloroethylene	N	N	X
Phenol	C	N	X
Phosphoric acid (ortho)	X	C	X
Phthalic acid	X	X	X
Plating solutions	X	N	X
Polyglycol	—	—	—
Potassium carbonate	X	—	X
Potassium chlorate	X	—	X
Potassium hydroxide (med conc)	X	C	X
Potassium hydroxide (conc)	X	C	X
Potassium iodide	X	—	X
Pyridine	N	N	N
Silicone fluids	—	C	X
Silicone oil	C	C	X
Silver nitrate	X	X	X
Soap solutions	X	X	X
Sodium bicarbonate	X	X	X
Sodium bisulfate	X	—	X
Sodium bisulfite	X	X	X
Sodium borate	X	X	X
Sodium carbonate	X	X	X
Sodium chlorate	X	—	X
Sodium chloride	X	X	X
Sodium ferrocyanide	X	—	X
Sodium hydrosulfite	X	C	X
Sodium hydroxide (dil)	X	C	X
Sodium hydroxide (med conc)	X	C	X
Sodium hydroxide (conc)	X	C	C
Sodium hypochlorite (below 5%)	X	—	X
Sodium hypochlorite (above 5%)	C	—	X
Sodium nitrate	X	N	—
Sodium silicate	X	—	X
Sodium sulfide	X	X	X
Sodium sulphite	X	X	X
Steam (up to 40 psi)	N	N	N
Stearic acid	X	C	—
Styrene	—	N	X
Sulfur chloride	C	N	X
Sulfur dioxide	X	C	X
Sulfur hexafluoride	—	C	N
Sulfur trioxide	X	C	X
Sulfuric acid (dil)	X	N	X
Sulfuric acid (med conc)	X	N	X
Sulfuric acid (conc)	X	N	X
Sulfurous acid	X	N	X
Tannic acid	X	C	X
Tanning extracts	X	—	X
Tartaric acid	X	C	X
Tin salts	X	—	—
Titanium salts	X	—	—
Toluene (Toluol)	N	N	X
Trichloracetic acid	C	—	N
Trichloroethylene	—	—	X
Tri-sodium phosphate	X	—	X
Turpentine	X	N	X
Urea	X	X	X
Uric acid	X	—	—
Vinyl plastisol	—	C	—
Water	X	X	X
Water (brine)	X	X	X
Xylene (Xylol)	N	N	X
Zinc chloride	X	—	X

Liquefied food products	Tygon "food"
Alcohol	C
Beer	C
Brandy	C
Butter	X
Carrot	X
Certo	X
Chocolate syrup	X
Citric acid	X
Fish	X
Fruit juices	X
Karo syrup	X
Mayonnaise	X
Milk	X
Milk of magnesia	X
Molasses	X
Sauerkraut	X
Sea foods	X
Sugar	X
Tomato	X
Vegetable oil	X
Vinegar	X
Whiskey	C
Wines	C

Liquefied food products	Silicone
Beer	X
Butter	X
Coca Cola syrup	X
Coffee	X
Lard	X
Mazola oil	X
Orange peel oil	N
Orange syrup	X
Scotch whiskey	X
Spry shortening	X
Tab concentrate	X
Tia Maria liqueur	X
Vegetable oil	X
Vinegar	X

TABLE 1.62: VARIOUS GLASS-REINFORCED RESINS—CELANESE PLASTICS

CHEMICAL RESISTANCE DATA @73°F

F = FAIR
P = POOR
G = GOOD

Chemical	Acetal Copolymer	Acetal Homopolymer	Styrene Mod. PPO	Polycarbonate	G.P. & H.S. Nylon 66	Thermoplastic Polyester *
Acetic Acid 5%	G	F	G	G	P	G
Acetone	G	G		P	G	G
Ammonium Hydroxide	G	P	G	G		G
Aqua Regia	P	P		P		P
Benzene	G	G		P	G	G
Carbon Tetrachloride	G	F		F	G	G
Chloroform	G	F		P	P	G
Citric Acid	G	F			G	G
Dimethylformamide	F	F				F
Ethyl Acetate	G	G			G	G
Ethyl Alcohol	G	G		G		G
Ethyl Ether	G	G		P	G	G
Ethylene Dichloride	G	F		P		F
Ethylene Glycol	G	F	G	G		G
Formaldehyde	G	G			G	G
Formic Acid	P	P				F
Freon	G	F		F	P	G
Gasoline	G	G		F	G	G
Heptane	G	G	G	G	G	G
Hexane	G	G		G	G	G
Hydrochloric Acid	P	P	G	F	P	F
Hydrogen Peroxide	F	P		G	P	G
Kerosene	G	G				G
Linseed Oil	G	G				G
Methyl Alcohol	G	G		P		G
Methyl Ethyl Ketone	G	G			G	G
Mineral Oils	G	G			G	G
Nitric Acid	P	P	G	G		P
Oleic Acid	G	F		G	G	G
Phenol	F	P		P	P	P
Phosphoric Acid	P	P		G	P	F
Soap Solutions	G	G			G	G
Sodium Carbonate	G	G		G	G	G
Sodium Chloride	G	G		G	G	G
Sodium Hydroxide	G	P	G		G	F
Sodium Hypochlorite	F	P		G		G
Sodium Thiosulfate	G	F		G		
Sulfuric Acid	P	P	G	G	P	F
Toluene	G	F		P	G	G
Water	G	G		G	G	G

*CELANEX

TABLE 1.63: VARIOUS POLYMERS—WESTLAKE PLASTICS

Chemical Resistance

At 20°C

Tested chemicals	Sulfuric acid (98%)	Nitric acid (70%)	Concentrated hydrochloric acid	Sodium hydroxide solution	Benzene	Trichloroethylene	Heptane	Methyl ethyl ketone	Ethyl acetate	Benzaldehyde
TPX	A	A	A	A	B	B	B	A	B	A
Polymethylmethacrylate	B	B	B	A	C	C	C	C	C	C
Acetylbutylcellulose	C	C	C	C	C	C	C	C	C	C
Polycarbonate	A	A	A	C	C	C	C	C	C	C
Polypropylene	A	A	A	A	B	B	B	A	B	A
Polystyrene	A	B	A	A	C	C	C	C	C	C
Polysulfone	A	B	A	A	C	C	C	C	C	C
SAN	A	B	A	A	C	C	C	C	C	C

At 60°C

Tested chemicals	Sulfuric acid (98%)	Nitric acid (70%)	Concentrated hydrochloric acid	Sodium hydroxide solution	Benzene	Trichloroethylene	Heptane	Methyl ethyl ketone	Ethyl acetate	Benzaldehyde
TPX	A	A	A	A	B	B	B	B	B	A
Polymethylmethacrylate	C	C	C	A	C	C	C	C	C	C
Acetylbutylcellulose	C	C	C	C	C	C	C	C	C	C
Polycarbonate	C	A	B	C	C	C	C	C	C	C
Polypropylene	A	A	A	A	B	B	B	B	B	A
Polystyrene	C	C	B	A	C	C	C	C	C	C
Polysulfone	C	B	B	A	C	C	C	C	C	C
SAN	C	C	B	A	C	C	C	C	C	C

[A] very good [B] good [C] poor

TPX = methylpentene polymer

TABLE 1.64: VARIOUS RESINS—GENERAL ELECTRIC

Comparison of Chemical Resistance of Six Plastics Resins

		% tensile retained[a]					
	Chemical	Nylon-6/6[1]	Poly-carbonate[3]	Poly-sulfone[4]	Noryl phenylene oxide based resin[2]	Polyphenyl-ene sulfide[5]	Phenolic
Acids	10% acetic	30	37	100	100	100	—
	Glacial acetic	0	67	91	78	98	98
	Acetic anhydride	74	0	0	55	100	—
	Lactic	22	100	100	100	100	—
	Benzene sulfonic	0	20	35	100	100	—
	88% formic	0	38	79	99	75	4
	10% HCl	0	100	100	100	100	—
	37% HCl	0	0	100	100	100	83
	10% HNO_3	0	100	100	100	96	—
	30% H_2SO_4	0	100	100	100	100	13
	85% H_3PO_4	0	100	100	100	100	73
	10% chromic	67	100	100	100	100	—
Bases	15% NaOH	69	98	100	100	100	—
	30% NaOH	89	7	100	100	100	63
	28% NH_4OH	85	0	100	100	100	99
Inorganic 10% aqueous solution	H_2O	66	100	100	100	100	—
	$Al_2(SO_4)_3$	33	100	100	100	100	—
	$(NH_4)_2SO_4$	62	100	100	100	100	—
	Na_2SO_4	76	100	100	100	100	—
	$Na_2S_2O_3$	90	100	100	100	100	—
	Na_2S	60	100	100	100	100	—
	NaCl	94	100	100	100	100	—
	NH_4Cl	73	100	100	100	100	—
	$CaCl_2$	82	100	100	100	100	—
	$BaCl_2$	86	100	100	100	100	—
	$MgCl_2$	74	100	100	100	100	—
	$AlCl_3$	19	100	100	100	100	100
	$FeCl_3$	13	100	100	100	100	—
	NH_4NO_3	47	100	100	100	100	—
	$Ca(NO_3)_2$	29	100	100	100	100	—
	$NaHCO_3$	76	100	100	100	100	—
	Na_2CO_3	80	100	100	100	100	—
	$Na_2Cr_2O_7$	57	100	100	100	100	—
	$KMnO_4$	39	100	100	100	100	—
	NaOCl	44	100	100	100	84	85
	Br_2	8	48	92	87	64	100
Alcohols	2-Aminoethanol	93	0	100	100	100	—
	Amyl alcohol	87	48	100	62	100	—
	Butyl alcohol	87	94	100	84	100	100
	Cyclohexanol	84	74	95	27	100	96
	Ethylene glycol	96	100	100	100	100	—
Amines	*n*-Butylamine	91	0	0	0	49	100
	Ethylenediamine	78	0	0	51	65	—
	Aniline	85	0	0	0	96	100
	Dimethylaniline	100	0	0	0	100	—
	Morpholine	93	0	0	0	80	—
	Pyridine	74	0	0	0	93	—

(continued)

TABLE 1.64: VARIOUS RESINS—GENERAL ELECTRIC (continued)

	Chemical	Nylon-6/6[1]	Polycarbonate[3]	Polysulfone[4]	Noryl phenylene oxide based resin[2]	Polyphenylene sulfide[5]	Phenolic[6]
		% tensile retained[a]					
Aldehydes, ketones	Acetophenone	87	0	0	0	100	—
	Cyclohexanone	87	0	0	0	99	—
	Methyl ethyl ketone	87	0	0	0	100	100
	Benzaldehyde	98	0	0	0	84	100
	37% Formaldehyde	77	100	100	100	100	—
	Furfural	81	0	0	0	100	100
Chlorinated organics	Acetyl chloride	0	0	0	0	100	—
	Benzyl chloride	80	0	0	0	100	—
	Carbon tetrachloride	76	0	17	0	100	—
	Chlorobenzene	73	0	0	0	100	100
	2-Chloroethanol	12	0	0	53	100	—
	Chloroform	57	0	0	0	87	100
	5% aq. chlorophenol	41	42	0	57	100	—
	Epichlorohydrin	84	0	0	0	74	—
	Ethylene chloride	65	0	0	0	72	—
Esters	Amyl acetate	88	46	0	0	100	—
	Butyl acetate	95	0	32	0	100	—
	Butyl phthalate	90	46	63	19	100	100
	Ethyl acetate	89	0	0	0	100	100
Ethers	Butyl ether	100	61	100	0	100	—
	Cellosolve	81	78	0	47	89	—
	p-dioxane	96	0	0	0	88	100
	Tetrahydrofuran	87	0	0	0	76	92
Hydrocarbons	Cyclohexane	90	75	99	0	100	—
	Heptane	84	100	100	36	91	98
	Diesel fuel	87	100	100	36	100	—
	Gasoline	80	99	100	0	100	—
	Stoddard solvent	86	100	100	0	100	—
	Mineral oil	90	100	100	100	100	—
	Motor oil	88	100	100	100	100	—
	Wesson oil	100	99	100	100	100	—
	Dowtherm	89	0	0	0	100	—
	Toluene	76	0	0	0	98	—
	Xylene	91	0	0	0	100	100
Nitriles	Acetonitrile	93	25	0	69	96	100
	Benzonitrile	88	0	0	0	100	—
Nitro compounds	Nitrobenzene	100	0	0	0	100	100
	Nitro methane	57	0	0	66	71	100
Phenols	*m*-cresol	0	0	0	0	100	—
	Phenol	0	0	0	0	100	100
Miscellaneous	Dimethyl sulfoxide	84	0	0	93	100	—
	Sulfolane	87	0	0	100	97	100
	N,N-dimethylformamide	95	0	0	—	100	94
	Cresyldiphenyl phosphate	88	62	55	19	100	—
	Triphenylphosphite	84	16	77	0	100	—

a—After 24-hr. exposure at 200° F.
1—Zytel 101, Du Pont Co.
2—Noryl, General Electric Co.
3—Lexan 141, General Electric Co.
4—Udel, Union Carbide Corp.
5—Ryton, Phillips Petroleum Co.
6—Genal 4300, General Electric Co.

(Reprinted from *Modern Plastics*)

TABLE 1.65: VARIOUS RESINS AND ELASTOMERS FOR LININGS AND MEMBRANES—ATLAS

KOROSEAL is an extruded, plasticized polyvinyl chloride sheet lining material.

ATLASTAFLEX is a polyvinyl chloride laminated sheet lining.

NEOPRENE is a synthetic rubber-based sheet lining.

CHLOROBUTYL is a synthetic rubber lining material.

3-PLY is a sheet lining consisting of a layer of hard natural rubber sandwiched between two layers of soft natural rubber.

Atlas PVDF sheet lining is a polyvinylidene fluoride.

ATLASTIC 31 is a hot-melt asphaltic compound with a ball-and-ring softening point of 200° to 225°F (93° to 107°C). ATLASTIC 40 is a corrosion-resistant membrane system consisting of a layer of ATLASTIC 40 textile in the center of two layers of ATLASTIC 31. ATLASTIC 50 is a textile-reinforced, hot-melt asphaltic membrane with a ball-and-ring softening point of 250° to 275°F (121° to 135°C).

CHEMPRUF linings are a series of heavy-duty monolithic systems based on epoxy, furan, polyester, and vinyl ester resins. The CHEMPRUF 1000 Series systems contain flake glass as filler and reinforcement. The CHEMPRUF 2000 Series systems contain fabric reinforcement which provides a lining with outstanding structural integrity and chemical resistance in broad thermal ranges.

Flake Glass Systems	Resin Binder	Fabric Reinforced Systems	Resin Binder
CHEMPRUF 1100	Furan	CHEMPRUF 2100	Furan
CHEMPRUF 1200	Epoxy	CHEMPRUF 2200	Epoxy
CHEMPRUF 1300	Polyester	CHEMPRUF 2300	Polyester
CHEMPRUF 1301	Polyester	CHEMPRUF 2301	Polyester
CHEMPRUF 1400	Vinyl Ester	CHEMPRUF 2400	Vinyl Ester

Chemical Resistance Chart

R: Recommended
N: Not recommended
A: Silica filler will be attacked. Sealing the surface may prolong life
C: Conditional; may be suitable but consult Atlas before using
X: Does not apply

	Koroseal	Atlastaflex	Nat. Rubber	Neoprene	Chlorobutyl	3-Ply Rubber	PVDF	Atlastic 31/40/50	CT-30	Membrane 88	ChemPruf 1100	ChemPruf 1200	ChemPruf 1300	ChemPruf 1301	ChemPruf 1400	ChemPruf 2100	ChemPruf 2200	ChemPruf 2300	ChemPruf 2301	ChemPruf 2400
C Room Temp. H 150°F	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H
Acetaldehyde	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Acetic acid, up to 10%	C N	R R	N N	N N	R R	N N	C C	R R	R R	R C	R R	C N	R C	R R	R R	R R	C N	R C	R R	R R
Acetic acid, glacial	N N	R N	N N	N N	R N	N N	C N	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Alum	R R	R R	R R	R R	R R	N N	R R	R R	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Aluminum Chloride	R R	R R	R C	R R	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Aluminum Nitrate	R R	R R	N N	N N	R R	N N	R R	R C	R C	C C	C N	C N	R R	R R	R R	C N	C N	R R	R R	R R
Aluminum Sulfate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Ammonium Chloride	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R C	RR
Ammonium Hydroxide	R C	R R	N N	N N	N N	N N	R R	R R	R R	R C	R R	R R	C N	R C	R C	R R	R R	C N	R R	R C

(continued)

TABLE 1.65: VARIOUS RESINS AND ELASTOMERS FOR LININGS AND MEMBRANES—ATLAS (cont'd)

	Koroseal	Atlastaflex	Nat. Rubber	Neoprene	Chlorobutyl	3-Ply Rubber	PVDF	Atlastic 31/40/50	CT-30	Membrane 88	ChemPruf 1100	ChemPruf 1200	ChemPruf 1300	ChemPruf 1301	ChemPruf 1400	ChemPruf 2100	ChemPruf 2200	ChemPruf 2300	ChemPruf 2301	ChemPruf 2400
C Room Temp. H 150°F	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H
Ammonium Nitrate	R R	R R	R C	C N	R R	R C	R R	R C	R C	C C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Ammonium Sulfate	R R	R R	R C	R R	R R	R R	R R	R R	R C	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Amyl Acetate	N N	N N	N N	N N	N N	N N	R R	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Amyl Alcohol	R C	R R	N N	N N	R C	N N	R R	N N	N N	N N	R R	N N	R C	R C	R C	R R	N N	R C	R C	R C
Aniline	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N
Aqua Regia	N N	R N	N N	N N	N N	N N	C N	N N	N N	N N	N N	N N	N N	C N	N N	N N	N N	N N	C N	N N
Barium Chloride	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Barium Hydroxide	R R	R R	R R	R R	R R	R R	R R	R R	R C	R C	R R	R R	N N	R C	R C	R R	R R	N N	R C	R C
Barium Nitrate	R R	R R	R R	R R	R R	R R	R R	R C	R C	C C	C C	C C	R R	R R	R R	C C	C C	R R	R R	R R
Barium Sulfide	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R N	R C	R R	R R	R R	R N	R C	R R
Benzene	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R C	N N	N N	N N	N N	R C	N N	N N	N N	N N
Benzene sulfonic acid, 10%	R R	R R	N N	R R	C C	N N	R R	R R	R C	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Benzoic acid	R R	R R	R C	R R	C C	C C	R R	R R	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Boric acid	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Bromine water	N N	R R	N N	N N	N N	N N	R C	N N	N N	N N	N N	N N	R C	N N	N N	N N	N N	R C	N N	N N
Butyl Acetate	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	N N	N N	C N	C N	R R	N N	N N	C N	N N
Butyl Alcohol	R R	R R	N N	N N	N N	N N	R C	N N	N N	N N	R R	C N	R C	R N	R C	R R	C N	R C	R N	R C
Butyric acid	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	N N	R N	R C	R C	R R	N N	R N	R C	R C
Cadmium Chloride	R R	R R	R R	R R	R R	R C	R R	R R	R R	R C	R C	R C	R R	R R	R R	R R	C C	R R	R R	R R
Cadmium Nitrate	R R	R R	R R	R R	R R	R C	R R	R C	R C	C C	C C	C C	R R	R R	R R	C C	C C	R R	R R	R R
Cadmium Sulfate	R R	R R	R R	R R	R R	N N	R R	R R	R R	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Calcium Bisulfite	R R	R R	N N	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Calcium Chloride	R R	R R	R R	R R	R R	R R	R R	R H	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Calcium Hydroxide	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	N N	R C	R R	R R	R R	N N	R C	R R
Calcium Nitrate	R R	R R	R R	R R	R R	N N	R R	R R	R C	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Carbon Disulfide	N N	N N	N N	N N	N N	N N	R N	N N	N N	N N	R C	N N	N N	N N	N N	R C	N N	N N	N N	N N
Carbon Tetrachloride	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	C N	R N	N N	N N	R R	C N	R N	N N	N N
Chlorine Dioxide, water solution	C C	R R	N N	N N	N N	N N	R N	N N	C N	C N	N N	N N	R R	N N	R R	N N	N N	R R	N N	R R
Chlorine gas, dry	R C	R N	N N	N N	N N	N N	R R	N N	N N	N N	C N	C N	R N	R R	R R	C N	C N	R N	R R	R R
Chlorine gas, wet	R C	N N	N N	N N	N N	N N	R R	N N	N N	N N	N N	C C	R N	R R	R R	N N	C C	R N	R R	R R
Chlorine water	R C	R R	R C	R C	R R	R R	R R	R C	R C	R C	N N	C N	R C	R C	R R	N N	C N	R C	R C	R R
Chloroacetic acid, 10%	C N	R C	N N	N N	R N	N N	R R	C N	C N	C N	R R	C N	R R	R N	R R	R R	C N	R R	R N	R R
Chlorobenzene	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	C R	N N	C N	N N	N N	R R	N N	C N	N N	N N
Chloroform	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Chromic acid, up to 5%	R R	R R	N N	N N	C N	N N	R R	C N	C N	C N	N N	C N	R R	N N	R C	N N	C N	R R	N N	R C
Chromic acid, 10%	R R	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N	N N	R R	N N	R N	N N	N N	R R	N N	R N
Chromic acid, 20%	R R	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N
Chromic acid, 50% and over	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N	N N	R C	N N	N N	N N	N N	R C	N N	N N
Citric acid	R R	R R	N C	N N	N N	N N	R R	R R	R C	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Copper Chloride	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R

(continued)

TABLE 1.65: VARIOUS RESINS AND ELASTOMERS FOR LININGS AND MEMBRANES—ATLAS (cont'd)

	Koroseal	Atlastaflex	Nat. Rubber	Neoprene	Chlorobutyl	3-Ply Rubber	PVDF	Atlastic 31/40/50	CT-30	Membrane 88	ChemPruf 1100	ChemPruf 1200	ChemPruf 1300	ChemPruf 1301	ChemPruf 1400	ChemPruf 2100	ChemPruf 2200	ChemPruf 2300	ChemPruf 2301	ChemPruf 2400
C Room Temp. H 150°F	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H
Copper Nitrate	R R	R R	N N	R R	N N	N N	R R	R C	R C	C C	C C	C C	R R	R R	R R	C C	C C	R R	R R	R R
Copper Sulfates	R R	R R	N N	R R	R R	N N	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Dichloroacetic acid, 10%	C N	C N	N N	N N	N N	N N	R R	N N	N N	N N	R R	N N	R N	R N	R N	R R	N N	R N	R N	R N
Dichlorobenzene	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Diethyl Ether	N N	N N	N N	N N	N N	N N	R N	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Ethyl Acetate	N N	N N	N N	N N	N N	N N	R R	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Ethyl Alcohol	R R	R R	C N	C N	C N	C N	R R	C N	C N	C N	R R	R R	R R	R N	R C	R R	R R	R R	R N	R C
Ethyl Sulfate	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	N N	R N	R N	C N	R R	N N	R N	R N	C N
Ethylene Dichloride	N N	N N	N N	N N	N N	N N	R N	N N	N N	N N	R C	N N	N N	N N	N N	R C	N N	N N	N N	N N
Ethylene Glycol	R R	R R	R C	R C	R R	R C	R R	C N	C N	C N	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Fluosilicic acid	R R	R R	R C	R R	R R	R R	R R	R R	R R	R C	N N	N N	N N	N N	N N	R*R*	N N	R*R*	R*R*	R*R*
Formaldehyde	R R	R R	N N	N N	R C	N N	R C	R C	R C	R N	R R	R R	R R	R N	R R	R R	R R	R R	R N	R R
Formic acid	C N	R N	N N	N N	N N	N N	R R	R C	R C	R C	R R	N N	R C	R C	R C	R R	N N	R C	R C	R C
Gasoline	N N	R R	N N	C C	N N	N N	R C	N N	N N	C C	R R	R C	R R	R N	R R	R R	R C	R R	R N	R R
Glycerine	R R	R R	R C	N N	N N	R C	R R	C N	C N	C N	R R	R C	R R	R C	R R	R R	R C	R R	R C	R R
Gold Cyanide	R R	R R	R R	R R	R R	R R	R R	R R	R C	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Hexane	N N	R R	N N	R N	N N	N N	R N	N N	N N	C N	R R	R C	R R	R N	R R	R R	R C	R R	R N	R R
Hydrobromic acid	R C	R R	R C	N N	R C	N N	R R	R C	R C	R C	N N	C N	R C	R R	R C	N N	C N	R C	R R	R C
Hydrochloric acid	R C	R R	R C	N N	R C	R C	R R	R R	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Hydrocyanic acid	R R	R R	R C	R C	R C	R C	R R	R R	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Hydrofluoric acid	R C	R R	C C	N N	C C	N N	R R	R R	R R	R C	N N	N N	N N	N N	N N	R*C*	C*C*	R*C*	R*R*	R*C*
Hydrofluosilicic acid	R R	R R	N N	N N	N N	N N	R R	R R	R R	R C	N N	N N	N N	N N	N N	R*C*	N N	R*C*	R*R*	R*C*
Hydrogen Peroxide	R R	R R	N N	R N	R N	N N	R R	C C	R C	R C	N N	C C	R C	R N	R C	N N	C C	R C	R N	R C
Hydrogen Sulfide gas, dry	R R	R R	N N	R R	N N	N N	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R C	R R
Hydrogen Sulfide gas, wet	R R	R R	N N	R R	N N	N N	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R C	R R
Iron Chlorides	R R	R R	N N	N N	R R	R C	R R	R C	R C	C N	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Iron Nitrates	R R	R R	C C	R R	R C	R C	R R	R C	R C	C C	C C	C C	R R	R R	R R	C C	C C	R R	R R	R R
Iron Sulfates	R R	R R	N N	R R	R R	R C	R R	R R	R R	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Isopropyl Ether	N N	N N	N N	N N	N N	N N	R N	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Kerosene	N N	R R	N N	C N	N N	N N	R C	N N	N N	C N	R R	R C	R R	R C	R R	R R	R C	R R	R C	R R
Lactic acid	R N	R R	C C	N N	N N	N N	R R	R R	R C	R C	R R	C N	R R	R R	R R	R R	C N	R R	R R	R R
Lead Acetate	R R	R R	R R	N N	R R	R R	R R	R C	R C	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Lead Nitrate	R R	R R	C C	R R	R R	R C	R R	R C	R C	C C	C C	C C	R R	R R	R R	C C	C C	R R	R R	R R
Linseed Oil	R C	R R	N N	R C	N N	N N	R R	N N	N N	C N	R R	C N	R R	R R	R R	R R	C N	R R	R R	R R
Magnesium Chloride	R R	R R	N N	R R	R R	N N	R R	R R	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Magnesium Hydroxide	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R C	N N	R R	R R	R R	R C	N N	R R	R R
Magnesium Nitrate	R R	R R	R R	R R	R R	R R	R R	R C	R C	C C	R C	R C	R R	R R	R C	R C	R C	R R	R R	R C
Magnesium Sulfate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Maleic acid	R R	R R	N N	N N	N N	N N	R R	R C	R C	R C	R R	N N	R R	R R	R R	R R	N N	R R	R R	R R

*Requires Synthetic Fabric

(continued)

TABLE 1.65: VARIOUS RESINS AND ELASTOMERS FOR LININGS AND MEMBRANES—ATLAS (cont'd)

	Koroseal	Atlastaflex	Nat. Rubber	Neoprene	Chlorobutyl	3-Ply Rubber	PVDF	Atlastic 31/40/50	CT-30	Membrane 88	ChemPruf 1100	ChemPruf 1200	ChemPruf 1300	ChemPruf 1301	ChemPruf 1400	ChemPruf 2100	ChemPruf 2200	ChemPruf 2300	ChemPruf 2301	ChemPruf 2400
C Room Temp. H 150°F	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H
Mercuric Acetate	R R	R R	N N	N N	R C	N N	R R	R C	R C	C C	R R	C N	R R	R C	R C	R R	C N	R R	R C	R C
Methyl Acetate	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Methyl Alcohol	R R	R R	C N	C N	N N	C N	R C	C N	C N	C N	R R	C N	R C	R C	R N	R R	C N	R C	R C	R N
Methyl Ethyl Ketone	N N	N N	N N	N N	N N	N N	C N	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Methyl Sulfate	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	N N	C N	R N	C N	R R	N N	C N	R N	C N
Mineral Oil	R C	R R	N N	C N	N N	N N	R R	N N	C N	C N	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Mineral Spirits	N N	R R	N N	C N	N N	N N	R C	N N	N N	C N	R R	R C	R C	R C	R C	R R	R C	R C	R C	R C
Muriatic acid	R C	R R	R R	N N	R R	R R	R R	R R	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Nickel Chloride	R R	R R	R R	R R	R R	R R	R R	R R	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Nickel Nitrate	R R	R R	R R	R R	R R	R R	R R	R C	R C	C C	C C	C C	R R	R R	R R	C C	C C	R R	R R	R R
Nickel Sulfate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R C	R R	R C	R R
Nitric acid, up to 5%	R R	R R	C N	N N	C N	C N	R R	C C	C C	C N	N N	C N	R C	R C	R C	N N	C N	R R	R N	R R
Nitric acid, 20%	R C	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N	N N	C N	R N	R C	N N	N N	R C	R N	R R
Nitric acid, 30%	R C	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N	N N	R C	N N	R C	N N	N N	R C	N N	R C
Nitric acid, 50%	C N	C N	N N	N N	N N	N N	C C	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	R N
Nitrobenzene	N N	N N	N N	N N	N N	N N	R R	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Oleic acid	R C	R R	N N	N N	N N	N N	R R	N N	C N	C N	R R	N N	R R	R R	R R	R R	N N	R R	R R	R R
Oxalic acid	R C	R R	N N	N N	N N	N N	R R	R C	R C	R C	R R	N N	R R	R R	R R	R R	N N	R R	R R	R R
Perchloric acid	C N	R N	N N	N N	N N	N N	R R	N N	N N	N N	N N	N N	C N	N N	C N	N N	N N	C N	N N	C N
Phenol	N N	R N	N N	N N	R C	N N	R R	C N	C N	N N	R C	N N	R C	R N	R C	R C	N N	R C	R N	R C
Phosphoric acid	R R	R R	R R	N N	R R	R R	R R	R R	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Phosphorous acid	R R	R R	R R	N N	R R	R R	R R	R R	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Phosphorous Trichloride	R R	N N	N N	N N	N N	N N	R N	N N	N N	N N	C N	N N	N N	N N	N N	C N	N N	N N	N N	N N
Phthalic acid	R R	R R	R C	N N	R C	R C	R R	R C	R C	R C	R R	N N	R R	R R	R R	R R	N N	R R	R R	R R
Picric acid	N N	N N	N N	N N	N N	N N	R N	N N	N N	N N	R C	N N	R C	N N	R C	R C	N N	R C	N N	R C
Potassium Bicarbonate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	C N	R C	R C	R R	R C	C N	R C	R C
Potassium Carbonate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R N	R R	R R	R R	R R	R N	R R	R R
Potassium Chloride	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Potassium Cyanide	R R	R R	R R	R C	R R	R R	R R	R R	R R	R C	R R	R R	C N	R R	R R	R R	R R	R C	R R	R R
Potassium Ferricyanide	R R	R R	R R	R R	R R	R R	R R	R R	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Potassium Ferrocyanide	R R	R R	R R	R R	R R	R R	R R	R R	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Potassium Hydroxide, up to 30%	R R	R R	R R	N N	R R	R R	N N	R R	R C	R C	R R	C C	N N	R C	R R	R R	C C	N N	R C	R R
Potassium Hydroxide, 30% and over	R R	R R	R R	N N	R R	R R	N N	R R	R C	C C	R R	N N	N N	R N	C N	R R	C C	N N	R N	C N
Potassium Nitrate	R R	R R	R R	R R	R R	R R	R R	R R	R C	C C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Potassium Sulfate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Pyridine	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N
Rochelle salt	R R	R R	R R	R C	R R	R R	R R	R R	R R	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Salicylic acid	R R	R R	N N	N N	N N	N N	R R	R C	R C	R C	R R	R R	R R	R C	R R	R R	R R	R R	R C	R R
Silver Nitrate	R R	R R	R R	R R	R R	R R	R R	R C	R C	C C	C C	C C	R R	R R	R R	C C	C C	R R	R R	R R
Sodium Acetate	R R	R R	N N	N N	N N	N N	R R	R C	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Sodium Bicarbonate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R C	R R	R R	R R	R C	R C	R R

(continued)

TABLE 1.65: VARIOUS RESINS AND ELASTOMERS FOR LININGS AND MEMBRANES—ATLAS (cont'd)

	Koroseal	Atlastaflex	Nat. Rubber	Neoprene	Chlorobutyl	3-Ply Rubber	PVDF	Atlastic 31/40/50	CT-30	Membrane 88	ChemPruf 1100	ChemPruf 1200	ChemPruf 1300	ChemPruf 1301	ChemPruf 1400	ChemPruf 2100	ChemPruf 2200	ChemPruf 2300	ChemPruf 2301	ChemPruf 2400
C Room Temp. H 150°F	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H	C H
Sodium Carbonate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R N	R R	R R	R R	R R	R N	R R	R R
Sodium Chloride	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Sodium Cyanide	R R	R R	R R	N N	R R	R R	R R	R R	R C	R C	R R	R R	C N	R R	R R	R R	R R	C N	R R	R R
Sodium Hydroxide, up to 30%	R R	R R	R R	R R	R R	R R	N N	R R	R R	R R	R R	R C	N N	R R	R C	R R	R C	N N	R R	R C
Sodium Hydroxide, 30% and over	R R	R R	R R	R R	R R	R R	N N	R R	R C	R C	R R	N N	N N	R R	R C	R R	C C	N N	R R	R C
Sodium Hypochlorite, up to 3%	R R	R R	N N	N N	R R	N N	R R	R C	R C	R C	N N	C N	C N	R C	R R	N N	C N	C N	R C	R R
Sodium Hypochlorite, 15% and over	R R	R R	N N	N N	R C	N N	R C	C N	C N	C N	N N	N N	R N	R C	R C	N N	N N	R N	R C	R C
Sodium Nitrate	R R	R R	R R	R R	R R	R R	R R	R R	R C	C C	R C	R C	R R	R R	R R	R C	R C	R R	R R	R R
Sodium Sulfate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Sodium Sulfide	R R	R R	R R	R R	R R	R R	C C	R R	R R	R C	R R	R R	C N	R C	R C	R R	R R	C N	R C	R C
Sodium Sulfite	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Sodium Thiosulfate	R R	R R	R R	R R	R R	R R	R R	R C	R C	R C	R R	R C	R R	R N	R R	R R	R C	R R	R N	R R
Soya Oil	R C	R R	N N	C N	N N	N N	R R	N N	N N	C N	R R	C N	R C	R C	R C	R R	C N	R C	R C	R C
Stearic acid	R R	R R	N N	R C	R C	N N	R R	R C	R C	R C	R R	N N	R R	R R	R R	R R	N N	R R	R R	R R
Sulfur Dioxide gas, dry	R R	R R	N N	R C	R C	N N	R R	C N	C N	C N	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Sulfur Dioxide gas, wet	R R	R R	N N	R C	R C	N N	R R	N N	N N	N N	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Sulfur Trioxide gas, dry	N N	R R	N N	R C	R C	N N	N N	N N	N N	N N	N N	N N	R N	N N	R N	N N	N N	R N	N N	R N
Sulfur Trioxide gas, wet	N N	R R	N N	R C	R C	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N
Sulfuric acid, up to 50%	R R	R R	R C	C C	R C	R R	R R	R R	R C	C N	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Sulfuric acid, 80%	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N	N N	C N	C C	N N	N N	N N	C N	N N	R R
Sulfuric acid, 93%	N N	R C	N N	N N	N N	N N	R C	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N
Sulfuric acid, over 93%	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N	N N
Sulfuric acid, Fuming	N N	N N	N N	N N	N N	N N	C N	N N	N N	N N	N N	N N	C N	N N	N N	N N	N N	C N	N N	N N
Sulfurous acid	R R	R R	N N	N N	N N	N N	R R	R R	R C	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Tannic acid	R R	R R	N N	N N	N N	N N	R R	R C	R C	C N	R R	C N	R R	R R	R R	R R	C N	R R	R R	R R
Tartaric acid	R R	R R	C N	N N	N N	N N	R R	R R	R C	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R
Tin Chloride	R R	R R	C N	R R	R R	C N	R R	R C	R C	C N	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Tin Sulfate	R R	R R	C N	R R	R R	C N	R R	R R	R R	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Toluene	N N	N N	N N	N N	N N	N N	R R	N N	N N	C N	R R	C N	C N	N N	N N	R R	C N	C N	N N	N N
Trichloroethylene	N N	N N	N N	N N	N N	N N	R N	N N	N N	N N	R R	N N	N N	N N	N N	R R	N N	N N	N N	N N
Trisodium Phosphate	R R	R R	R R	R C	R R	R R	R R	R R	R R	R C	R R	R R	C C	R C	R C	R R	R R	C C	R C	R C
Tung Oil	R C	R R	N N	C N	N N	N N	R R	N N	N N	C N	R R	C N	R C	R C	R C	R R	C N	R C	R C	R C
Urea	R R	R R	R R	N N	R R	R R	R C	R R	R R	R C	R R	R R	R R	R C	R R	R R	R R	R R	R C	R R
Xylene	N N	N N	N N	N N	N N	N N	R C	N N	N N	N N	R R	C N	R N	R N	R N	R R	C N	R N	R N	R N
Zinc Chloride	R R	R R	C C	R R	R R	C C	R R	R R	R C	R C	R R	R C	R R	R R	R R	R R	R C	R R	R R	R R
Zinc Nitrate	R R	R R	R R	R R	R R	R R	R R	R C	R C	C C	R R	C C	R R	R R	R R	C C	C C	R R	R R	R R
Zinc Sulfate	R R	R R	R R	R R	R R	R R	R R	R R	R R	R C	R R	R R	R R	R R	R R	R R	R R	R R	R R	R R

TABLE 1.66: VARIOUS RESINS AND METALS—PHILLIPS CHEMICAL

CORROSION RESISTANCE GUIDE

KEY: A ACCEPTABLE Q QUESTIONABLE NR NOT RECOMMENDED

Ratings are based on media at ambient temperatures (about 70°F) unless otherwise specified

MEDIA	200° F RYTON	200° F PENTON	200° F KYNAR	200° F TEFLON	200° F POLY-SULFONE	200° F NORYL	200° F NYLON	200° F POLYCAR-BONATE	316 S.S.	CARBON STEEL	ALU-MINUM (3003)
Acetaldehyde	A	NR	—	A	—	—	—	—	A	NR	Q
Acetic Acids	A	Q	A	A	A	A	NR	NR	A	NR	Q
Acetic Anhydride Acid	A	NR	NR	A	NR	Q	Q	NR	A	Q	NR
Acetic Acid, Glacial	A	A	A/Q	A	A	A	NR	Q	A	Q	A
Acetone	A	NR	NR	A	—	—	—	—	A	A	A
Acetonitrile	A	NR	Q	A	NR	Q	A	NR	A	A	A
Acetophenone	A	—	A/NR	—	NR	NR	A	NR	A	—	—
Acetylene	A	—	—	A	—	—	—	—	A	A	A
Acetyl Chloride (dry)	A	NR	A/—	A	NR	NR	NR	NR	A	A	NR
Acid Mine Water	A/—	—	—	A	—	—	—	—	Q	NR	NR
Alcohol, Amyl	A	A	A	A	A	Q	A	NR	A	A	Q
Alcohol, Butyl	A	Q	A	A	A	A	A	A	A	A	Q
Alcohol, 2-Aminoethanol	A	—	—	—	A	A	A	NR	A	A	Q
Aluminum Chloride (dry)	A	A	A	A	A	A	NR	A	A	A	A
Aluminum Sulfate	A	A	A	A	A	A	NR	A	A	NR	NR
Chlorohydroxide (wet)	A	—	—	A	—	—	—	—	NR	NR	NR
Ammonia, anhydrous	A/—	Q	A	A	—	—	—	—	A	A	Q
Ammonium Chloride	A	A	A	A	A	A	A	A	—	—	—
Ammonium Hydroxide	A	A	A	A	A	A	A	NR	Q	Q	Q
Ammonium Nitrate	A	A	A	A	A	A	NR	A	A	NR	Q
Ammonium Sulfate	A	A	A	A	A	A	Q	A	Q	Q	Q
Amyl Acetate	A	Q	Q	A	NR	NR	A	NR	Q	Q	Q
Aniline	A	NR	Q	A	NR	NR	A	NR	A	A	Q
Asphalt Emulsions	A	—	—	A	—	—	—	—	A	A	Q
Barium Hydroxide	A	Q	A	A	—	—	—	—	A	A	NR
Barium Chloride	A	A	A	A	A	A	A	A	Q	Q	Q
Barium Sulfate	A	A	A	A	—	—	—	—	A	A	A
Benzene	A	NR	A/Q	A	—	—	—	—	A	A	A
Benzaldehyde	NR/Q	NR	A/Q	A	NR	NR	A	NR	A	NR	A
Benzene Sulfonic Acid	A	NR	A/Q	A	NR	A	NR	NR	A	NR	NR
Benzonitrile	A	NR	—	A	NR	NR	A	NR	—	—	—
Benzyl Chloride	A	NR	A	A	NR	NR	A	NR	—	—	—
Borax	A	Q	A	A	—	—	—	—	A	A	Q
Bromine (wet)	NR/Q	NR	A	A	A	A	NR	NR	NR	NR	NR
Butadiene	A/—	Q	A	A	—	—	—	—	A	A	A
Butane	A	Q	A	A	—	—	—	—	A	A	A
Butylene	A	Q	A/NR	A	—	—	—	—	A	A	A
Butyl Acetate	A	NR	NR	—	NR	NR	A	NR	A	A	A
Butyl Amine	A/Q*	—	NR	A	NR	NR	A	NR	A	A	A
Butyl Ether	A	—	A	A	A	NR	A	Q	A	A	A
Butyl Phthalate	A	—	—	—	Q	NR	A	NR	—	—	—
Calcium Chloride	A	A	A	A	A	A	A	A	Q	Q	NR
Calcium Nitrate	A	A	A	A	A	A	NR	A	—	—	—
Calcium Sulfate	A	A	A	A	A	A	NR	A	A	A	Q
Carbon Dioxide	A	A	A	A	—	—	—	—	A	A	A
Disulfide	A	NR	A/—	A	—	—	—	—	A	A	A
Tetrachloride (wet)	A/Q	NR	A	A	NR	NR	A	NR	NR	NR	NR
Cellosolves	A	Q	A	A	NR	NR	A	A	A	A	A
Chlorobenzene (dry)	A	NR	A	A	NR	NR	A	NR	A	A	A
2-Chloroethanol	A	—	—	—	NR	Q	NR	NR	—	—	—
Chloroform	A/Q	NR	A	A	NR	NR	Q	NR	A	A	A
Chlorophenol, 5% Aqueous	A	—	—	—	NR	Q	NR	NR	—	—	—
Chlorosulfonic Acid	NR	NR	NR	A	—	—	—	—	Q	NR	NR
Chlorine (dry)	Q	A	A	A	—	—	—	—	Q	Q	Q
Chromic Acid	A	NR	A	A	A	A	Q	A	NR	NR	NR
Cottonseed Oil	A	A	—	A	A	A	A	A	A	Q	A
m-Cresol (crude)	A	NR	A	A	NR	NR	NR	NR	A	A	A
Cresyldiphenyl Phosphate	A	—	—	—	Q	NR	A	Q	—	—	—
Crude Oil	A	Q	A	A	—	—	—	—	A	Q	A
Copper Sulfate	A	A	A	A	—	—	—	—	A	NR	NR
Cyclohexane	A	Q	A	A	A	NR	A	A	A	A	A
Cyclohexanol	A	A	A	A	A	NR	A	Q	A	A	Q
Cyclohexanone	A	NR	NR	A	NR	NR	A	NR	A	A	A
Detergents	A	A	—	A	—	—	—	—	A	A	Q
Diesel Fuel	A	Q	A	A	A	NR	A	A	A	A	A

(continued)

TABLE 1.66: VARIOUS RESINS AND METALS—PHILLIPS CHEMICAL (continued)

MEDIA	200° F RYTON	200° F PENTON	200° F KYNAR	200° F TEFLON	200° F POLY-SULFONE	200° F NORYL	200° F NYLON	200° F POLYCAR-BONATE	316 S.S.	CARBON STEEL	ALU-MINUM (3003)
Diisobutylene	A	—	A	A	—	—	—	—	A	A	A
Dimethyl Aniline	A	—	A/Q	—	NR	NR	A	NR	—	—	—
Dimethyl Formamide	A	NR	—	A	NR	NR	A	NR	A	Q	A
Dimethyl Phthalate	A	—	NR	A	—	—	—	—	A	A	A
Dimethyl Sulfoxide	A	—	—	—	NR	A	A	NR	—	—	—
Diphenyl Ether	A	—	—	A	—	—	—	—	A	Q	A
Dioctyl Phthalate	A	Q	—	A	—	—	—	—	A	A	A
p-Dioxane	A	NR	NR	A	NR	NR	A	NR	Q	Q	Q
Dowtherm	A	—	—	A	NR	NR	A	NR	A	Q	A
Epichlorohydrin (dry)	A	—	NR	A	NR	NR	A	NR	A	A	A
Ethanolamine	A	NR	NR	A	—	—	—	—	A	A	Q
Ethers	A	—	A/Q	A	—	—	—	—	A	A	A
Ethyl Acetate	A	NR	A/Q	A	NR	NR	A	NR	A	Q	A
Ethyl Chloride (wet)	A	Q	A	A	—	—	—	—	NR	NR	NR
Ethylene Chloride	A	Q	A	A	NR	NR	Q	NR	Q	Q	Q
Ethylene Diamine	Q	NR	A/NR	A	NR	NR	Q	NR	A	Q	Q
Ethylene Dichloride	A/Q	NR	—	A	—	—	—	—	Q	Q	Q
Ethylene Glycol	A	Q	A	A	A	A	A	A	A	Q	Q
FC-77 (Cyclic Fluorinated Ether)	A	—	—	—	—	—	—	—	—	—	—
Ferric Chloride	A	A	A	A	A	A	NR	A	NR	NR	NR
Ferrous Chloride	A	A	A	A	—	—	—	—	NR	NR	NR
Flo-Cool 180 (Silicate Ester)	A	—	—	—	—	—	—	—	—	—	—
Fluorosilicic Acid, 25%	A	—	—	—	—	—	—	—	—	—	—
Formaldehyde, 37%	A	A	A/—	A	A	A	Q	A	Q	NR	Q
Formic Acid	A/Q	A	A	A	A	A	NR	NR	A	NR	NR
Freon (dry)	A	NR	—	A	—	—	—	—	A	A	A
Fuel Oil	A	A	A	A	—	—	—	—	A	A	A
Furan	A	—	Q/NR	A	—	—	—	—	A	A	A
Furfural	A	—	NR	A	NR	NR	A	NR	A	A	A
Gasoline	A	Q	A	A	A	NR	A	A	A	A	A
Glycolic Acid	A	Q	NR	A	—	—	—	—	A	NR	Q
Heptane	A	Q	A	A	A	NR	A	A	A	A	A
Hexane	A	Q	A	A	—	—	—	—	A	A	A
Hydrochloric Acid, 20%	NR/Q	A	A	A	A	A	NR	A	NR	NR	NR
Hydrochloric Acid, 37%	NR/Q	A	A	A	A	A	NR	NR	—	—	—
Hydrofluoric Acid, 5-75%	A*	A	A	A	—	NR	—	—	NR	NR	NR
Hydrogen Gas	A	A	A	A	—	—	—	—	A	A	A
Hydrogen Peroxide, 30%	Q	Q	A	A	—	—	—	—	Q	NR	A
Hydrogen Sulfide (wet)	A	Q	A	A	—	—	—	—	A	Q	A
Kerosene	A	Q	A	A	—	—	—	—	A	A	A
JP Fuels	A	Q	A	A	—	—	—	—	A	A	A
Ketones	A	NR	NR	A	—	—	—	—	A	A	A
Lactic Acid	A	Q	NR	A	A	A	NR	A	A	NR	Q
LPG	A	—	A	A	—	—	—	—	A	A	A
Lubricating Oil	A	A	A	A	—	—	—	—	A	A	A
Magnesium Chloride	A	A	A	A	A	A	Q	A	Q	Q	NR
Magnesium Hydroxide	A	Q	A	A	—	—	—	—	A	A	Q
Methylene Chloride	A	—	—	—	—	—	—	—	—	—	—
Methyl Ethyl Ketone	A	NR	NR	A	NR	NR	A	NR	A	A	A
Methyl Isobutyl Ketone	A	NR	NR	A	—	—	—	—	A	A	A
Mineral Oil	A	Q	A	A	A	A	A	A	A	A	A
Morpholine	A/Q	—	NR	A	NR	NR	A	NR	A	A	A
Motor Oil	A	—	—	A	A	A	A	A	A	Q	A
Naphtha	A	A	A	A	—	—	—	—	A	A	A
Naphthalene	A	Q	A	A	—	—	—	—	A	A	A
Nitric Acid, 10%	NR/Q	Q	A	A	Q	A	NR	A	A	NR	NR
35%	A/Q	NR	A	A	—	—	—	—	A	NR	NR
(Conc.)	Q	NR	A	A	—	—	—	—	A	NR	Q
Nitrobenzene	A/Q	NR	A/Q	A	NR	NR	A	NR	A	A	A
Nitrogen	A	A	A	A	—	—	—	—	A	A	A
Nitromethane	A/Q	Q	—	—	NR	Q	Q	NR	—	—	—

(continued)

TABLE 1.66: VARIOUS RESINS AND METALS—PHILLIPS CHEMICAL (continued)

MEDIA	200° F RYTON	200° F PENTON	200° F KYNAR	200° F TEFLON	200° F POLY-SULFONE	200° F NORYL	200° F NYLON	200° F POLYCAR-BONATE	316 S.S.	CARBON STEEL	ALU-MINUM (3003)
Perchloroethylene (dry)	A	—	A	A	—	NR	—	—	A	Q	A
Phenol	A	A	A	A	NR	NR	NR	NR	Q	NR	A
Phosphoric Acid	A/Q	A	A	A	A	A	NR	A	NR	NR	NR
Phosphorus Trichloride (dry)	A	NR	A	A	—	—	—	—	A	A	NR
Potassium Chloride	A	A	A	A	—	—	—	—	Q	Q	NR
Potassium Hydroxide, 50%	A	A	A	A	—	—	—	—	Q	A	NR
Potassium Permanganate	A	Q	A	A	A	A	NR	A	Q	Q	Q
Propylene Chlorohydrin	A/Q	—	A/NR	A	—	—	—	—	—	—	—
Pyridine	A	—	NR	A	NR	NR	Q	NR	A	A	A
Sodium Bicarbonate	A	A	A	A	A	A	A	A	A	Q	Q
Sodium Carbonate	A	A	A	A	A	A	A	A	A	A	Q
Sodium Chloride	A	A	A	A	A	A	A	A	Q	Q	Q
Sodium Chromate	A	Q	—	A	A	A	Q	A	A	Q	NR
Sodium Hydroxide, 15%	A	A	A	A	A	A	Q	A	A	Q	NR
Sodium Hydroxide, 30%	A*	A	A	A	A	A	A	NR	A	Q	NR
Sodium Hydroxide, 50%	A*	A	A	A	—	A	—	—	Q	A	NR
Sodium Hypochlorite Soln.	Q	Q	A	A	A	A	NR	A	NR	NR	NR
Sodium Sulfate	A	A	A	A	A	A	A	A	A	Q	Q
Sodium Sulfide	A	A	A	A	A	A	Q	A	A	Q	Q
Sodium Thiosulfate	A	A	A	A	A	A	A	A	A	Q	Q
Steam—300° F	A	—	Q	A	—	—	—	—	A	A	NR
Stoddard Solvent	A	—	A	A	A	NR	A	A	A	A	A
Sulfinol	A	—	A	A	—	—	—	—	A	A	—
Sulfolane	A	—	—	—	NR	A	A	NR	—	—	—
Sulfur Dioxide	A	Q	A	A	—	—	—	—	A	Q	A
Sulfuric Acid, 30%	A	A	A	A	A	A	NR	A	NR	NR	NR
Sulfuric Acid, 50%	A*	A	A	A	—	A	—	—	NR	NR	NR
Sulfuric Acid, 98%	A/Q*	NR	A	A	—	A	—	—	A	A	NR
Tetrahydrofuran	A	Q	Q/NR	A	NR	NR	A	NR	A	A	Q
Toluene	A	NR	A	A	NR	NR	Q	NR	A	A	A
Tomato Juice	A	Q	—	A	—	—	—	—	A	NR	A
Trichlorethylene	A/Q	NR	A	A	—	—	—	—	Q	Q	Q
Trichloracetic Acid	A	NR	A/NR	A	—	—	—	—	NR	NR	NR
Triethyl Phosphate	A	NR	—	A	—	—	—	—	A	A	A
Triphenyl Phosphite	A	—	—	—	A	NR	A	NR	—	—	—
Trisodium Phosphate	A	Q	A	A	—	—	—	—	A	A	Q
Turpentine (dry)	A	Q	A	A	—	—	—	—	A	A	A
Vinegar	A	Q	Q	A	—	—	—	—	A	NR	Q
Water, Deionized	A	Q	A	A	—	—	—	—	A	NR	A
Sea	A	Q	A	A	—	—	—	—	Q	Q	Q
Tap	A	A	A	A	A	A	Q	A	A	NR	Q
Xylene	A	NR	—	A	NR	NR	A	NR	A	A	A
Zinc Chloride	A	A	A	A	—	—	—	—	NR	Q	NR

*Ryton grades containing glass fiber and/or mineral fillers will be less chemically resistant than indicated.

RYTON — polyphenylene sulfide
PENTON — poly-3,3-bis(chloromethyl)oxacyclobutane
KYNAR — polyvinylidene fluoride
TEFLON — polytetrafluoroethylene
NORYL — phenylene oxide-based polymer

TABLE 1.67: VARIOUS RESINS FOR MEMBRANE LININGS—WATERSAVER

WATERSAVER MEMBRANE LININGS

HYPALON®
(Chlorosulfonated Polyethylene)

...provides excellent resistance to weathering and chemical attack. Hypalon is available only as a reinforced membrane and does not require a protective cover for most applications. Hypalon is approved for potable water containment.

PVC (Polyvinyl Chloride)

...membrane offers good chemical resistance, sealability, and serviceability in unexposed applications. It has performed satisfactorily as a liner for recreational lakes, canals, evaporation ponds, sewage lagoons, brine ponds, etc. It is recommended that an earthen cover be provided for PVC to maximize its service life as a fluid barrier.

OR CPE (Chlorinated Polyethylene)

...specifically formulated for resistance to oils. Membrane features excellent weatherability, sealability, chemical resistance and long term durability. CPE does not require a cover material for most applications.

OR CPE R
(Reinforced Chlorinated Polyethylene)

...specifically formulated for resistance to oils. Offers all of the desirable characteristics of Watersaver CPE and in addition, provides greater strength and resistance to creep, sagging, and puncture where conditions of use are severe, such as steep slopes or other high stress applications.

EPDM
(Ethylene Propylene Diene Monomer)

...has been used for roofing and lining applications for many years. Superior weathering and elongation characteristics have made EPDM the most widely used single ply roofing membrane in the U.S.A.

EPDM R (Reinforced EPDM)

...has the superior weathering characteristics of the non-reinforced EPDM with additional strength and tear resistance required by some applications. Many potable water reservoirs are rehabilitated with EPDM R or Hypalon.

	POLYVINYL CHLORIDE (PVC)	CHLORINATED POLYETHYLENE (CPE)	CHLOROSULFONATED POLYETHYLENE (HYPALON) (CSM)	ETHYLENE PROPYLENE DIENE MONOMER (EPDM)	POLYCHLOROPRENE (NEOPRENE) (CR)	ISOBUTYLENE ISOPRENE (BUTYL) (IIR)	OIL RESISTANT POLYVINYL CHLORIDE (ORPVC)
EXPOSED LINER	NR	R	RR	R	R	R	NR
EXPOSED SIDE SLOPE LINER	NR	RR	RR	RR	RR	RR	NR
BURIED LINERS	R	R	RR	R	R	R	R
ACID RESISTANCE pH 2 to 7	R	R	RR	R	R	R	R
ALKALINE RESISTANCE pH above 8	NR	R	RR	R	R	R	NR
PETROLEUM PRODUCTS	NR	R	NR	NR	R	NR	R
POTABLE WATER	NR	R	RR	R	NR	R	NR
DOMESTIC WASTE	R	R	RR	R	R	R	R
ROOFING MEMBRANE	NR	R	NR	R	R	NR	NR

R - RECOMMENDED   RR - RECOMMENDED ONLY WITH REINFORCING   NR - NOT RECOMMENDED

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL

DOW plastic lined pipe, fittings, and valves are designed and manufactured specifically for safety with long service life and process integrity in handling corrosive media, either liquids or gases.

The variety of lining materials in the line of DOW piping products allows the engineer designing a piping system to select components best suited for that particular service. The complete line includes:

SL piping products lined with SARAN* polyvinylidene chloride resin.
PPL piping products lined with polypropylene resin.
KL piping products lined with KYNAR** polyvinylidene fluoride resin.
PTFE piping products lined with polytetrafluoroethylene resin.

*Trademark of The Dow Chemical Company
**Trademark of Pennwalt Corporation

Ratings of serviceability of DOW plastic lined pipe, in terms of resistance to corrosive attack by process media and maximum operating temperatures, are shown in the following table.

Unless otherwise noted:

Solutions of inorganic materials appearing in the listing are saturated solutions.
Where concentration percentages are indicated, the percentages are by weight.

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Acetaldehyde	PTFE						SL PPL*			KL*
Acetamide	PTFE								KL*	
Acetic acid (5%)	PTFE			KL*	PPL		SL			
Acetic acid (10%)	PTFE			KL*	PPL		SL			
Acetic acid (50%)	PTFE				PPL KL			SL		
Acetic acid (80%)	PTFE				PPL	KL*		SL		
Acetic acid—glacial	PTFE				PPL			SL KL		
Acetic anhydride	PTFE								KL PPL SL	
Acetone (10%)	PTFE							KL PPL	SL	
Acetone (100%)	PTFE							PPL*	SL	KL
Acetonitrile	PTFE							KL	PPL*	
Acetophenone	PTFE									KL
n-Acetyl-dl-alanine	PTFE							SL		
Acetyl chloride	PTFE							KL SL		PPL
n-Acetyl-dl-leucine	PTFE							SL		
n-Acetyl-dl-methionine	PTFE							SL		
n-Acetyl-dl-tryptophan	PTFE							SL	•	
n-Acetyl-dl-valine	PTFE							SL		
Acetylene tetrabromide	PTFE	KL*							SL	
Acetylene tetrachloride	PTFE	KL*							SL	
Acrylonitrile	PTFE								KL* PPL*	
Adipic acid	PTFE						KL* SL PPL*			
Air	PTFE	KL		PPL		SL				
Allyl alcohol	PTFE				PPL			KL*	SL	
Allyl chloride	PTFE					KL				PPL
Alum	PTFE	KL		PPL		SL				

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Alum, ammonium	PTFE	KL		PPL		SL				
Alum, chrome	PTFE				KL*	SL				
Alum, potassium	PTFE	KL		PPL		SL				
Aluminum chloride (aqueous)	PTFE	KL[1]		PPL			SL			
Aluminum fluoride	PTFE	KL					PPL SL			
Aluminum hydroxide	PTFE	KL			PPL	SL				
Aluminum nitrate	PTFE	KL					PPL* SL			
Aluminum oxychloride	PTFE	KL*					SL			
Aluminum sulfate	PTFE	KL		PPL		SL				
dl-a-Aminobutyric acid	PTFE							PPL* SL		
2-Aminoisobutyric acid	PTFE							PPL* SL		
Ammonia (anhydrous liquid)	PTFE			PPL*						KL
Ammonia (anhydrous gas)	PTFE						PPL			KL
Ammonium acetate (saturated)	PTFE					KL*		PPL* SL*		
Ammonium beryllium fluoride (gas)	PTFE					SL				
Ammonium bifluoride	PTFE	KL			PPL		SL*			
Ammonium bromide (50%)	PTFE		KL*							
Ammonium carbonate (saturated)	PTFE	KL		PPL		SL				
Ammonium chloride (saturated)	PTFE	KL		PPL		SL				
Ammonium dichromate	PTFE		KL*					PPL*	SL	
Ammonium fluoride (10%)	PTFE	KL				PPL			SL	
Ammonium fluoride (25%)	PTFE	KL				PPL			SL	
Ammonium fluoride (saturated)	PTFE	KL*				PPL*				
Ammonium hydroxide (1%)	PTFE			PPL	KL					SL
Ammonium hydroxide (10%)	PTFE			PPL	KL					SL
Ammonium hydroxide (28%-conc.)	PTFE			PPL	KL					SL
Ammonium metaphosphate	PTFE	KL*					PPL SL*			
Ammonium nitrate (saturated)	PTFE	KL					PPL SL			
Ammonium persulfate	PTFE						PPL		KL*	
Ammonium phosphate	PTFE	KL				PPL	SL*			
Ammonium sulfate (saturated)	PTFE	KL				PPL		SL*		
Ammonium sulfide	PTFE			KL*			PPL			
Ammonium thiocyanate	PTFE	KL*					SL* PPL			
Amyl acetate	PTFE							SL KL	PPL*	
Amyl alcohol	PTFE	KL					SL		PPL	
Amyl chloride	PTFE	KL								PPL
Aniline	PTFE						PPL		KL	SL
Aniline hydrochloride (10%)	PTFE						PPL		SL* KL	
Antimony trichloride	PTFE						SL PPL		KL	
Aqua regia	PTFE						PPL*	SL	KL	
Arsenic acid	PTFE	KL						SL* PPL*		
Aryl sulfonic acids	PTFE						PPL*	SL*		
Barium carbonate	PTFE	KL			PPL*	SL				
Barium chloride	PTFE	KL			PPL*	SL				
Barium hydroxide	PTFE	KL			PPL*	SL				
Barium sulfate	PTFE	KL*			PPL*	SL				
Barium sulfide	PTFE	KL				PPL*	SL*			
Beer	PTFE			PPL	KL*	SL				
Beet sugar liquors	PTFE			KL*	PPL*		SL			
Benzaldehyde	PTFE							KL	PPL*	
Benzalkonium chloride	PTFE								SL	
Benzene	PTFE					KL			SL PPL	
Benzenesulfonic acid	PTFE						KL	SL*	PPL	
Benzoic acid	PTFE			KL			PPL	SL		
Benzoyl chloride	PTFE							KL		PPL
Benzyl Alcohol	PTFE	KL					PPL			

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests

[1] Rating for aluminum chloride does not apply for Friedel-Crafts reaction applications

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature —°F (°C)									Not Recommended
	450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	
Benzyl amine	PTFE						PPL*		KL*	SL
Benzyl chloride	PTFE	KL							SL* PPL*	
Bismuth carbonate	PTFE	KL*		PPL		SL				
Bis (2-Butoxyethyl) phthalate	PTFE								SL	
Black liquor	PTFE					KL	SL			
Borax	PTFE	KL				PPL				
Boric acid	PTFE	KL		PPL		SL				
Brine (acid)	PTFE	KL			PPL		SL*			
Brine (basic)	PTFE	KL*				PPL				
Brine (chlorinated acid)	PTFE				KL*			PPL		
Bromine (dry gas)	PTFE						KL			PPL
Bromine (water—3% saturated)	PTFE				KL				PPL* SL	
Bromine (liquid)	PTFE							KL		PPL SL
Bromine chloride (dry gas)	PTFE		KL							PPL SL
Bromine chloride water (8%)	PTFE				KL				PPL SL	
Bromine chloride[1] (liquid)	PTFE				KL					
mono-Bromobenzene	PTFE						KL*		SL PPL*	
Bromoform	PTFE						KL*		SL	PPL
m-Bromotoluene	PTFE					KL*			SL	PPL
Butadiene	PTFE		KL				SL			
Butane	PTFE	KL					SL	PPL		
Butanediol	PTFE	KL*				PPL	SL			
Butanol (Butyl alcohol)	PTFE	KL			PPL		SL			
Butyl acetate	PTFE							KL SL		PPL
Butyl acrylate	PTFE							KL	SL*	PPL
Butyl bromide	PTFE	KL								SL PPL
Butyl chloride	PTFE	KL								SL PPL

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

[1] Above 275°F (135°C) pressure of an equilibrium mixture of bromine chloride exceeds maximum pressure allowed for Dow rated class 300 pipe and fittings

Corrosive Stream	Maximum Temperature —°F (°C)									Not Recommended
	450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	
Butyl mercaptan	PTFE	KL								
Butyl phenol	PTFE			KL					SL	
Butyl phthalate	PTFE							PPL SL	KL*	
Butylene	PTFE	KL								
Butyraldehyde	PTFE						KL*		SL	
Butyric acid	PTFE			KL		PPL			SL	
Calcium bisulfide	PTFE	KL			PPL*					
Calcium bisulfite	PTFE	KL			PPL*				SL	
Calcium bisulfite bleach liquor (*6% total SO_2 5% free*)	PTFE					KL PPL			SL	
Calcium carbonate	PTFE	KL		PPL		SL				
Calcium chlorate	PTFE	KL			PPL		SL			
Calcium chloride (saturated)	PTFE	KL		PPL		SL				
Calcium chlorite	PTFE				KL		PPL	SL		
Calcium hydroxide (saturated)	PTFE	KL		PPL		SL				
Calcium hypochlorite	PTFE				KL	PPL*		SL		
Calcium nitrate	PTFE	KL			PPL*		SL*			
Calcium oxide	PTFE		KL*	PPL		SL				
Calcium oxide-sulfur	PTFE								SL	
Calcium sulfate	PTFE	KL		PPL		SL				
Calcium sulfide	PTFE			KL*						
Cane sugar liquors	PTFE						SL		PPL*	
Caprylic acid	PTFE				KL					
CARBITOL[1] diethylene glycol ethers	PTFE				KL*		PPL*		SL	
Carbolic acid (See Phenol 5%)	PTFE									
Carbon bisulfide	PTFE							KL	SL	PPL
Carbon dioxide (gas)	PTFE	KL		PPL		SL				
Carbon disulfide (liquid)	PTFE								KL SL	PPL
Carbon monoxide	PTFE	KL		PPL		SL				
Carbon tetrachloride	PTFE	KL					SL			PPL
Carbon tetrachloride (wet gases)	PTFE	KL*					SL			PPL

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests

[1] Trademark of Union Carbide Corporation.

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature —°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recom-mended
Carbonic acid	PTFE	KL		PPL		SL				
Castor oil	PTFE	KL					SL	PPL*		
Caustic potash See Potassium Hydroxide	PTFE									
Caustic soda See Sodium Hydroxide	PTFE									
CELLOSOLVE[1] ethylene glycol ethers	PTFE	KL			PPL				SL	
Chloral (10%)	PTFE							KL*		PPL
Chloral hydrate	PTFE				KL*					
Chlorinated phenol	PTFE						KL*	SL		
Chlorine (5% in CCl_4)	PTFE				KL				SL	PPL
Chlorine dioxide	PTFE				KL			SL[3]		PPL
Chlorine gas (dry or wet)	PTFE				KL				SL	PPL
Chlorine liquid (under pressure)					KL PTFE[2]					PPL SL
Chlorine water (saturated)	PTFE			KL		SL[3]	PPL[3]			
mono-Chloroacetic acid	PTFE				KL			SL* PPL*		
Chloroacetyl chloride	PTFE							KL*		PPL
Chlorobenzene	PTFE					KL			SL	PPL
Chlorobenzyl chloride	PTFE						KL*		SL*	PPL
Chloroform	PTFE				KL				SL	PPL
Chlorohydrin (liquid)	PTFE							KL* SL		PPL
1-Chloro-1-nitropropane	PTFE							SL		
2-Chloro-4-phenylphenol	PTFE							SL		
Chloropicrin	PTFE						KL*		SL	PPL
Chlorosulfonic acid (100%)	PTFE									KL PPL SL
Chromic acid (20%)	PTFE					KL	SL	PPL[4]		
Chromic acid (40%)	PTFE					KL	SL	PPL[4]		
Chromium plating solution	PTFE					SL KL		PPL[4]		
Chromium trioxide (30%)	PTFE					KL SL		PPL[1]		
Chromyl chloride	PTFE							KL		
Citric acid	PTFE	KL		PPL		SL				
CLOROX bleach solution (5½% NaOCl)	PTFE	KL*					PPL[2]	SL[2]		
Coal gas	PTFE			KL			PPL* SL*			
Coconut oil	PTFE	KL						SL PPL*		
Copper carbonate, basic	PTFE	KL*			PPL	SL				
Copper chloride (saturated)	PTFE	KL			PPL	SL				
Copper cyanide (10%)	PTFE	KL			PPL			SL		
Copper fluoride	PTFE	KL			PPL		SL			
Copper nitrate	PTFE	KL			PPL	SL				
Copper sulfate (saturated)	PTFE	KL			PPL	SL				
Corn oil	PTFE	KL				PPL*	SL*			
Cottonseed oil	PTFE	KL					SL PPL			
Cresol	PTFE						KL SL		PPL	
Cresylic acid (50%)	PTFE						KL SL		PPL	
Croton aldehyde	PTFE							KL		
Crude oil	PTFE	KL					PPL SL			
Cupric chloride (saturated) See Copper chloride	PTFE									
Cyanoacetic acid	PTFE								SL	
Cyclohexane	PTFE	KL						SL	PPL*	
Cyclohexanol	PTFE						KL		PPL SL	
Cyclohexanone	PTFE								KL	SL PPL
Desoxyephedrine hydrochloride	PTFE								SL	
Dextrose	PTFE	KL*		PPL		SL				
Diacetone alcohol	PTFE								KL SL	

Footnotes to the left half of the table (Carbonic acid to Chromium plating solution):

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field test.

[1] Trademark Union Carbide Corporation

[2] Above 200°F pressure of liquid chlorine exceeds maximum pressure allowed for Dow rated class 300 rated pipe and fittings

[3] If decomposition to free chlorine is possible, SL and PPL should not be used. KL is preferred material

[4] May cause cracking of material under stress

Footnotes to the right half of the table (Chromium trioxide to Diacetone alcohol):

[1] May cause cracking of material under stress.

[2] If decomposition to free chlorine is possible, SL and PPL should not be used. KL is preferred material

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature —°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Diazo salts	PTFE						SL			
1,2-Dibromo propane	PTFE				KL*				SL	
Dibutoxy ethyl phthalate	PTFE							SL		
Dibutyl phthalate	PTFE							PPL SL		KL
Dibutyl sebacate	PTFE							SL		KL
Dichloroacetic acid	PTFE							KL SL PPL*		
o-Dichlorobenzene	PTFE							KL*		SL PPL
Dichloroethylene	PTFE			KL		PPL*				
Dichloropropionic acid	PTFE							KL*	SL	
Diesel fuels	PTFE	KL						SL	PPL*	
Diethanol amine	PTFE						PPL			KL SL
Diethyl amine (aqueous)	PTFE								KL PPL	SL
Diethyl ether	PTFE							KL	PPL*	SL
Diethyl malonate	PTFE								SL	KL
Diethylene triamine	PTFE							KL PPL		
Diglycolic acid	PTFE								KL PPL	
Di-B (3,4-dihydroxyphenol aniline)	PTFE								SL	
Di-isobutylene	PTFE	KL								
Di-isobutylketone	PTFE				KL				PPL* SL*	
Dimethanolamine	PTFE						PPL			KL
Dimethyl acetamide	PTFE							PPL*		KL
Dimethyl amine (aqueous)	PTFE							PPL	KL	
Dimethyl aniline	PTFE						PPL		KL	
Dimethyl formamide	PTFE							PPL		KL SL
Dimethyl phthalate	PTFE								KL PPL SL*	

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests

Corrosive Stream	Maximum Temperature —°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Dimethyl sulfate	PTFE								KL*	
Dioctyl phthalate	PTFE								KL* SL	
1,4-Dioxane	PTFE								PPL	KL SL
Diphenyl oxide	PTFE							KL*		SL
Dipropylene glycol methyl ether	PTFE						PPL		KL* SL	
Disodium phosphate	PTFE				PPL KL*		SL			
Distilled water	PTFE	KL		PPL		SL				
Divinyl benzene	PTFE							KL*		
Epichlorohydrin	PTFE							PPL*		KL
Ethyl acetate	PTFE							PPL*	SL	KL
Ethyl acetoacetate	PTFE								KL*	PPL
Ethyl acrylate	PTFE								KL*	PPL
Ethyl alcohol	PTFE	KL				PPL	SL			
Ethyl benzene (acidic)	PTFE							KL*		PPL
Ethyl chloride	PTFE	KL								SL PPL
Ethyl chloroacetate	PTFE							PPL*	KL* SL	
Ethyl cyanoacetate	PTFE							PPL*	KL* SL	
Ethylene bromide See Ethylenedibromide	PTFE									
Ethylene chlorohydrin	PTFE							PPL*	KL	
Ethylene chloride See Ethylenedichloride	PTFE									
Ethylene diamine	PTFE						PPL		KL	
Ethylene dibromide	PTFE			KL					PPL* SL	
Ethylene dichloride	PTFE	KL							PPL SL	
Ethylene glycol	PTFE	KL				SL		PPL		
DOWANOL[1] DB glycol ether	PTFE				KL*		PPL*		SL	
DOWANOL DE glycol ether	PTFE				KL*		PPL*		SL	

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

[1] Trademark of The Dow Chemical Company

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature —°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
DOWANOL EB glycol ether	PTFE				KL*		PPL*		SL	
DOWANOL EE glycol ether	PTFE				KL*		PPL*		SL	
DOWANOL EM glycol ether	PTFE				KL*		PPL*		SL	
DOWANOL PM glycol ether	PTFE				KL*		PPL*		SL	
Ethylene oxide (5% aqueous)	PTFE				KL					SL PPL
Ethylene trichloride	PTFE	KL*							SL	PPL
Fatty acids	PTFE	KL					PPL SL			
Ferric chloride	PTFE	KL		PPL				SL		
Ferric chloride-Hydrochloric acid	PTFE	KL		PPL[1]				SL		
Ferric nitrate	PTFE	KL			PPL			SL		
Ferric sulfate	PTFE	KL			PPL		SL			
Ferrous chloride	PTFE	KL			PPL*			SL*		
Ferrous chloride-Hydrochloric acid	PTFE	KL			PPL[1]			SL*		
Ferrous nitrate	PTFE	KL			PPL*				SL	
Ferrous sulfate	PTFE	KL			PPL*			SL		
Fish solubles	PTFE							SL	PPL*	
Fluoroboric acid	PTFE	KL*				SL	PPL*			
Fluorine (gaseous)									KL	PPL SL PTFE
Fluosilicic acid	PTFE	KL				SL	PPL			
Formaldehyde (37%)	PTFE				PPL			KL SL		
Formaldehyde (50%)	PTFE				PPL			SL		
Formic acid	PTFE		KL				PPL SL			
FREON[2] 11 Fluorocarbon	PTFE				KL*				SL*	PPL
FREON 12 Fluorocarbon	PTFE				KL*				SL*	PPL
FREON 13 Fluorocarbon	PTFE				KL*				SL*	PPL
FREON 14 Fluorocarbon	PTFE				KL*				SL*	PPL
FREON 21 Fluorocarbon	PTFE				KL*				SL*	PPL
FREON 22 Fluorocarbon	PTFE				KL*				SL*	PPL

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

1 May cause cracking of material under stress.

2 Trademark of E. I. Dupont de Nemours Co.

Corrosive Stream	Maximum Temperature —°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
FREON 113 Fluorocarbon	PTFE				KL*				SL*	PPL
FREON 114 Fluorocarbon	PTFE				KL*				SL*	PPL
Fructose	PTFE	KL*		PPL		SL				
Fruit juices, pulp	PTFE			PPL		SL				
Fuel oil	PTFE	KL						SL*	PPL*	
Furfural	PTFE								KL SL	PPL
Gallic acid	PTFE					PPL*	SL		KL	
Gas (manufactured)	PTFE	KL					PPL SL			
Gas (natural)	PTFE	KL					PPL SL			
Gasoline (leaded)	PTFE	KL					SL		PPL	
Gasoline (unleaded)	PTFE	KL					SL		PPL	
Gin	PTFE			KL*	PPL*		SL			
Glucose	PTFE	KL		PPL		SL				
Glycerin	PTFE	KL		PPL		SL				
Glycerol triacetate	PTFE							SL		
Glycine (saturated)	PTFE							SL	KL*	
Glycolic acid	PTFE						PPL		KL	
Heptane	PTFE	KL					SL		PPL*	
HERCOLYN[1] plasticizer	PTFE							SL		
Hexane	PTFE	KL					SL		PPL	
Hydrazine dihydrochloride	PTFE					SL			KL*	
Hydriodic acid	PTFE	KL			PPL*			SL*		
Hydrobromic acid (10%)	PTFE	KL		PPL				SL		
Hydrobromic acid (50%)	PTFE	KL			PPL			SL		
Hydrochloric acid (10%)	PTFE	KL			PPL	SL				
Hydrochloric acid (20%)	PTFE	KL			PPL	SL				
Hydrochloric acid (35%)	PTFE	KL			PPL	SL				
Hydrocyanic acid	PTFE	KL					PPL	SL		
Hydrofluoric acid (20%)	PTFE		KL		PPL	SL				
Hydrofluoric acid (30%)	PTFE		KL		PPL	SL				

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

1 Trademark of Hercules, Inc.

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Hydrofluoric acid (37%)	PTFE		KL		PPL	SL				
Hydrofluoric acid (48%)	PTFE			KL*	PPL		SL			
Hydrofluoric acid (60%)	PTFE				PPL KL			SL*		
Hydrofluoric acid (100%)	PTFE				KL					PPL SL
Hydrofluosilicic acid See Fluosilicic acid	PTFE									
Hydrogen	PTFE	KL		PPL		SL				
Hydrogen chloride (anhydrous gas)	PTFE	KL		PPL*		SL*				
Hydrogen cyanide	PTFE	KL								
Hydrogen peroxide (3-8%)	PTFE				KL			PPL SL		
Hydrogen peroxide (30%)	PTFE				KL			PPL SL		
Hydrogen peroxide (90%)	PTFE							KL PPL SL		
Hydrogen sulfide (dry)	PTFE	KL				PPL	SL			
Hydrogen sulfide (wet)	PTFE	KL				PPL	SL			
Hydrogen sulfide (aqueous solution)	PTFE			KL*		PPL	SL			
Hydroquinone	PTFE		KL*				SL PPL			
Hypochlorous acid	PTFE	KL					PPL	SL		
Hypo (sodium thiosulfate)	PTFE	KL					PPL* SL*			
1-Isoleucine + d-Alloisoleucine	PTFE							SL		
Isopropylamine	PTFE						PPL*	KL*		SL
Iodine (gas)	PTFE						KL		SL*	
Iodine (10%)	PTFE						KL*		PPL	
Iodoform	PTFE				KL				PPL* SL*	
Jet fuel (JP4, JP5)	PTFE				KL				PPL* SL*	
Kerosene	PTFE	KL						SL	PPL*	
Lactic acid (80%)	PTFE						PPL*	KL SL*		

*Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Lard oil	PTFE	KL				PPL	SL			
Lauric acid	PTFE			KL		PPL	SL			
Lauryl chloride	PTFE		KL			PPL*	SL*			
Lauryl sulfate (saturated)	PTFE		KL*			PPL		SL		
Lead acetate	PTFE	KL				PPL*	SL			
Lemon oil	PTFE		KL*					SL	PPL*	
dl-Leucine	PTFE								SL	
Lime sulfur solution	PTFE								SL	
Linoleic acid	PTFE		KL				PPL SL			
Linseed oil	PTFE	KL					PPL SL			
Lithium bromide (saturated)	PTFE			KL*				SL		
Lubricating oil	PTFE	KL						PPL* SL		
dl-Lysine monohydrochloride	PTFE							SL		
Magnesium carbonate	PTFE	KL		PPL		SL				
Magnesium chloride	PTFE	KL		PPL		SL				
Magnesium hydroxide	PTFE	KL		PPL		SL				
Magnesium nitrate	PTFE	KL		PPL		SL				
Magnesium sulfate (10%)	PTFE	KL		PPL		SL				
Magnesium sulfate (20%)	PTFE	KL		PPL		SL				
Magnesium sulfate (saturated)	PTFE	KL		PPL		SL				
Maleic acid (10%)	PTFE		KL				PPL	SL		
Maleic anhydride	PTFE								KL* PPL* SL*	
Malic acid	PTFE		KL					PPL*		
Manganese sulfate (10%)	PTFE						SL		PPL*	
Manganese sulfate (20%)	PTFE						SL		PPL*	
Manganese sulfate (saturated)	PTFE						SL		PPL*	
Mercuric chloride	PTFE		KL			PPL	SL			
Mercuric cyanide	PTFE		KL				PPL	SL		
Mercuric nitrate	PTFE	KL				PPL	SL			

*Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Mercury	PTFE	KL					PPL SL			
Methacrylic acid	PTFE							KL*		
Methane	PTFE	KL					SL*		PPL*	
Methane sulfonic acid	PTFE				KL			PPL* SL*		
Methyl alcohol	PTFE	KL			PPL		SL			
Methyl bromide	PTFE	KL							SL*	PPL
Methyl CELLOSOLVE ethers	PTFE	KL						SL*	PPL*	
Methyl chloride	PTFE	KL							SL	PPL
Methyl chloroform	PTFE							KL	SL	PPL
Methyl chloromethyl ether	PTFE								KL* SL	
Methyl cyanoacetate	PTFE							PPL*	SL	
Methyl ethyl ketone	PTFE							PPL*		SL KL
Methyl isobutyl ketone	PTFE							PPL*	SL	KL
Methyl methacrylate	PTFE			PPL				KL*	SL	
Methyl salicylate	PTFE						KL*	PPL SL		
Methyl sulfuric acid	PTFE							KL PPL		
Methyl trichlorosilane	PTFE						KL*			
Methylene bromide	PTFE					KL*		SL		
Methylene chloride	PTFE									KL SL PPL
Methylene iodide	PTFE				KL*			SL		
Methoxy ethyl oleate	PTFE								SL	
Milk	PTFE			KL PPL			SL*			
Mineral oil	PTFE	KL						SL PPL		
Molasses	PTFE			PPL		SL	KL*			
Monochloroacetic acid See Chloroacetic acid	PTFE									
Monoethanolamine	PTFE					PPL				KL

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Morpholine	PTFE						PPL*		KL	
Naphtha	PTFE	KL					SL	PPL*		
Naphthalene	PTFE			PPL	KL					
Nickel chloride	PTFE	KL			PPL	SL				
Nickel nitrate	PTFE	KL			PPL	SL				
Nickel sulfate	PTFE	KL			PPL	SL				
Nicotinic acid	PTFE		KL							
Nitric acid (fuming)	PTFE									PPL KL SL
Nitric acid (5%)	PTFE					PPL KL	SL			
Nitric acid (10%)	PTFE					PPL KL	SL			
Nitric acid (30%)	PTFE						PPL SL	KL		
Nitric acid (50%)	PTFE							SL KL	PPL	
Nitric acid (70%)	PTFE								SL KL*	PPL
Nitric acid (concentrated)	PTFE									PPL KL SL
Nitrobenzene	PTFE						PPL		KL	
Nitrogen	PTFE	KL		PPL		SL				
Nitrogen dioxide	PTFE					KL			SL*	
Nitroglycerine	PTFE							KL* SL		
Nitromethane	PTFE							KL PPL* SL*		
Nitrous acid (10%)	PTFE				KL				SL	PPL
Nitrous oxide	PTFE								PPL* SL	KL
Nonyl isophenyl sulfide	PTFE					SL				
dl-Norvaline	PTFE							SL		
Octane	PTFE	KL					SL*		PPL*	
Oils and fats	PTFE	KL*				PPL	SL			

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Oleic acid	PTFE		KL				SL PPL			
Oleum	PTFE									KL PPL SL
Oxalic acid	PTFE							PPL KL SL		
Oxygen	PTFE	KL				SL		PPL*		
Ozone	PTFE			KL				SL		PPL
Palmitic acid	PTFE		KL			PPL	SL			
Perchloric acid (10%)	PTFE				KL		PPL	SL		
Perchloric acid (70%)	PTFE						PPL	KL SL		
Perchloroethylene	PTFE	KL								SL
Petrolatum	PTFE	KL*				PPL		SL		
Petroleum ether	PTFE						KL*			PPL
Phenol (5%)	PTFE				PPL	KL			SL	
Phenol (90%)	PTFE						PPL	KL	SL	
Phenol (100%)	PTFE						PPL	KL	SL*	[illegible]
Phenolsulfonic acid (65%)	PTFE							KL*	SL	
Phenylhydrazine	PTFE							KL		SL
Phenylhydrazine hydrochloride	PTFE							KL*		
Phenyl glycine potassium salt	PTFE							SL		
o-Phenylphenol	PTFE					KL*			SL	
o-Phenylphenol sodium salt	PTFE					KL*			SL	
Phosgene (dry)	PTFE					KL				PPL
Phosgene (wet)	PTFE			KL						PPL
Phosphoric acid (10%)	PTFE	KL		PPL		SL				
Phosphoric acid (30%)	PTFE	KL		PPL		SL				
Phosphoric acid (85%)	PTFE			KL PPL				SL		
Phosphorus oxychloride	PTFE									PPL SL KL*
Phosphorus pentachloride	PTFE				KL*					SL PPL

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Phosphorus pentoxide	PTFE				KL	PPL				
Phosphorus—red	PTFE								PPL* SL	
Phosphorus trichloride	PTFE				KL					SL PPL
Phosphorus—yellow	PTFE								PPL* SL	
Phthalic acid	PTFE				KL				PPL	
Picric acid	PTFE							SL	KL PPL*	
Plasticizer (DOW P-5)	PTFE								SL	
Plasticizer (C-24 Rohm and Haas)	PTFE								SL	
PLATING SOLUTIONS: Brass	PTFE				KL*		PPL		SL	
Cadmium	PTFE				KL*		PPL		SL	
Chrome	PTFE					SL KL		PPL[1]		
Copper	PTFE				KL*		PPL			
Gold	PTFE				KL*		PPL		SL	
Iron	PTFE				KL*		SL PPL			
Lead	PTFE				KL*		PPL			
Nickel	PTFE				KL*	SL	PPL			
Rhodium	PTFE				KL*		PPL		SL	
Silver	PTFE						PPL	SL		
Speculum	PTFE				KL*		PPL*		SL	
Tin	PTFE				KL*	SL	PPL			
Zinc	PTFE				KL*	SL	PPL			
Polyglycol E-400	PTFE				KL*	PPL* SL				
Polyglycol P-750	PTFE				KL*	PPL* SL				
Polyethylene glycol 600E	PTFE				KL*	PPL* SL				
Polyvinyl acetate	PTFE	KL							PPL	
Polyvinyl alcohol	PTFE	KL*						PPL		

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests

[1] May cause cracking of material under stress.

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS–DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Potassium aluminum chloride	PTFE	KL*		PPL		SL				
Potassium aluminum sulfate (50%)	PTFE	KL*		PPL		SL				
Potassium bicarbonate	PTFE	KL*		PPL		SL				
Potassium borate	PTFE	KL*			PPL*	SL				
Potassium bromate	PTFE	KL*		PPL			SL			
Potassium bromide	PTFE	KL		PPL				SL*		
Potassium carbonate	PTFE	KL		PPL		SL				
Potassium chlorate (aqueous)	PTFE			PPL‡	KL		SL*‡			
Potassium chloride	PTFE	KL			PPL			SL		
Potassium chromate (alkaline)	PTFE	KL*		PPL			SL			
Potassium chromate (neutral)	PTFE	KL*		PPL			SL			
Potassium cyanide	PTFE	KL		PPL*				SL*		
Potassium dichromate (alkaline saturated)	PTFE	KL		PPL			SL			
Potassium dichromate (neutral saturated)	PTFE	KL		PPL			SL			
Potassium ferricyanide (saturated)	PTFE	KL*		PPL*			SL			
Potassium ferrocyanide	PTFE	KL		PPL*			SL			
Potassium fluoride	PTFE	KL*				PPL* SL				
Potassium hydroxide (50%)	PTFE					PPL			KL SL	
Potassium hypochlorite	PTFE				KL*	PPL‡		SL‡		
Potassium nitrate	PTFE	KL				PPL	SL*			
Potassium perborate	PTFE	KL*		PPL*			SL			
Potassium perchlorate	PTFE				KL*		PPL			
Potassium permanganate (10%)	PTFE		KL				PPL	SL		
Potassium persulfate	PTFE							KL* SL		
Potassium sulfate	PTFE	KL		PPL		SL				
Potassium sulfide	PTFE	KL				PPL*	SL*			
Propane	PTFE	KL					PPL SL			

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

‡ If decomposition to free chlorine is possible SL and PPL should not be used. KL is the preferred material.

Corrosive Stream	Maximum Temperature—°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Propyl alcohol	PTFE						KL SL PPL			
Propylene chlorohydrin	PTFE					PPL				
Propylene dibromide	PTFE				KL*			SL	PPL*	
Propylene dichloride	PTFE				KL*			SL	PPL*	
Propylene oxide	PTFE								SL	KL
Pyrethrum oil	PTFE							SL		
Pyridine	PTFE								PPL	KL
Salicyl aldehyde	PTFE							KL	PPL*	
Salicylic acid	PTFE				KL			PPL* SL*		
Sea water	PTFE	KL		PPL		SL				
Selenic acid (aqueous)	PTFE						KL*		PPL*	
dl-Serine	PTFE				PPL		SL			
Sesame oil	PTFE						SL			
Silver cyanide	PTFE	KL			PPL				SL	
Silver nitrate	PTFE	KL		PPL		SL				
Soap solution (saturated)	PTFE					PPL* SL				
Sodium acetate	PTFE	KL			PPL		SL			
Sodium benzoate	PTFE	KL			PPL		SL			
Sodium bicarbonate	PTFE	KL		PPL		SL				
Sodium bisulfate	PTFE	KL		PPL		SL				
Sodium bisulfite	PTFE	KL		PPL			SL*			
Sodium borate (Borax)	PTFE	KL				PPL				
Sodium bromide	PTFE	KL		PPL				SL*		
Sodium carbonate	PTFE	KL		PPL		SL				
Sodium chlorate	PTFE		KL		PPL‡		SL*‡			
Sodium chloride	PTFE	KL		PPL		SL				
Sodium chlorite	PTFE		KL*		PPL*			SL*		
Sodium cyanide (saturated)	PTFE	KL				PPL		SL*		
Sodium dichromate (alkaline)	PTFE			PPL	KL*		SL			

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

‡ If decomposition to free chlorine is possible SL and PPL should not be used. KL is the preferred material.

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature —°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Sodium dichromate (neutral)	PTFE			PPL	KL*		SL			
Sodium dodecyl benzene (30%)	PTFE		KL*						SL	
Sodium ferricyanide	PTFE	KL*					SL* PPL			
Sodium ferrocyanide	PTFE	KL*					SL* PPL			
Sodium fluoride (saturated)	PTFE	KL				PPL SL				
Sodium hydroxide (5%)	PTFE				PPL		SL	KL†		
Sodium hydroxide (50%)	PTFE				PPL				SL	KL†
Sodium hydroxide (73%)	PTFE						PPL			KL†
Sodium hypochlorite (5%)	PTFE	KL*					PPL‡	SL‡		
Sodium hypochlorite (15%)	PTFE				KL		PPL‡	SL‡		
Sodium hypochlorite (17.2%)	PTFE				KL		PPL‡	SL‡		
Sodium iodide	PTFE	KL*				PPL* SL*				
Sodium nitrate	PTFE	KL				PPL*	SL*			
Sodium nitrite	PTFE	KL				PPL*	SL			
Sodium peroxide	PTFE				KL*			PPL* SL*		
Sodium phosphate	PTFE	KL				PPL	SL*			
Sodium resinate	PTFE						PPL*	SL		
Sodium silicate	PTFE	KL		PPL*		SL*				
Sodium sulfate	PTFE	KL		PPL		SL				
Sodium sulfide	PTFE	KL					PPL SL*			
Sodium sulfite	PTFE	KL					PPL SL			
Sodium thiosulfate (Hypo)	PTFE	KL					PPL* SL*			
Sour crude oil	PTFE	KL					PPL SL			
Sperry oil (UNIVIS[1] 40 oil)	PTFE							SL		
Stannic chloride	PTFE	KL				SL	PPL			
Stannous chloride (50%)	PTFE	KL				SL	PPL			

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

† Rating for sodium hydroxide does not apply for applications in which mercury amalgam is present.

‡ If decomposition to free chlorine is possible SL and PPL should not be used. KL is the preferred material.

1 Trademark of Standard Oil Co.

Corrosive Stream	Maximum Temperature —°F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Stearic acid	PTFE	KL				PPL	SL			
Stoddard solvent	PTFE		KL				SL*	PPL*		
Styrene monomer	PTFE								SL	
Succinic acid	PTFE						KL* PPL SL*			
Sulfamic acid	PTFE					PPL		KL*		
Sulfur	PTFE		KL				PPL			
Sulfur chloride	PTFE								KL PPL	SL
Sulfur dichloride	PTFE								KL	SL PPL
Sulfur dioxide (dry gas)	PTFE					PPL KL		SL		
Sulfur dioxide (wet gas)	PTFE					PPL KL		SL		
Sulfur dioxide (liquid)	PTFE					KL			SL	
Sulfur trioxide (liquid)	PTFE									KL PPL SL
Sulfur trioxide (wet gas)	PTFE									PPL KL SL
Sulfuric acid (10%)	PTFE		KL	PPL				SL		
Sulfuric acid (16%)	PTFE		KL		PPL			SL		
Sulfuric acid (30%)	PTFE			KL	PPL				SL	
Sulfuric acid (60%)	PTFE			KL	PPL					SL
Sulfuric acid (60%-saturated with Cl_2)	PTFE				KL*				PPL	SL
Sulfuric acid (85%)	PTFE				KL	PPL				SL
Sulfuric acid (93%)	PTFE				KL	PPL				SL
Sulfuric acid (96%)	PTFE					KL*	PPL			SL
Sulfuric acid (98%)	PTFE						KL‡	PPL‡		SL
Sulfuric acid (fuming) >98%	PTFE									KL PPL SL

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests.

‡ Free sulfur trioxide will attack polypropylene and Kynar. Therefore 98% sulfuric acid should be considered the absolute maximum concentration to be handled in polypropylene and Kynar lined piping products. Other circumstances where free sulfur trioxide is present should be avoided.

(continued)

TABLE 1.68: VARIOUS RESINS FOR PLASTIC LINED PIPING PRODUCTS—DOW CHEMICAL (continued)

Corrosive Stream	Maximum Temperature — °F (°C) 450 (232)	275 (135)	250 (121)	225 (107)	200 (93)	175 (79)	150 (66)	125 (52)	75 (24)	Not Recommended
Sulfurous acid	PTFE				KL	PPL			SL	
Sulfuryl fluoride	PTFE								KL*	SL PPL
Tall oil	PTFE	KL				PPL				
Tannic acid	PTFE			KL			PPL SL*			
Tartaric acid	PTFE		KL				SL* PPL			
2,3,4,6-Tetrachlorophenol	PTFE						KL*		PPL*	SL
Tetraethyl lead	PTFE	KL								
Tetrahydrofuran	PTFE									KL PPL SL
Tetramethyl ammonium hydroxide	PTFE				KL		PPL*	SL*		
Thread cutting oils	PTFE				KL*			PPL SL		
Thionyl chloride	PTFE									SL KL PPL
Titanium tetrachloride	PTFE						KL			PPL SL
Toluene	PTFE					KL			SL	PPL
Toluene (25%) + kerosene (75%)	PTFE					KL*			SL	PPL
Tomato juice	PTFE			PPL	KL	SL				
Toxaphene (90%) + xylene (10%)	PTFE								SL*	PPL
ar-Tribromoethylbenzene	PTFE								SL	
ar-Tribromoethylbenzene (75%) + dibromoethylbenzene (25%)	PTFE								SL	
Tribromoethylbenzene (75%) + ALKAZENE[1] #42 (25%) gage fluid	PTFE								SL	
Tributyl citrate	PTFE								SL	
Tributyl phosphate	PTFE								KL SL	
Trichloroacetic acid (10%)	PTFE				KL*		PPL		SL	
Trichloroacetic acid (100%)	PTFE							KL	PPL SL	
1,1,2-Trichloroethane	PTFE						KL*		SL	PPL
Trichloroethylene	PTFE	KL							SL	PPL
Trichloromethane See Chloroform	PTFE									
2,4,5-Trichlorophenol	PTFE						KL*		PPL	SL
2,4,5-Trichlorophenol-sodium salt (5%)	PTFE						KL PPL		SL	
Tricresyl phosphate	PTFE									KL
Triethanolamine	PTFE						PPL	KL	SL	
Triethyl amine	PTFE							KL	PPL* SL	
Trimethylamine	PTFE						KL			
Trimethyl propane	PTFE				KL*		SL		PPL	
Tripropylene glycol methyl ether	PTFE						PPL		SL	
Trisodium phosphate	PTFE	KL				PPL*	SL*			
dl-Tryptophan	PTFE							SL		
Turpentine	PTFE	KL						SL		PPL
dl-Tyrosine	PTFE							SL		
Urea	PTFE		KL		PPL			SL		
Urine	PTFE		KL		PPL			SL		
Vegetable oil	PTFE	KL*					SL	PPL*		
Vinegar	PTFE			KL*	PPL		SL			
Vinyl acetate	PTFE		KL							
Vinyl chloride monomer (liquid)	PTFE				KL					SL PPL
Vinylidene chloride (monomer)	PTFE				KL				SL	PPL
Water — acid mine	PTFE		KL	PPL		SL				
Water — deionized	PTFE	KL		PPL		SL				
Water — demineralized	PTFE	KL		PPL		SL				
Water — distilled	PTFE	KL		PPL		SL				
Water — fresh	PTFE	KL		PPL		SL				
Water — salt	PTFE	KL		PPL		SL				
Water — sewage	PTFE		KL	PPL		SL				
Whiskey	PTFE			PPL	KL*		SL			
Wine	PTFE				KL* PPL		SL			
Xylene	PTFE				KL				SL	PPL
Zinc chloride	PTFE	KL				PPL	SL			
Zinc hydrosulfite (10%)	PTFE				KL*				SL	
Zinc nitrate	PTFE	KL			PPL*				SL	
Zinc sulfate	PTFE	KL			PPL*				SL	

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests

[1] Trademark of The Dow Chemical Company

* Estimates based on limited data or devised by extrapolation. All other ratings based on operating experience or field tests

TABLE 1.69: VARIOUS THERMOPLASTIC AND ELASTOMERIC PIPING MATERIALS—NIBCO

Chemical Resistance of Industrial Thermoplastics

R = Recommended
NR = Not Recommended
· · = No Data Available

	PVC[1]		CPVC[2]		POLYPROPYLENE				PVDF				VITON			EPDM		
	73°F	140°F	73°F	185°F*	73°F	120°F	150°F	180°F†	73°F	150°F	230°F	280°F	73°F	140°F	185°F	73°F	140°F	210°F
Acetaldehyde	NR	NR	· ·	· ·	R	R	· ·	· ·	· ·	· ·	· ·	· ·	NR	NR	NR	R	R	R
Acetamide	· ·	· ·	· ·	· ·	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	NR	NR	NR	R	R	R
Acetic Acid, 10%	R	R	R	· ·	R	R	R	R	R	R	R	· ·	NR	NR	NR	R	R	NR
Acetic Acid, 20%	R	R	R	NR	R	R	R	R	R	R	R	· ·	NR	NR	NR	R	R	NR
Acetic Acid, 50%	R	R	· ·	NR	R	R	R	R	R	R	R	· ·	NR	NR	NR	R	R	NR
Acetic Acid, 80%	R	NR	R	NR	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	NR	NR	NR	R	R	NR
Acetic Acid, Glacial	R	NR	NR	NR	R	R	NR	NR	R	R	NR	· ·	NR	NR	NR	R	R	NR
Acetic Anhydride	NR	NR	· ·	· ·	· ·	· ·	· ·	· ·	R	NR	NR	NR	NR	NR	NR	NR	NR	NR
Acetone	NR	NR	NR	NR	R	NR	NR	R	NR	NR	NR	NR	NR	NR	NR	R	R	R
Acetophenone	· ·	· ·	· ·	· ·	R	R	NR	R	NR	NR	NR	NR	NR	NR	NR	· ·	· ·	· ·
Acetyl Chloride	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	R	· ·	· ·	R	R	R	NR	NR	NR
Acetylene	R	R	· ·	· ·	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	R	R
Acetyl Nitrile	NR	NR	· ·	· ·	· ·	· ·	· ·	· ·	R	R	NR	· ·	NR	NR	NR	NR	NR	NR
Acrylic Acid, Ethyl Ester	NR	NR	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·
Acrylonitrile	NR	NR	NR	NR	· ·	· ·	· ·	· ·	R	NR	· ·	· ·	NR	NR	NR	NR	NR	NR
Adipic 105 Acid	R	R	R	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·
Alcohol, Allyl	R	NR	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	NR	NR
Alcohol, Amyl	NR	NR	R	NR	R	R	R	R	R	R	R	R	NR	NR	NR	R	R	R
Alcohol, Benzyl	NR	NR	· ·	· ·	R	R	R	· ·	R	R	R	R	R	R	R	R	R	· ·
Alcohol, Butyl, Primary	R	R	R	NR	R	R	R	· ·	R	R	R	R	R	R	R	R	R	R
Alcohol, Butyl, Secondary	R	NR	R	NR	R	R	R	· ·	R	R	R	R	R	R	R	R	R	R
Alcohol, Diacetone	· ·	· ·	· ·	· ·	R	· ·	· ·	· ·	R	NR	NR	NR	NR	NR	NR	R	R	R
Alcohol, Ethyl	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR	NR	R	R	R
Alcohol, Hexyl	R	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	NR	NR	NR
Alcohol, Isopropyl	R	R	· ·	· ·	R	R	R	· ·	R	R	NR	NR	R	R	R	R	R	R
Alcohol, Methyl	R	R	· ·	· ·	R	R	R	R	R	R	R	R	NR	NR	NR	R	R	R
Alcohol, Propargyl	R	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·
Alcohol, Propyl	R	R	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	R	R	R	R	R	R
Allyl Chloride	NR	NR	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	NR	R	NR	NR			
Alum	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Alum, Ammonium	R	R	· ·	· ·	R	R	R	· ·	R	R	R	R	R	R	R	R	R	R
Alum, Chrome	R	R			R	R	R	· ·	· ·	· ·	· ·	· ·	R	R	R			
Alum, Potassium	R	R	· ·	· ·	R	R	R	· ·	R	R	R	R	R	R	R	R	R	R
Aluminum Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Aluminum Fluoride	R	NR	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	R	R	R	R	R	R
Aluminum Hydroxide	R	R	R	R	· ·	· ·	· ·	· ·	R	R	R	R	R	R	R			
Aluminum Nitrate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Aluminum Oxychloride	R	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	NR	NR	NR			
Aluminum Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Ammonia, Gas	R	R	R	R	R	R	R	· ·	R	R	R	R	NR	NR	NR	R	R	NR
Ammonia, Aqua, 10%	R	R	R	NR	R	RS	R	· ·	R	R	R	· ·	NR	NR	NR	R	R	R
Ammonia, Liquid	NR	NR	· ·	· ·	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	NR	NR	NR	R	R	R
Ammonium Acetate	R	R	· ·	· ·	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	NR	NR	R	R	· ·
Ammonium Bifluoride	R	R	R	R	· ·	· ·	· ·	· ·	R	R	R	R	· ·	· ·	· ·			
Ammonium Bisulfide	R	R	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	· ·	· ·	· ·			
Ammonium Carbonate	R	R	· ·	· ·	R	R	R	R	R	R	R	R	· ·	· ·	· ·	R	R	R
Ammonium Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Ammonium Dichromate	R	· ·			· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·			
Ammonium Fluoride, 10%	R	R			· ·	· ·	· ·	· ·	R	R	R	R	· ·	· ·	· ·	R	R	R
Ammonium Fluoride, 25%	R	NR	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	· ·	· ·	· ·	R	R	NR
Ammonium Hydroxide	R	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR	R	R	R
Ammonium Metaphosphate	R	R	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	R	R	R	R	R	R
Ammonium Nitrate	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR	NR	R	R	R
Ammonium Persulphate	R	R	R	NR	R	R	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R
Ammonium Phosphate	R	R	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	R	R	R	R	R	R
Ammonium Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR	NR	R	R	R
Ammonium Sulfide	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	NR	NR	NR	R	R	R
Ammonium Thiocyanate	R	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	· ·	· ·	· ·
Amyl Acetate	NR	NR	· ·	· ·	NR	NR	NR	NR	R	R	NR	NR	NR	NR	NR	R	R	R
Amyl Chloride	NR	NR	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	R	R	R	NR	NR	NR
Aniline	NR	NR	NR	NR	R	R	R	R	R	NR	NR	NR	NR	NR	NR	R	R	NR
Aniline Chlorohyorate	NR	NR	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·			
Aniline Hydrochloride	NR	NR	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R	R	R	R
Anthraquinone	R	R	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	· ·	R	R	R			

[1] Polyvinyl Chloride, Type 1, Grade 1
[2] Chlorinated Polyvinyl Chloride
† For drainage application only
* R* Recommended to 210°F. — Data to 210°F. for other chemicals presently not available

(continued)

TABLE 1.69: VARIOUS THERMOPLASTIC AND ELASTOMERIC PIPING MATERIALS—NIBCO (continued)

CHEMICAL	PVC[1]		CPVC[2]		POLYPROPYLENE				PVDF				VITON			EPDM		
	73°F	140°F	73°F	185°F*	73°F	120°F	150°F	180°F†	73°F	150°F	230°F	280°F	73°F	140°F	185°F	73°F	140°F	210°F
Anthraquinone Sulfonic Acid	R	R											R	R	R			
Antimony Trichloride	R	R			R	R	R	R	R				R	R	R	R	R	
Aqua Regia	NR	NR	R	NR					R				R	R	R	NR	NR	NR
Arsenic Acid	R	R	R	R					R	R	R	R	R	R	R	R	R	R
Aryl Sulfonic Acid	R	R											R	R	R			
Barium Carbonate	R	R							R	R	R	R				R	R	R
Barium Chloride	R	R							R	R	R	R	R	R	R	R	R	R
Barium Hydroxide	R	R							R	R	R	R	R	R	R	R	R	R
Barium Nitrate	R												R	R	R	R	R	R
Barium Sulfate	R	R	R	R					R	R	R	R	R	R	R	R	R	R
Barium Sulfide	R	R							R	R	R	R	R	R	R	R	R	R
Beer	R	R			R	R	R	R					R	R	R	R	R	R
Beet Sugar Liquors	R	R			R	R	R	R					R	R	R	R	R	R
Benzaldehyde, 10%	R	NR			R				R	NR	NR	NR				R	R	R
Benzaldehyde, Above 10%	NR	NR			R				R	NR	NR	NR	NR	NR	NR			
Benzalkonium Chloride	R																	
Benzene, Benzol	NR	NR	NR	NR	NR	NR	NR	NR	R	R	NR	NR	R	R	R	NR	NR	NR
Benzene Sulfonic Acid, 10%	R	R			R	R	R	R	R	NR	NR	NR	R	R	R	NR	NR	NR
Benzoic Acid	R	R			R				R	R	R		R	R	R	NR	NR	NR
Bismuth Carbonate	R	R																
Black Liquor	R	R	R	R					R	R	R	R	R	R	R	NR	NR	NR
Bleach, 12.5% Active Cl_2	R	R	R	R	R	R			R	R	R	R	R	R	R	R	R	NR
Bleach, 5.5% Active Cl_2	R	R			R	R			R	R	R	R	R	R	R	R	R	NR
Borax	R	R			R	R	R	R	R	R	R	R	R	R	R	R	R	R
Boric Acid	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Brine, Acid	R				R	R	R		R	R	R	R	R	R	R	R	R	R
Bromic Acid	R	R	R	R					R	R	R					R	R	NR
Bromine, Liquid	NR	NR							R	R			R	R	R	NR	NR	NR
Bromine, Vapor 25%	R	R							R	R			R	R	R	NR	NR	NR
Bromine, Water	R	R			NR	NR	NR	NR	R	R	R		R	R	R	NR	NR	NR
Bromobenzene	NR	NR											R	R	R	NR	NR	NR
Bromotoluene	NR	NR			NR	NR	NR	NR										
Butadiene	R	R	R						R	R	R		R	R	R	NR	NR	NR
Butane	R	R			R				R	R	R		R	R	R	NR	NR	NR
Butyl Acetate	NR	NR	R	NR	NR	NR	NR	NR	R	NR	NR	NR	NR	NR	NR	R	R	NR
Butyl Alcohol	R	R	R	NR	R	R	R	R	R	R	R	R	NR	NR	NR	R	R	R
Butyl Cellosolve	R												NR	NR	NR	R	R	NR
Butyl Phthalate					R	R	R	R					R	NR	NR			
Butylene	R	R							R	R	R	R	R	R	R	NR	NR	NR
Butyl Phenol	R	NR							R	R	R							
Butyl Stearate	R												R	R	R	NR	NR	NR
Butyne Diol	R	NR																
Butyric Acid	R	NR			R	R	R	R	R	R	R		R	NR	NR	R	R	NR
Cadmium Cyanide	R	R	R	R														
Caffeine Citrate	R																	
Calcium Bisulfide	NR	NR							R	R	R	R	R	R	R			
Calcium Bisulfite	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR	NR
Calcium Carbonate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Calcium Chlorate	R	R							R	R	R	R	R	R	R			
Calcium Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Calcium Hydroxide	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Calcium Hypochlorite	R	R	R	R	R	R	R	NR	R	R	R	R	R	R	R	R	R	R
Calcium Nitrate	R	R			R	R	R	R	R	R	R	R	R	R	R	R	R	R
Calcium Oxide	R	R							R	R	R	R				R	R	R
Calcium Sulfate	R	R							R	R	R	R				R	R	R
Camphor Crystals	R																	
Cane Sugar Liquors	R	R			R								R	R	R	R	R	R
Carbitol	R												R	NR	NR	R	R	NR
Caprylic Acid									R	R	NR	NR						
Carbon Dioxide, Wet	R	R	R	R	R	R	R		R	R	R	R	R	NR	NR	R	R	R
Carbon Dioxide, Dry	R	R	R	R	R	R	R		R	R	R	R	R	NR	NR	R	R	R
Carbon Disulfide	NR	NR			NR	NR	NR	NR	R				R	R	R	NR	NR	NR
Carbon Monoxide	R	R	R	R									R	R	R	R	R	R
Carbon Tetrachloride	R	NR	R		NR	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR

[1] Polyvinyl Chloride, Type 1, Grade 1
[2] Chlorinated Polyvinyl Chloride
† For drainage application only
* R* Recommended to 210°F — Data to 210°F for other chemicals presently not available

(continued)

TABLE 1.69: VARIOUS THERMOPLASTIC AND ELASTOMERIC PIPING MATERIALS—NIBCO (continued)

CHEMICAL	PVC[1]		CPVC[2]		POLYPROPYLENE				PVDF				VITON			EPDM		
	73°F	140°F	73°F	185°F*	73°F	120°F	150°F	180°F†	73°F	150°F	230°F	280°F	73°F	140°F	185°F	73°F	140°F	210°F
Carbonic Acid	R	R	R	R					R	R	R	R	R	R	R	R	R	R
Castor Oil	R	R	R	R					R	R	R	R	R	R	R	R	NR	NR
Caustic Potash	R	R	R	R					R	R	R	R	NR	NR	NR			
Cellosolve	R	NR							R	R	R	R	NR	NR	NR	R	R	NR
Cellosolve Acetate	R												NR	NR	NR	R	R	NR
Chloracetic Acid	R	R							R	R	R		NR	NR	NR	R	NR	NR
Chloral Hydrate	R	R											NR	NR	NR			
Chloramine	R																	
Chloric Acid, 20%	R	R																
Chlorine Gas, Dry	R	NR			NR	NR	NR	NR	R	R	R		R	R	R	NR	NR	NR
Chlorine Gas, Wet	NR	NR			NR	NR	NR	NR	R	R	R		R	R	R	NR	NR	NR
Chlorine, Liquid	NR	NR	NR	NR					R	R	R		R	R	R	NR	NR	NR
Chlorine Water, Saturated	R	R	R	NR					R	R	R		R	R	R	R		
Chloracetic Acid	R	R							R	R	R		NR	NR	NR	R	NR	NR
Chloroacetyl Chloride	R																	
Chlorobenzene	NR	NR			R	NR	NR	NR	R	R	NR	NR	R	R	R	NR	NR	NR
Chlorobenzyl Chloride	NR	NR											R	R	R			
Chloroform	NR	NR	NR	NR	NR	NR	NR	NR	R	R	R		R	R	R	NR	NR	NR
Chloropicrin	NR	NR																
Chlorosulfonic Acid	R	NR			NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Chromic Acid, 10%	R	R	R	R*	R	R	R		R	R	NR	NR	R	R	R	R		
Chromic Acid, 30%	R	R	R	R*	R	R	R		R	R	NR	NR	R	R	R	R		
CHromic Acid, 40%	R	R	R	R*	R	R	R	NR	R	R	NR	NR	R	R	R	R		
Chromic Acid, 50%	NR	NR	R	R*	R	R	R	R	R	R	NR	NR	R	R	R	R		
Citric Acid	R	R	R	R	R	R	R	R	R	R	R		R	R	R	R	R	R
Coconut Oil	R	R			R				R	R	R	R	R	R	R	NR	NR	NR
Coke Oven Gas	R	R			R				R	R	R		R	R	R	NR	NR	NR
Copper Carbonate	R	R											R	R	R	R	R	R
Copper Chloride	R	R	R	R					R	R	R	R	R	R	R	R	R	R
Copper Cyanide	R	R	R	R					R	R	R	R	R	R	R	R	R	R
Copper Fluoride	R	R							R	R	R	R	R	R	R	R	R	R
Copper Nitrate	R	R							R	R	R	R	R	R	R	R	R	R
Copper Sulfate	R	R	R	R	R	R			R	R	R	R	R	R	R	R	R	R
Corn Syrup	R	R			R	R	R		R	R	R	R	R	R	R			
Cottonseed Oil	R	R	R	R	R	R	R		R	R	R	R	R	R	R	NR	NR	NR
Cresol	NR	NR			R				R	R	NR	NR				NR	NR	NR
Cresylic Acid, 50%	R	R							R	R	NR	NR	R	R	R	NR	NR	NR
Croton Aldehyde	NR	NR							R	NR	NR	NR						
Crude Oil	R	R	R	R					R	R	R	R	R	R	R	NR	NR	NR
Cupric Fluoride	R	R							R	R	R	R				R	R	R
Cupric Sulfate	R	R			R				R	R	R	R	R	R	R	R	R	R
Cuprous Chloride	R	R											R	R	R			
Cyclohexane	NR	NR			NR	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Cyclohexanol	NR	NR			R	R	NR		R	R	NR	NR	R	R	R	NR	NR	NR
Cyclohexanone	NR	NR	NR	NR		NR	NR	NR	R	NR	NR	NR	NR	NR	NR	R	NR	NR
Desocyephedrine Hydrochloride	R																	
Detergents	R	R	R	R	R	R	R						R	R	R	R	R	R
Detergent Solution (Heavy Duty)	R	R	R	R	R	R	R						R	R	R	R	R	R
Dextrin	R	R							R	R	R					NR	NR	NR
Dextrose	R	R							R	R	R		R	R	R			
Diazo Salts	R	R																
Dibutoxy Ethyl Phthalate	NR	NR																
Dibutyl Phthalate	NR	NR			R	R	NR	R					NR	NR	NR	R	NR	NR
Dibutyl Sebacate	R	NR														R	NR	NR
Dichlorobenzene	NR	NR											R	R	R	NR	NR	NR
Dichoroethylene	NR	NR			NR	NR	NR	NR					R	R	R	NR	NR	NR
Diesel Fuels	R	R							R	R	R	R	R	R	R	NR	NR	NR
Diethylamine	NR	NR							R	NR	NR	NR	R	NR	NR	R	NR	NR
Diethyl Cellosolve									R	R	R	R				NR	NR	NR
Diethyl Ether	R				R	NR	NR	NR	R	NR	NR	NR	NR	NR	NR	NR	NR	NR
Diglycolic Acid	R	R							R									
Dimethylamine	R	R			R	R			NR	NR	NR	NR	NR	NR	NR			
Dimethyl Formamide	NR	NR	NR	NR	R	R			NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dimethyl Hydrazine	NR	NR							NR	NR	NR	NR	NR	NR	NR			

[1] Polyvinyl Chloride, Type 1, Grade 1
[2] Chlorinated Polyvinyl Chloride
† For drainage application only
* R* Recommended to 210°F — Data to 210°F for other chemicals presently not available

(continued)

TABLE 1.69: VARIOUS THERMOPLASTIC AND ELASTOMERIC PIPING MATERIALS—NIBCO (continued)

CHEMICAL	PVC[1]		CPVC[2]		POLYPROPYLENE				PVDF				VITON			EPDM		
	73°F	140°F	73°F	185°F*	73°F	120°F	150°F	180°F†	73°F	150°F	230°F	280°F	73°F	140°F	185°F	73°F	140°F	210°F
Dioctyl Phthalate	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	R	NR	NR	R	NR	NR
Dioxane	NR	NR	. .	. .	R	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	R	NR	NR
Dioxane, 1, 4	NR	NR	. .	. .	. .	. .	. .	. .	NR	NR	NR	NR	NR	NR	NR	. .	. .	. .
Disodium Phosphate	R	R	R	R	. .	. .	. .	. .	R	R	R	R	. .	. .	. .	R	R	R
Divinylbenzene	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Epsom Salt	R	. .	. .	. .	. .	. .	. .	. .	R	R	R	R	. .	. .	. .	R	R	R
Ethyl Acetate	NR	NR	. .	. .	R	R	NR	NR	NR	NR	NR	NR	NR	NR	NR	R	NR	NR
Ethyl Acetoacetate	NR	NR	. .	. .	. .	. .	. .	. .	R	NR	NR	NR	NR	NR	NR	R	NR	NR
Ethyl Acrylate	NR	NR	. .	. .	. .	. .	. .	. .	R	NR	NR	NR	NR	NR	NR	R	NR	NR
Ethyl Chloride	NR	NR	. .	. .	R	NR	NR	NR	R	R	R	R	R	R	R	R	R	R
Ethyl Chloroacetate	NR	NR	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ethyl Ether	NR	NR	. .	. .	NR	NR	NR	NR	R	NR	NR	NR	NR	NR	NR	NR	NR	NR
Ethylene Bromide	NR	NR	. .	. .	. .	. .	. .	. .	R	R	R	R	. .	. .	. .	NR	NR	NR
Ethylene Chloride	NR	NR	. .	. .	R	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Ethylene Chlorohydrin	NR	NR	. .	. .	. .	. .	. .	. .	R	NR	NR	NR	R	R	R	R	NR	NR
Ethylene Diamine	. .	. .	. .	. .	. .	. .	. .	. .	NR	NR	NR	NR	NR	NR	NR	R	R	R
Ethylene Dichloride	NR'	NR	. .	. .	NR	NR	NR	NR	. .	. .	. .	. .	R	R	R	NR	NR	NR
Ethylene Glycol	R	R	R	R	R	R	NR	R	R	R	R	R	R	R	R	R	R	R
Ethylene Oxide	NR	NR	. .	. .	. .	. .	. .	. .	R	R	R	NR	NR	NR	NR	R	R	R
Fatty Acids	R	R	. .	. .	. .	. .	. .	. .	R	R	R	R	R	R	R	NR	NR	NR
Ferric Acetate	R	NR	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ferric Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Ferric Hydroxide	R	R	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ferric Nitrate	R	R	. .	. .	. .	. .	. .	. .	R	R	R	R	R	R	R	R	R	R
Ferric Sulfate	R	R	. .	. .	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Ferrous Chloride	R	R	R	R	R	R	R	R	R	R	R	R	. .	. .	. .	. .	. .	. .
Ferrous Hydroxide	R	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ferrous Nitrate	R	. .	. .	. .	. .	. .	. .	. .	R	R	R	R	. .	. .	. .	. .	. .	. .
Ferrous Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	. .	. .	. .
Fish Solubles	R	R	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fluorine Gas, Wet	R	NR	. .	. .	. .	. .	. .	. .	R	. .	. .	. .	NR	NR	NR	. .	. .	. .
Fluoboric Acid	R	R	R	NR	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fluosilicic Acid	R	R	R	NR	. .	. .	. .	. .	R	R	R	R	R	NR	NR	R	R	R
Formaldehyde, 35%	R	R	R	NR	R	R	R	R	R	R	. .	. .	NR	NR	NR	R	R	NR
Formaldehyde, 37%	R	R	R	NR	R	R	R	R	R	R	. .	. .	NR	NR	NR	R	R	NR
Formaldehyde, 50%	R	R	R	NR	. .	. .	. .	. .	. .	. .	. .	. .	NR	NR	NR	R	R	NR
Formic Acid	R	NR	R	NR	R	R	R	. .	R	R	R	. .	R	R	R	R	R	R
Formic Acid (Anhydrous)	. .	. .	. .	. .	R	R	R	R	. .	. .	. .	. .	R	R	R	. .	. .	. .
Freon F-11	R	R	R	. .	. .	. .	. .	. .	. .	. .	. .	. .	R	R	R	NR	NR	NR
Freon F-12	R	R	R	. .	R	. .	. .	. .	. .	. .	. .	. .	R	R	R	.	NR	NR
Freon F-21	NR	NR	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	NR	NR	NR	NR	NR	NR
Freon F-22	NR	NR	. .	. .	R	. .	. .	. .	. .	. .	. .	. .	NR	NR	NR	R	R	R
Freon F-113	R	R	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	R	NR	NR	NR	NR	NR
Freon F-114	R	R	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	R	R	R	R	R	R
Fructose	R	R	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	R	R	R	. .	. .	. .
Fruit Juices, Pulp	R	R	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	R	R	R	. .	. .	. .
Furfural	NR	NR	. .	. .	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	R	NR	NR
Gallic Acid	R	R	R	NR	. .	. .	. .	. .	R	NR	NR	NR	R	R	R	R	NR	NR
Gas, Natural	R	R	. .	. .	R	. .	. .	. .	R	R	R	R	R	R	R	. .	. .	. .
Gasoline, Leaded	R	R	. .	. .	NR	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Gasoline, Unleaded	R	R	. .	. .	NR	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Gasoline, Sour	R	R	. .	. .	NR	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Gelatin	R	R	. .	. .	R	R	R	R	. .	. .	. .	. .	R	R	R	R	R	R
Gin	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Glucose	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Glycerine, Glycerol	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Glycolic Acid	R	R	. .	. .	. .	. .	. .	. .	R	NR	NR	NR	. .	. .	. .	R	. .	. .
Glycols	R	R	R	R	. .	. .	. .	. .	R	R	R	R	R	R	R	R	R	R
Grape Sugar	R	R	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	R	R	R	. .	. .	. .
Heptane	R	R	. .	. .	NR	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Hexane	R	NR	R	. .	R	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Hydrobromic Acid, 20%	R	R	R	NR	R	R	. .	. .	R	R	R	R	R	R	R	R	R	NR
Hydrobromic Acid, 50%	. .	. .	. .	. .	R	R	NR	. .	R	R	R	R	R	R	R	R	R	NR
Hydrochloric Acid, Conc. 37%	R	R	R	R*	R	R	R	. .	R	R	R	R	R	R	R	R	NR	NR

[1] Polyvinyl Chloride, Type 1, Grade 1
[2] Chlorinated Polyvinyl Chloride
† For drainage application only
* R* Recommended to 210°F. — Data to 210°F. for other chemicals presently not available

(continued)

TABLE 1.69: VARIOUS THERMOPLASTIC AND ELASTOMERIC PIPING MATERIALS—NIBCO (continued)

CHEMICAL	PVC[1]		CPVC[2]		POLYPROPYLENE				PVDF				VITON			EPDM		
	73°F	140°F	73°F	185°F*	73°F	120°F	150°F	180°F†	73°F	150°F	230°F	280°F	73°F	140°F	185°F	73°F	140°F	210°F
Hydrocyanic Acid	R	R			R				R	R	R	R	R	R	R	R	R	R
Hydrocyanic Acid, 10%	R	R			R				R	R	R	R	R	R	R	R	R	R
Hydrofluoric Acid, Dilute	R	NR	R	NR	R	R	R	R	R	R	R	R	R	NR	NR	R	NR	NR
Hydrofluroic Acid, 30%	R	NR		NR	R	R			R	R	R		R	NR	NR	R	NR	NR
Hydrofluoric Acid, 40%	R	NR	NR	NR	R	R	R	NR	R	R	R	NR	R	NR	NR	R	NR	NR
Hydrofluoric Acid, 50%	R	NR	NR	NR	R				R	R	R	NR	R	NR	NR	R	NR	NR
Hydrofluosilicic Acid	R	R							R	R	R	R	R	R	R	R	R	R
Hydrogen	R	R	R		R				R	R	R	R	R	R	R	R	R	R
Hydrogen Cyanide	R	R							R	R	R	R						
Hydrogen Fluoride, Anhydrous	NR	NR	NR	NR	R								NR	NR	NR			
Hydrogen Peroxide					R	R	R		R				R	R	R	NR	NR	NR
Hydrogen Peroxide, 50%	R	R	R	R	R	R	R		R	R			R	R	R	NR	NR	NR
Hydrogen Peroxide, 90%	R	R							R				R	R	R	NR	NR	NR
Hydrogen Phosphide	R	R							R	R						R		
Hydrogen Sulfide, Dry	R	R	R	R	R	R	R		R	R	R	R	NR	NR	NR	R	R	R
Hydrogen Sulfide, Aqueous Sol.	R	R											NR	NR	NR	R	R	
Hydroquinone	R	R							R	R	R		R	R	R	NR	NR	NR
Hydroxylamine Sulfate	R	R														R		
Hypochlorous Acid	R	R							R	R	R	R	R	R	R	R	R	
Hydrazine	NR	NR																
Iodine	NR	NR							R	R			R	R	R	R	NR	NR
Iodine Solution, 10%	NR	NR							R	R			R	R	R	R	R	
Isopropyl Ether													NR	NR	NR	NR	NR	NR
Isooctane					R	NR	NR	NR					R	R	R	NR	NR	NR
Jet Fuel, JP-4	R	R	R						R	R	R		R	R	R	NR	NR	NR
Jet Fuel, JP-5	R	R	R						R	R	R		R	R	R	NR	NR	NR
Kerosene	R	R	R	R	R	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Kraft Liquor	R	R	R	R														
Lactic Acid, 25%	R	R			R	R	R		R	NR	NR	NR	R	R	R	R	NR	NR
Lactic Acid, 80%	R				R	R	R		R	NR	NR	NR	R	R	R	R	NR	NR
Lard Oil	R	R	R	R					R	R	R	R	R	R	R	NR	NR	NR
Lauric Acid	R	R							R	R	R							
Lauryl Chloride	R	R							R	R	R							
Lead Acetate	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR	NR	R	R	R
Lead Chloride	R	R														R	R	R
Lead Nitrate	R	R											R	R	R	R	R	R
Lead Sulfate	R	R														R	R	R
Lemon Oil					NR	NR	NR	NR	R	R	R							
Ligroine					R	R							R	R	R	NR	NR	NR
Lime Sulfur	R	R			R								R	R	R	R	R	R
Linoleic Acid	R	R							R	R	R		R	R	NR	NR	NR	NR
Linoleic Oil	R	R											R	NR	NR			
Linseed Oil	R	R	R	R	R	R	R		R	R	R	R	R	R	R	NR	NR	NR
Linseed Oil, Blue													R	R	R			
Liqueurs	R	R																
Lithium Bromide	R	R											R	R	R			
Lubricating Oil, ASTM #1	R	R							R	R	R	R	R	R	R	NR	NR	NR
Lubricating Oil, ASTM #2	R	R							R	R	R	R	R	R	R	NR	NR	NR
Lubricating Oil, ASTM #3	R	R							R	R	R	R	R	R	R	NR	NR	NR
Machine Oil	R	R			R	R	NR	NR								NR	NR	NR
Magnesium Carbonate	R	R							R	R	R	R				R	R	R
Magnesium Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Magnesium Citrate	R	R														R	R	R
Magnesium Hydroxide	R	R			R	R	R	R	R	R	R	R	R	R	R	R	R	R
Magnesium Nitrate	R	R			R	R	R	R	R	R	R	R				R	R	R
Magnesium Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Manganese Sulfate	R	R			R	R	R											
Maleic Acid	R	R							R	R	R		R	R	R	NR	NR	NR
Malic Acid	R	R	R	R	R	R	R	NR	R	R	R		R	R	R	NR	NR	NR
Mercuric Chloride	R	R			R	R	R	R	R	R	R		R	R	R	R	R	R
Mercuric Cyanide	R	R							R	R	R					R	R	R
Mercuric Sulfate	R	R							R	R	R		R	R	R	R	R	R
Mercurous Nitrate	R	R							R	R	R							
Mercury	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R

[1] Polyvinyl Chloride, Type 1, Grade 1
[2] Chlorinated Polyvinyl Chloride
† For drainage application only
* R* Recommended to 210°F. — Data to 210°F. for other chemicals presently not available

(continued)

TABLE 1.69: VARIOUS THERMOPLASTIC AND ELASTOMERIC PIPING MATERIALS—NIBCO (continued)

CHEMICAL	PVC[1]		CPVC[2]		POLYPROPYLENE				PVDF				VITON			EPDM		
	73°F	140°F	73°F	185°F*	73°F	120°F	150°F	180°F†	73°F	150°F	230°F	280°F	73°F	140°F	185°F	73°F	140°F	210°F
Methane	R	R							R	R	R		R	R	R	NR	NR	NR
Methylene Chlorobromide	NR	NR																
Methoxyethyl Oleate	R																	
Methylamine	NR	NR																
Methyl Bromide	NR	NR							R	R	R	R	R	R	R	NR	NR	NR
Methyl Cellosolve	NR	NR							R	R	R	R	NR	NR	NR	R	NR	NR
Methyl Chloride	NR	NR							R	R	R	R	R	R	R	NR	NR	NR
Methyl Chloroform	NR	NR							R	R								
Methyl Ethyl Ketone	NR	NR	NR	NR	R	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	R	NR	NR
Methyl Isobutyl Ketone	NR	NR	NR	NR	R	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Methyl Methacrylate	R												NR	NR	NR	NR	NR	NR
Methyl Sulfate	R	NR							R	R	R	R						
Methyl Sulfuric Acid	R	R							R									
Methylene Bromide	NR	NR							NR	NR	NR	NR				NR	NR	NR
Methylene Chloride	NR	NR			NR	NR	NR	NR	NR	NR	NR	NR	R	NR	NR	NR	NR	NR
Methylene Iodine	NR	NR							NR	NR	NR	NR						
Methylisobutyl Carbinol					R	R												
Milk	R	R	R						R	R	R		R	R	R	R	R	R
Mineral Oil	R	R	R	R	R	R	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Molasses	R	R			R								R	R	R	R	R	R
Monoethanolamine	NR	NR							NR	NR	NR	NR	R	R	R	R	NR	NR
Motor Oil	R	R	R	R	R	NR	NR	NR					R	R	R	NR	NR	NR
Naphtha	R	R	R						R	R	R	R	R	R	R	NR	NR	NR
Naphthalene	NR	NR							R	R	NR	NR	R	R	R	NR	NR	NR
Natural Gas	R	R			R								R	R	R	NR	NR	NR
Nickel Acetate	R												NR	NR	NR	R	R	R
Nickel Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Nickel Nitrate	R	R							R	R	R	R	R	R	R	R	R	R
Nickel Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Nicotine	R	R							R	NR	NR	NR						
Nicotinic Acid	R	R							R	R	R							
Nitric Acid, 10%	R	R	R	R					R	R	NR	NR	R	R	R	R	NR	NR
Nitric Acid, 30%	R	R	R	R*	R	R			R	R	NR	NR	R	R	R	R	NR	NR
Nitric Acid, 40%	R	R	R	R*	R	NR	NR	NR	R	R	NR	NR	R	R	R	NR	NR	NR
Nitric Acid, 50%	R	R	R	NR	R	NR	NR	NR	R	R	NR	NR	R	R	R	NR	NR	NR
Nitric Acid, 70%	R	NR	R	NR	NR	NR	NR	NR	R	NR	NR	NR	R	R	R	NR	NR	NR
Nitric Acid, 100%	NR	NR			NR	NR	NR	NR	NR	NR	NR	NR	R	NR	NR	NR	NR	NR
Nitrobenzene	NR	NR			R	NR	NR	NR	R	NR	NR	NR	R	NR	NR	NR	NR	NR
Nitroglycerine	NR	NR																
Nitrous Acid, 10%	R	NR			NR	NR	NR	NR	R	R	R							
Nitrous Oxide	R	NR			R								R					
Nitroglycol	NR	NR																
Oils, Vegetable	R	R	R	R	R								R	R	R	NR	NR	NR
Oleic Acid	R	R	R	R	R	R	R		R	R	R		R	NR	NR	NR	NR	NR
Oleum	NR	NR			NR	NR	NR	NR	NR	NR	NR	NR	R	R	R	NR	NR	NR
Oxalic Acid	R	R	R	R	R				R	NR	NR	NR	R	R	R	R	R	R
Oxalic Acid, 50%	R	R	R	R	R	R	R	R	R	NR	NR	NR	R	R	R	R	R	R
Oxygen, Gas	R	R	R	R	R	R	R		R	R	R	R	R	R	R	NR	NR	NR
Ozone	R	R							R	R	R	R	R	R	R	R	R	R
Palmitic Acid					R	R	R	R	R	R	R		R	R	R	R	NR	NR
Palmitic Acid, 10%	R	R	R		R	R	R	R	R	R	R		R	R	R	R	NR	NR
Palmitic Acid, 70%	R	NR	R		R	R	R	R					R	R	R			
Paraffin	R	R											R	R	R			
Peracetic Acid, 40%	R	NR																
Perchloric Acid, 10%	R	NR	R	R	R				R	R			R	R	R	R	R	R
Perchloric Acid, 70%	R	NR	R	R	R				R				R	R	R	R	R	
Perphosphate	R																	
Petroleum Oils, Sour	R	R											R	R	R	NR	NR	NR
Petroleum Oils, Refined	R	R											R	R	R	NR	NR	NR
Phenol	NR	NR	R		R	NR	NR	NR	R	R	NR	NR	R	R	R	NR	NR	NR
Phenylhydrazine	NR	NR							R				R	R	R	NR	NR	NR
Phenylhydrazine Hydrochloride	NR	NR																
Phosgene, Liquid	NR	NR											NR	NR	NR	R		
Phosgene, Gas	R	NR											NR	NR	NR	R	R	

[1] Polyvinyl Chloride, Type 1, Grade 1
[2] Chlorinated Polyvinyl Chloride
† For drainage application only
* R* Recommended to 210°F — Data to 210°F for other chemicals presently not available

(continued)

TABLE 1.69: VARIOUS THERMOPLASTIC AND ELASTOMERIC PIPING MATERIALS—NIBCO (continued)

CHEMICAL	PVC[1]		CPVC[2]		POLYPROPYLENE				PVDF				VITON			EPDM		
	73°F	140°F	73°F	185°F*	73°F	120°F	150°F	180°F†	73°F	150°F	230°F	280°F	73°F	140°F	185°F	73°F	140°F	210°F
Phosphoric Acid, 10%	R	R	R	R*	R	R	R	R	R	R	R	R	R	R	R	R	R	
Phosphoric Acid, 50%	R	R	R	R*	R	R	R	R	R	R	R		R	R	R	R	R	
Phosphoric Acid, 85%	R	R	R	NR	R	R	R	R	R	R	R	NR	R	R	R	R	R	
Phosphorus Yellow	R	NR																
Phosphorus, Red	R	R																
Phosphorus Pentoxide	R	NR							R	R	R					R	R	
Phosphorus Trichloride	NR	NR							R	R	R		R	R	R	R	R	R
Photographic Solutions	R	R	R	R	R	R	R						R	R	R			
Picric Acid	NR	NR			R				R				R	R	R	R	R	
Plating Solutions, Brass	R	R	R	R	R	R	R	R					R	R	R	R	R	R
Plating Solutions, Cadmium	R	R	R	R	R	R	R	R					R	R	R	R	R	R
Plating Solutions, Chrome	R	R	R	R*	R	R	R	R					R	R	R	R	R	R
Plating Solutions, Copper	R	R	R	R*	R	R	R	R					R	R	R	R	R	R
Plating Solutions, Gold	R	R	R	R	R	R	R	R					R	R	R	R	R	R
Plating Solutions, Lead	R	R	R	R*	R	R	R	R					R	R	R	R	R	R
Plating Solutions, Nickel	R	R	R	R*	R	R	R	R					R	R	R	R	R	R
Plating Solutions, Rhodium	R	R	R	R	R	R	R	R					R	R	R			
Plating Solutions, Silver	R	R	R	R	R	R	R	R					R	R	R	R	R	R
Plating Solutions, Tin	R	R	R	R*	R	R	R	R					R	R	R	R	R	R
Plating Solutions, Zinc	R	R	R	R	R	R	R	R					R	R	R	R	R	R
Potash	R	R							R	R	R	R				R	R	
Potassium Alum	R	R							R	R	R	R				R	R	R
Potassium Aluminum Sulfate									R	R	R	R				R	R	R
Potassium Amyl Xanthate	R	NR																
Potassium Bicarbonate	R	R	R	NR									R	R	R			
Posassium Bichromate	R	R							R	R	R							
Potassium Bisulfate	R	R							R	R	R		R	R	R			
Potassium Borate	R	R														R	R	R
Potassium Bromate	R	R			R	R	R	R					R	R	R	R	R	R
Potassium Bromide	R	R			R	R	R	R	R	R	R	R	R	R	R	R	R	R
Potassium Carbonate	R	R			R	R	R	R	R	R	R	R	R	R	R	R	R	R
Potassium Chlorate, Aqueous	R	R			R	R	R	R	R	R	R	R	R	R	R	R	R	
Potassium Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Potassium Chromate	R	R							R	R	R	R				R		
Potassium Chlorate	R	R			R	R	R		R	R	R	R	R	R	R	R	R	
Potassium Cyanide	R	R	R	R					R	R	R	R	R	R	R	R	R	R
Potassium Dichromate	R	R	R	R					R	R	R	R	R	R	R	R	R	R
Potassium Ethyl Xanthate	R	NR																
Potassium Ferricyanide	R	R							R	R	R	R	R	R	R	R	R	R
Potassium Ferrocyanide	R	R							R	R	R	R	R	R	R	R	R	R
Potassium Fluoride	R	R											R	R	R			
Potassium Hydroxide	R	R	R	R	R	R	R		R	R			NR	NR	NR	R	R	R
Potassium Hypochlorite																		
Potassium Iodide					R				R	R	R					R	R	
Potassium Nitrate	R	R							R	R	R	R	R	R	R	R	R	R
Potassium Perborate	R	R																
Potassium Perchlorate	R	R														R	R	
Potassium Permanganate, 10%	R	R			R	R	R		R	R	R	R				R	R	R
Potassium Permanganate, 25%	R	NR			R	R	R		R	R	R	R				R	R	R
Potassium Persulfate	R	R														R	R	R
Potassium Sulfate	R	R			R	R	R	R	R	R	R	R	R	R	R	R	R	R
Propane	R	R	R						R	R	R	R	R	R	R	NR	NR	NR
Propylene Dichloride	NR	NR																
Propylene Oxide	NR	NR							NR	NR	NR	NR	NR	NR	NR	R		
Pyridine	NR	NR			R	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Pyrogallic Acid	R	NR							R	R								
Salicylic Acid	R	R							R	R			R	R	R	R	R	R
Salicylaldehyde	NR	NR							R	NR	NR	NR						
Selenic Acid	R	R																
Silicic Acid	R	R														R	R	
Silicone Oil	R	NR			R	R	R						R	R	R	R	R	
Silver Cyanide	R	R	R	R					R	R	R	R				R	R	R
Silver Nitrate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Silver Sulfate	R	R							R	R	R		R	R	R	R	R	R

[1] Polyvinyl Chloride, Type 1, Grade 1
[2] Chlorinated Polyvinyl Chloride
† For drainage application only
* R* Recommended to 210°F — Data to 210°F for other chemicals presently not available

(continued)

TABLE 1.69: VARIOUS THERMOPLASTIC AND ELASTOMERIC PIPING MATERIALS—NIBCO (continued)

CHEMICAL	PVC[1]		CPVC[2]		POLYPROPYLENE				PVDF				VITON			EPDM		
	73°F	140°F	73°F	185°F*	73°F	120°F	150°F	180°F†	73°F	150°F	230°F	280°F	73°F	140°F	185°F	73°F	140°F	210°F
Soaps	R	R	R	R	R								R	R	R	R	R	R
Sodium Acetate	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR	NR	R	R	R
Sodium Alum	R	R							R	R	R	R				R	R	R
Sodium Benzoate	R	R							R	R	R	R				R	R	R
Sodium Bicarbonate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Bichromate	R	R														R	R	R
Sodium Bisulfate	R	R			R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Bisulfite	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Borate					R								R	R	R	R	R	R
Sodium Bromide	R	R			R	R	R	R	R	R	R	R				R	R	R
Sodium Carbonate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Chlorate	R	NR			R	R	R	R	R	R	R	R	R	R	R	R	R	NR
Sodium Chloride	R	R	R	R*	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Chlorite	NR	NR	R													R	R	R
Sodium Cyanide	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Dichromate	R	R	R	R	R	R	R	R										
Sodium Ferricyanide	R	R																
Sodium Ferrocyanide	R	R	R	R														
Sodium Fluoride	R	R							R	R	R	R						
Sodium Hydroxide, 15%	R	R	R	R	R	R	R	R	R	R	R		R	NR	NR	R	R	R
Sodium Hydroxide, 30%	R	R	R	R*	R	R	R	R	R	R	R		R	NR	NR	R	R	R
Sodium Hydroxide, 50%	R	R	R	R*	R	R	R	R	R	R			R	NR	NR	R	R	
Sodium Hydroxide, 70%	R	R			R	R	R	R					R	NR	NR			
Sodium Hypochlorite	R		R	R	R	R	NR	NR	R	R	R	R	R	R	R	R	R	
Sodium Iodide																		
Sodium Metaphosphate					R				R	R	R	R	R	R	R	R	R	R
Sodium Nitrate	R	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR	R	R	R
Sodium Nitrite	R	R							R	R	R	R				R	R	R
Sodium Palmitate Solution, 5%					R													
Sodium Perborate	R	R			R								R	R	R	R	R	R
Sodium Perchlorate	R	R																
Sodium Peroxide	R	R							R	R	R	R	R	R	R	R	R	R
Sodium Phosphate, Alkaline					R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Phosphate, Acid					R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Phosphate, Neutral					R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Silicate					R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Sulfate	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R
Sodium Sulfide	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R
Sodium Sulfite	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Thiosulfate	R	R			R	R	R		R	R	R	R	R	R	R	R	R	R
Sour Crude Oil	R	R							R	R	R	R	NR	NR	NR	NR	NR	NR
Stannic Chloride	R	R	R	R					R	R	R	R	R	R	R	R	R	R
Stannous Chloride	R	R	R	R					R	R	R	R	R	R	R	R	R	R
Starch	R	R											R	R	R	R	R	R
Stearic Acid	R	R	R	R	R											NR	NR	NR
Stoddard's Solvent	NR	NR							R	R	R	R	R	R	R	NR	NR	NR
Succinic Acid	R	R			R	R	R		R	R	R							
Sulfamic Acid, 20%	R	R			R	R	R	R										
Sulfated Detergents																		
Sulfate Liquors					R													
Sulfite Liquor	R	R											R	R	R			
Sulfur	R	R			NR	NR	NR	NR	R	R	R		NR	NR	NR	R	R	R
Sulfur Chloride					NR	NR	NR	NR	R				R	R	R	NR	NR	NR
Sulfur Dioxide, Dry	R	R	NR		R				R	R	R		NR	NR	NR	R	R	R
Sulfur Dioxide, Wet	R	NR	NR		R				R	R			NR	NR	NR	R	R	R
Sulfur Trioxide	R	R							NR	NR	NR	NR	R	R	R			
Sulfur Trioxide, Gas	R	R							NR	NR	NR	NR	R	R	R			
Sulfuric Acid, 10%	R	R	R	R*	R	R	R	R	R	R	R		R	R	R	R	R	R
Sulfuric Acid, 30%	R	R	R	R*	R	R	R	R	R	R	R		R	R	R	R	R	
Sulfuric Acid, 50%	R	R	R	R*	R	R	R	NR	R	R	R	NR	R	R	R	R	R	
Sulfuric Acid, 60%	R	R	R	R*	R	R	R	NR	R	R	R	NR	R	R	R	R	R	
Sulfuric Acid, 70%	R	R	R	R*	R	R	NR	NR	R	R	NR	NR	R	R	R	R	R	
Sulfuric Acid, 80%	R	R	R	R*	R	NR	NR	NR	R	R	NR	NR	R	R	R	NR	NR	NR
Sulfuric Acid, 90%	R	NR	R	NR	NR	NR	NR		R	R	NR	NR	R	R	R	NR	NR	NR

[1] Polyvinyl Chloride, Type 1, Grade 1
[2] Chlorinated Polyvinyl Chloride
† For drainage application only
* R* Recommended to 210°F. — Data to 210°F. for other chemicals presently not available

(continued)

TABLE 1.69: VARIOUS THERMOPLASTIC AND ELASTOMERIC PIPING MATERIALS—NIBCO (continued)

CHEMICAL	PVC[1]		CPVC[2]		POLYPROPYLENE				PVDF				VITON			EPDM		
	73°F	140°F	73°F	185°F*	73°F	120°F	150°F	180°F†	73°F	150°F	230°F	280°F	73°F	140°F	185°F	73°F	140°F	210°F
Sulfuric Acid, 93%	R	NR	R	NR	NR	NR	NR		R	R	NR	NR	R	R	R	NR	NR	NR
Sulfuric Acid, 94%	NR	NR	R	NR	NR	NR	NR		R	R	NR	NR	R	R	R	NR	NR	NR
Sulfuric Acid, 95%	NR	NR	R	NR	NR	NR	NR		R	R	NR	NR	R	R	R	NR	NR	NR
Sulfuric Acid, 96%	NR	NR	R	NR	NR	NR	NR		R	NR	NR	NR	R	R	R	NR	NR	NR
Sulfuric Acid, 98%	NR	NR	R	NR	NR	NR	NR		R	NR	NR	NR	R	R	R	NR	NR	NR
Sulfuric Acid, 100%	NR	NR	NR	NR	NR	NR	NR	NR					R	R	R	NR	NR	NR
Sulfurous Acid	NR	NR			R	R	R		R	R	R		R	R	R	NR	NR	NR
Tall Oil	R	R							R	R	R	R						
Tannic Acid	R	R	R	R	R	R	R	R	R	R	R					R	R	
Tanning Liquors	R	R	R	R									R	R	R			
Tar													R	R	R	NR	NR	NR
Tartaric Acid	R	R			R	R	R		R	R	R		R	R	R	NR	NR	NR
Tetraethyl Lead	R	NR							R	R	R	R	R	R	R	NR	NR	NR
Tetrahydrodurane	NR	NR							NR	NR	NR	NR				NR	NR	NR
Tetrahydrofuran	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	R	NR	NR	NR	NR	NR
Tetra Sodium Pyrophosphate	R	R																
Thionyl Chloride	NR	NR																
Thread Cutting Oils	R															NR	NR	NR
Tirpineol	NR	NR														NR	NR	NR
Titanium Tetrachloride	NR	NR											R	R	R	NR	NR	NR
Toluene, Toluol	NR	NR	NR	NR	NR	NR	NR	NR	R	R	NR	NR	R	R	R	NR	NR	NR
Tomato Juice					R	R	R	R	R	R			R	R	R			
Transformer Oil	R	R			R	R	NR	NR					R	R	R	NR	NR	NR
Transformer Oil DTE/30																NR	NR	NR
Tributyl Phosphate	NR	NR							R	NR	NR	NR	NR	NR	NR	R	NR	NR
Tributyl Citrate	R																	
Trichloroacetic Acid	R	R			R	R	R		R	NR	NR	NR	NR	NR	NR	R	NR	NR
Trichloroethylene	NR	NR	NR	NR	NR	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Triethanolamine	R	NR							R	NR	NR	NR	NR	NR	NR	R	NR	NR
Triethylamine	R	R							R	NR	NR	NR	R	R	R			
Trimethylpropane	R	NR																
Trisodium Phosphate	R	R	R	R	R	R	R		R	R	R	R	R	R	R			
Turpentine	R	R	R		NR	NR	NR	NR	R	R	R	R	R	R	R	NR	NR	NR
Urea	R	R	R	R	R	R	R	R	R	R	R		R	R	R	R	R	R
Urine	R	R			R	R	R	R					R	R	R	R	R	R
Vaseline	NR	NR			R	R	R	NR								NR	NR	NR
Vinegar	R	R	R	NR	R	R	R		R	R	R		R	R	R	R	R	R
Vinegar, White					R	R	R		R	R	R		R	R	R	R	R	R
Vinyl Acetate	NR	NR							R	R	R					R		
Water	R	R	R	R*	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Water, Acid Mine	R	R	R	R					R	R	R		R	R	R			
Water, Demineralized	R	R	R	R*	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Water, Distilled or Fresh	R	R	R	R*	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Water, Potable	R	R	R	R*	R	R	R	R					R	R	R	R	R	R
Water, Salt	R	R	R	R*	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Water, Sea	R	R	R	R*	R				R	R	R	R	R	R	R	R	R	R
Water, Sewage	R	R	R	R	R	R	R	R	R	R	R		R	R	R			
Whiskey	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R
White Liquor	R	R	R	R					R	R	R		R	R	R			
Wines	R	R	R	R	R	R	R		R	R	R		R	R	R	R	R	
Xylene (Xylol)	NR	NR	NR	NR	NR	NR	NR	NR	R	R			R	R	R	NR	NR	NR
Zinc Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Zinc Nitrate	R	R							R	R	R	R	R	R	R	R	R	R
Zinc Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

[1] Polyvinyl Chloride, Type 1, Grade 1
[2] Chlorinated Polyvinyl Chloride
† For drainage application only
* R* Recommended to 210°F. — Data to 210°F for other chemicals presently not available

VITON: trade name for vinylidene fluoride-hexafluoropropylene copolymer.

TABLE 1.70: VARIOUS THERMOPLASTIO POLYMERS FOR HOSE STOCKS—GATES RUBBER

Stock Type	Composition
G	Plasticized Polyvinyl Chloride
Z	Polyamide Resins (Nylon 610)
Y	Polyester Elastomer (Hytrel)
E	Ethylene Vinyl Acetate (EVA)
U	Polyurethane
O	Special Material (Gates Tufflex Hose)

GATES CHEMICAL RATING SYSTEM

"1" **Excellent Resistance** — This fluid is expected to have minor or no effect on the polymer.

"2" **Good Resistance** — This polymer should give reasonably satisfactory service. Due to the nature of this chemical and under prolonged continuous exposure, the stock may exhibit minor to moderate deterioration and/or solution discoloration. Environmental changes such as temperature, concentration, etc., may promote increased degradation.

"x" **Not Recommended** — The stock is unsatisfactory for this chemical and should not be used.

"-" **(Dash)** — Insufficient or no data is available for this material. Testing is advised.

Note 1: The above ratings as applied to the Chemical Resistance Tables are intended as guides only. They are compiled from the best data available to us. Ratings shown in the tables are based on a temperature of 70°F. and 100% concentrated or saturated solutions unless otherwise noted.

Note 2: If unusual conditions exist, a stock test in the fluid is suggested.

Note 3: Where a chemical listed in the Resistance Tables is soluble in a solvent other than water, the solvent should also be checked for its suitability with the stock.

Note 4: Discoloration of fluids conveyed in hose — There are no generally accepted standard tests for measuring or rating discoloration of fluids passing through a hose.

The amount of discoloration that can be tolerated is usually established by the user on the basis of application. Obviously, products such as paint must be conveyed through a hose having very good nondiscoloring characteristics. If the product is not visually affected, then the hose is satisfactory. For some products, the discoloration may not be objectionable from a visual standpoint. However, the amount and makeup of the particles causing discoloration may be objectionable if they affect the final use of the product.

Some of the more common methods of checking discoloration are:

1. Allowing the fluid to remain in a sample piece of hose for a given period, and then inspecting visually for discoloration.

2. Testing fluid as in No. 1 above and then passing it through filter paper to check foreign content.

3. A more refined test can be made with a spectrophotometer. This instrument measures light transmission through the fluid before and after immersion tests with the stocks. This gives a relative rating expressed in percent, the original fluid being rated as 100%.

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL RESISTANCE TABLE

CHEMICAL	HOSE POLYMER TYPES G	Z	Y	E	U	Q
A						
Acetaldehyde	X	2	1	2	1	—
Acetamide	—	—	1	—	—	—
Acetic Acids	Use Chemical Hoses					
Acetone	X	1	1	X	X	X
Acetophenone	—	—	2	X	—	X
Acetylene	Use Welding Hoses					
Acrylonitrile	1	—	1	—	—	—
Aero-Safe 2300	—	—	X	—	—	—
Aeroshell, 1A, 1AC, 4	—	—	1	—	—	—
Air, Ambient	1	1	1	1	1	1
Air, 150°F	2	1	1	—	2	2
Air, 180°F	X	2	1	—	—	X
Air, 200°F	X	X	1	—	—	X
Aircraft Hyd. Oil AA	—	—	1	—	—	—
Alcohol, Amyl	1	—	1	—	—	2
Alcohol, Butyl	1	—	—	2	—	—
Alcohol, Furfural	—	1	1	—	—	—
Alcohol, Ethyl	1	—	2	2	—	—
Alcohol, Isopropyl	2	—	2	2	—	—
Alcohol, Methyl (6%)	1	—	2	—	—	2
Alcohol, Methyl (100%)	2	—	2	—	—	—
Alkazene	—	—	—	—	—	—
Aluminum Chloride	1	—	1	2	—	—
Aluminum Fluoride	1	—	—	1	—	—
Aluminum Hydroxide	1	—	1	—	—	1
Aluminum Nitrate	1	—	—	—	—	1
Aluminum Sulfate	1	1	—	1	—	1
Alum 5	1	1	1	1	—	1
Ammonia, Anhydrous	No Hose Available					
Ammonia, Aqueous	1	1	1	1	—	1
Ammonium Acetate	1	—	1	1	—	—
Ammonium Bicarbonate	1	—	1	—	—	2
Ammonium Carbonate	1	2	1	1	2	2
Ammonium Chloride	1	X	1	1	1	1
Ammonium Hydroxide	Use Chemical Hoses					
Ammonia Metaphosphate	2	—	—	—	—	2
Ammonium Nitrate (Fertilizer)	1	1	1	1	1	1
Ammonium Nitrite	—	—	—	—	—	—
Ammonium Persulfate	—	—	—	—	—	—
Ammonium Phosphate	1	1	1	1	1	—
Ammonium Sulfate	1	1	1	1	1	2
Ammonium Sulfide	1	—	—	—	—	2
Ammonium Thiocyanate	—	—	—	—	—	—
Amyl Acetate	X	X	2	2	2	X
Amyl Borate	—	—	—	—	—	—
Amyl Chloride	2	—	2	X	—	X
Amyl Chloronaphthalene	—	—	—	—	—	—
Amyl Naphthalene	—	—	—	—	—	—
Amyl Phenol	—	—	—	—	—	—
Anethole	—	—	—	—	—	—
Aniline	—	2	X	X	X	—
Aniline Oils	2	2	1	—	1	X
Animal Fats	1	—	2	—	—	X
Anti-Freeze (Glycol)	1	1	1	—	—	1
Antimony Chloride (50%)	1	X	X	—	—	2
Antimony Salts	1	1	1	—	1	2
Aqua Regia	Use Chemical Hoses					
Arco A.T.F. Dexron	2	1	1	—	—	—
Arco A.T.F. Type 2	2	1	1	—	—	—
Arco C-2, 100	2	1	1	—	—	1
Aroclor, Monsanto	—	—	—	—	—	—
Aromatic Hydrocarbons	—	1	2	—	2	—
Arsenic Salts	1	1	1	—	1	X
Askarel (Transformer Oil)	X	—	1	—	—	X

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES					
	G	Z	Y	E	U	Q
A-Continued						
Asphalt, 180°F	—	1	1	1	1	X
ASTM Oil No 1	2	1	1	—	1	2
ASTM Oil No 2	X	1	1	—	1	X
ASTM Oil No 3	X	1	1	—	—	X
ASTM Ref. Fuel A	2	1	1	—	—	X
ASTM Ref. Fuel B	X	1	1	—	—	X
ASTM Ref. Fuel C	X	1	2	—	—	X
B						
Baltic Types 100, 150, 200, 300, 500	2	1	1	—	—	2
Banvel, Concentrated	—	2	—	—	—	—
Barium Carbonate	1	—	1	—	—	1
Barium Chloride	1	X	1	—	1	1
Barium Hydroxide			Use Chemical Hoses			
Barium Sulfate	1	1	2	—	—	2
Barium Sulfide	1	2	2	—	—	1
Basic Copper Arsenate	1	1	1	—	1	2
Baygon						
Beer			Use FDA Hoses			
Beet Sugar Liquors	1	1	1	1	1	1
Bellows, 80-20 Hydraulic Oil	2	1	1	—	2	X
Benzaldehyde	X	2	2	X	1	X
Benzene	X	1	2	X	2	X
Benzoic Acid			Use Chemical Hoses			
Benzyl Alcohol	1	1	2	—	2	2
Black Sulfur Liquor	1	2	2	—	—	2
Borax (Sodium Borate)	1	1	1	2	1	2
Bordeaux Mixture	1	1	1	—	1	2
Boric Acid	1	X	1	2	1	1
Boric Copper Sulfate	1	1	1	—	1	2
Brake Fluid (Petroleum)	2	1	1	—	—	X
Brake Fluid (Synthetic)	2	2	1	—	—	2
Brine (Salt)	1	1	1	—	1	1
Bunker Oil	—	2	2	—	2	X
Butane, Gas or Liquid			Use 20BHB Only			
Butter			Use FDA Hoses			
Butyl Acetate	—	1	2	X	—	X
Butyl Alcohol (Butanol)	1	1	1	1	1	2
C						
Calcium Arsenate	1	2	1	2	1	2
Calcium Bisulfate	2	—	—	—	—	—
Calcium Bisulfide	2	1	1	—	1	X
Calcium Bisulfite	1	2	1	1	—	2
Calcium Carbonate	1	1	1	1	1	1
Calcium Chlorate	1	—	—	—	—	X
Calcium Chloride	1	X	1	—	1	1
Calcium Hydroxide (Conc.)			Use Chemical Hoses			
Calcium Hypochlorite (5%)	1	2	2	1	—	2
Calcium Hypochlorite (15%)	2	X	—	1	—	X
Calcium Nitrate	1	1	—	—	—	1
Calcium Silicate	1	—	—	—	—	2
Calcium Sulfide	2	—	—	—	—	2
Cane Sugar Liquors	1	1	1	1	1	1
Carbolic Acid (Phenol)			Use Chemical Hoses			
Carbon Disulfide	X	1	1	—	2	X
Carbon Dioxide (Dry)	1	1	1	1	1	1
Carbon Dioxide (Wet)	1	1	1	1	—	2
Carbon Tetrachloride	X	1	2	X	X	X
Carbonic Acid			Use Chemical Hoses			
Carter Motor Oil	2	1	1	—	2	2

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES					
	G	Z	Y	E	U	Q
C-Continued						
Casein	1	1	1	—	—	1
Castor Oil	1	1	1	—	2	2
Caustic Potash (30%)			Use Chemical Hoses			
Caustic Soda (20%)			Use Chemical Hoses			
Cellosolve Acetate	—	2	2	—	—	—
Cellosolve, Union Carbide	2	2	2	—	—	X
Cellugard, Cellugard 200	1	1	1	—	—	2
Cellulube, 90, 150, 220, 300 550, 1000, 220A, ST220, A60	X	2	2	—	—	X
Chlorine Water (25%)	2	2	2	—	2	—
Chlorine Gas			No Hose Available			
Chlorine Trifluoride	X	—	—	—	—	X
Chlorobenzene	X	—	X	—	—	X
Chlorobromo Methane	X	—	X	—	—	X
Chlorodane	2	—	—	—	—	X
Chloroform	X	—	—	—	—	X
Chlorosulfonic Acid			No Hose Available			
Chlorotoluene			Use Chemical Hoses			
Chlorox	1	2	2	1	—	2
Chocolate Syrup	1	1	1	1	—	2
Chrome Alum	1	—	—	2	—	2
Chromic Acid			Use Chemical Hoses			
Chromium Salts	1	—	1	—	1	2
Cider	2	1	1	—	1	2
Citgo A.T.F. Type F; Dexron	2	1	1	—	2	2
Citgo FR Fluids	2	1	1	—	2	2
Citgo Glycol FR-20XD	2	1	1	—	2	2
Citgo Pacemaker	2	1	1	—	2	2
Citgo Sentry	2	1	1	—	2	2
Citgo Tractor Hyd. Fluids	2	1	1	—	2	2
Citric Acid	1	2	1	1	2	2
Coal Gas	1	—	1	—	1	—
Coal Tar	X	—	—	—	—	X
Coke Oven Gas	—	—	1	2	—	—
Condor Oils, 1000, 1002, 1004 1006, 1008, 1010, 1012, 1014, 1016	2	—	2	—	—	—
Copper Chloride	1	X	1	2	1	2
Copper Cyanide	1	—	2	—	—	2
Copper Nitrate	1	—	2	2	—	2
Copper Sulfate	1	1	1	2	1	1
Corn Oils	1	1	1	X	—	2
Cottonseed Oils	—	2	1	X	1	X
Creosote	X	X	X	X	X	X
Creosol (Cresylic Acid)			Use Chemical Hoses			
Crude Petroleum Oil	1	2	1	—	1	2
Cyclohexane	X	2	1	—	1	X
Cyclohexanol	X	2	1	X	—	X
Cyclohexanone	X	—	2	X	1	X
Cymene	X	—	—	—	—	X
D						
Dasco, FR150; FR200, FR200B, FR310	—	2	1	—	—	—
Dasco IFR	—	2	1	—	—	—
DC 200, 510, 550, 560	—	2	1	—	—	—
DDT Weed Killer (DIL.)	1	2	1	—	—	2
Decalin	—	2	2	—	—	—
Deionized Water			Contact Gates			
Dectol R & O Oils	2	1	1	—	2	2
Denatured Alcohol	1	2	1	—	—	1
Detergent Solutions	1	1	1	—	2	2
Developing Solutions	1	—	—	—	—	2
Dexron	2	1	1	—	—	—
Dextrin	1	2	1	—	—	1
Diacetone Alcohol	X	1	2	—	—	X
Diammonium Phosphate	1	1	2	—	—	2

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES					
	G	Z	Y	E	U	O
D-Continued						
Diazinon, Dilute	2	2	2	2	—	2
Dibutyl Phthalate	X	2	1	X	2	X
Dichlorobenzene	X	—	X	X	X	X
Dichloroethylene	—	2	2	X	—	—
Diesel Oil	—	1	1		1	—
Diethanolamine (20%)	2	2	2	—	2	—
Diethylamine	1	—	2	—	—	2
Diethyl Ether	2	—	2	—	2	2
Diethyl Glycol	1	1	1	1	1	1
Dioctyl Phosphate	X	—	2	—	2	X
Dioxane	X	—	2	X	—	X
Dow General Weed Killer (H_2O)	2	2	1	—	—	2
Dowtherm A	X	—	—	X	—	X
Duro FR-HD	X	—	X	—	—	X
Duro Oils	2	1	1	—	—	2
DP 47, 200 Fluid (Dow)	—	—	1	—	—	—
E						
Enamels	2	1	1	—	—	X
Energol HL68	—	—	1	—	—	—
Energol HLPC68	—	—	1	—	—	—
E P Hydraulic Oils, Chevron	2	1	1	—	—	X
Essential Oils	2	1	1	—	1	X
Ethanolamine	2	—	1	—	—	X
Ethers	2	X	2	—	2	X
Ethyl Acetate	X	1	2	1	2	X
Ethyl Alcohol (Ethanol)	2	1	1	1	2	2
Ethyl Chloride	X	—	X	—	X	X
Ethyl Ether	X	—	2	—	—	X
Ethyl Mercaptan	X	—	—	—	—	X
Ethylene Chloride	X	1	X	—	X	X
Ethylene Chlorohydrin	X	—	X	—	X	X
Ethylene Glycol	1	1	1	1	1	1
F						
Factovis 52	—	—	1	—	—	—
Fatty Acids	1	—	1	—	1	X
Ferric Chloride	1	—	1	1	—	X
Ferric Sulfate	1	—	1	1	—	2
Ferrous Chloride	1	—	1	1	—	2
Ferrous Nitrate	2	—	2	—	—	2
Ferrous Sulfate	1	—	1	1	—	2
Fire Resistant Hyd. Fluid (Texaco)	—	—	1	—	—	—
Fixing Solution (Photo)	1	—	—	—	—	—
Fluorboric Acid			Use Chemical Hoses			
Fluorine Liquid			No Hose Available			
Fluosilicic Acid			Use Chemical Hoses			
Formaldehyde (37%)	1	1	2	1	2	—
Formic Acid			Use Chemical Hoses			
FR Fluid D	—	—	1	—	—	—
FR Hydraulic Fluid	—	—	1	—	—	—
FRM	—	—	1	—	—	—
Freon (all types)			Special Hose Required			
Fruit Juices	X	—	1	2	1	—
Fuel Oil	—	2	1	—	1	—
Fumaric Acid			Use Chemical Hoses			
Furan (Furfuran)	X	—	—	—	—	X
Furfural (Ant Oil)	X	—	2	2	—	X
Fyrguard 150, 200, 225	—	2	1	—	—	—
Fyrquel 90, 150, 220, 300, 550, 1000, 15R & O, 220R & O, 550R & O	—	2	1	—	—	—

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES					
	G	Z	Y	E	U	Q
G						
Gallic Acid			Use Chemical Hoses			
Gas, Natural			Contact Gates			
Gasoline, Regular Unleaded	X	—	1	X	X	X
Gasoline, Regular, Leaded	X	—	1	X	X	X
Gasoline, Premium	X					X
Gasohol	X					X
Gelatin	1	1	1	1	1	1
Glucose	1	1	1	1	1	1
Glue	1	2	1	1	1	—
Glycerine (Glycerol)	1	1	1	1	1	1
Glycol FR Fluids	—	1	1	—	—	—
Grease	1	1	1	—	1	2
Gulf FR Fluid G-200	1	1	1	X	X	X
Gulf FR Fluid P37, P40, P43, P45, P47	—	1	1	X	X	X
H						
Heptachlor (in Petroleum)	2	—	2	—	—	—
Heptane	2	2	1	X	1	X
Hexane	2	—	1	—	1	X
Houghto-Safe 271, 416 520, 526, 616, 620 625, 640	—	1	2	—	2	—
Houghto-Safe 5046, 5046W	—	2	1	—	—	—
Hy-Chock Oil	—	2	1	—	—	—
Hydra Fluid, AZR & O, A, B, AA, C	—	2	1	—	—	—
Hydra Fluid 760	—	2	1	—	—	—
HydraSol A	—	2	1	—	—	—
Hydraulic Fluid HF-31	—	—	—	—	—	—
Hydraulic Fluid HF-18, HF-20	2	1	1	—	2	2
Hydraulic Fluid (Std. Petroleum)	1	1	1	—	2	2
Hydraulic Fluid (Phosphate Ester)	1	2	1	—	2	2
Hydraulic Fluid (Water Glycol)	1	1	1	2	1	2
Hydraulic Fluid (Texaco Safety 200, 300)	1	2	1	2	1	2
Hydraulic Oils (Shell)	2	2	1	—	2	2
Hydrazine	—	—	—	—	—	—
Hydrobromic Acid			Use Chemical Hoses			
Hydrochloric Acid			Use Chemical Hoses			
Hydrocyanic Acid			Use Chemical Hoses			
Hydro-drine Oil	2	2	1	—	2	—
Hydrofluoric Acid			Use Chemical Hoses			
Hydrofluosilicic Acid			Use Chemical Hoses			
Hydrogen			Contact Gates			
Hydrogen Chloride			Use Chemical Hoses			
Hydrogen Fluoride	—	—	—	—	—	—
Hydrogen Peroxide (10°)	1	2	—	2	1	X
Hydrogen Peroxide (Over 10%)			Use Chemical Hoses			
Hydrogen Sulfide			Contact Gates			
Hydrolubric Oil (Houghton)	2	2	1	—	2	2
Hydrolube (Water Glycol)	1	2	1	—	1	2
Hypochlorous Acid						
I						
Imol, Imol 5150, 5220, 5300, 5500	2	2	1	—	2	2
Industron	2	2	1	—	2	2
Ink, Printers	—	—	—	—	—	—
Insulating Oil, Transformer	2	1	1	—	2	X
Iodine	X	—	X	—	—	X
Iodine, in Alcohol	1	1	1	2	—	X
Irus Fluid 902	2	1	1	—	1	2
Irus Fluid 905	2	1	1	—	1	2
Isobutane			Use LPG Hoses Only			
Isobutyl Alcohol	2	2	2	—	—	2
Iso Octane	X	1	1	—	2	X
Iso Propyl Acetate	X	2	2	—	2	X
Iso Propyl Alcohol (Isopropanol)	2	1	1	2	2	2
Iso Propyl Ether	X	—	1	—	—	X

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS–GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES					
	G	Z	Y	E	U	Q
I-Continued						
Iso Cyanate (Toluene Di-Isocyanate)	—	—	2	—	1	—
J						
Jet Fuel JP-3	X	2	1	X	2	X
Jet Fuel JP-4	X	2	1	X	—	X
Jet Fuel JP-5	X	2	1	X	—	X
Jet Fuel JP-6	X	—	—	X	—	X
Jet Fuel JP-X	X	—	—	X	—	X
K						
Karo Syrup	2	1	1	1	1	2
Kerosene	2	—	2	—	—	X
Ketones	—	—	2	—	—	—
L						
Lacquers	X	1	2	X	—	X
Lacquer Solvents	X	1	2	X	2	X
Lactic Acid			Use Chemical Hoses			
Lasso (Ag Spray)	—	1	1	—	—	—
Lead Acetate	1	2	2	1	—	2
Lead Arsenate	1	1	1	—	1	2
Lead Sulfate	2	1	1	—	1	2
Lead, Tetraethyl	—	—	1	—	—	—
Lead, Tetramethyl	—	—	2	—	1	—
Lime	1	1	1	—	1	2
Lime Bleach	2	2	2	1	—	2
Lime Sulfur	2	2	1	—	—	2
Lindane (Ag Spray)	—	2	2	—	—	—
Linseed Cake	—	—	1	—	1	—
Linseed Oil (Boiled)	1	2	1	X	1	—
Liquid Soap	2	—	2	—	—	—
Lubricating Oils	2	1	1		2	—
Lubricating Oils (Diester)	X	1	2	—	X	X
M						
Machine Oil	2	1	1	X	—	2
Magnesium Carbonate	1	1	1	—	1	1
Magnesium Chloride	1	1	1	1	1	2
Magnesium Hydroxide			Use Chemical Hoses			
Magnesium Nitrate	1	—	1	—	—	2
Magnesium Sulfate	1	1	1	1	1	2
Magnus-Light	2	1	1	—	—	2
Magnus-Medium	2	1	1	—	—	2
Malathion (Ag. Spray C on C)	—	1	2	—	—	—
Malathion (Ag Spray Dilute)	1	1	1	1	—	1
Malic Acid			Use Chemical Hoses			
Manganese Salts	1	1	1	—	—	2
Manganese Sulfate	1	—	—	—	—	1
Maximul (Hyd. Fluid)	2	1	1	—	—	—
Mayonnaise	2	—	1	—	—	2
Melamine Varnish	—	—	—	—	—	—
Mercuric Chloride	2	1	1	1	2	2
Mercuric Cyanide	—	—	—	—	—	—
Mercurous Nitrate	—	—	—	—	—	—
Mercury	1	1	1	1	2	—
Mercury Salts	1	—	—	2	—	—
Metallic Soaps	1	—	—	—	—	—
Mesityl Oxide	X	—	—	—	—	X
Methane			Contact Gates			
Methoxychlor (Insecticide)	—	—	2	—	—	—
Methyl Acetate	X	1	2	—	—	X
Methyl Acrylate	—	—	—	—	—	—
Methyl Alcohol (Methanol)	1	1	1	2	2	2
Methyl Amine (25% Aqueous Soln)	—	—	2	—	—	—

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES G	Z	Y	E	U	O
M-Continued						
Methyl Amine (60%)	—	—	2	—	—	—
Methyl Amine (99%)	—	—	—	—	—	—
Methyl Amyl Carbinol	—	—	2	—	—	—
Methyl Bromide	X	—	X	—	X	X
Methyl Butyl Ketone (MBK)	X	1	2	—	—	X
Methyl Cellosolve	—	1	1	—	—	—
Methyl Chloride	X	1	—	—	—	X
Methyl Ethyl Ketone (MEK)	X	2	X	—	X	X
Methyl Formate	—	—	—	—	—	—
Methyl Isobutyl Ketone (MIBK)	X	2	X	—	X	X
Methyl Isopropyl Ketone	X	2	X	—	X	X
Methyl Methacrylate	—	—	—	—	—	—
Methyl Salicylate	—	—	—	—	—	—
Methyl Sulfate	—	1	1	—	1	—
Methylene Chloride	X	X	X	X	—	X
Methylene Dichloride	X	X	X	X	—	X
Milk	1	1	1	1	1	1
Mineral Oil	1	1	1	2	1	1
Mineral Spirits	—	—	—	—	—	—
Mobile Hydraulic Oils	2	1	1	—	2	2
Mobilmet S 122	2	1	1	—	2	2
Molasses	2	1	1	1	1	2
Monochlorobenzene	X	X	X	X	X	X
Motor Oils	2	1	1	—	2	2
Muriatic Acid (Hydrochloric)			Use Chemical Hoses			
Mustard	—	1	1	—	—	—
N						
Naphtha (Low Aromatic Content)	X	2	2	—	—	X
Naphthalene						
Natural Gas			Contact Gates			
Nickel Acetate	—	—	2	—	—	—
Nickel Chloride	1	—	2	1	—	2
Nickel Nitrate	2	2	2	—	—	2
Nickel Salts	2	—	2	1		2
Nickel Plating Solution			Use Chemical Hoses			
Nickel Sulfate	1	2	1	1	—	2
Nicotine	1	2	1	—	1	2
Niter Cake (Sodium Bisulfate)	1	1	1	—	1	1
Nitric Acid			Use Chemical Hoses			
Nitrobenzene	X	X	X	X	X	X
Nitroethane	—	—	—	—	—	—
Nitrogen	1	1	1	1	1	1
Nitrogen Oxide up to 50%	1	1	1	—	—	2
Nitromethane	—	—	2	X	—	—
Nitropropane	—	—	2	X	—	—
Nitrous Acid			Use Chemical Hoses			
Nyvac FR Fluid	2	1	1	—	—	2
Nyvac FR 200 Fluid	2	1	1	—	—	2
Nyvac 20 (WG) 30 (WG)	2	1	1	—	—	2
n-Octane	—	—	2	—	—	—
O						
Octyl Alcohol	2	—	2	—	—	—
Oil (SAE)	2	1	1	—	1	2
Oil of Turpentine	1	1	1	—	1	2
Oils, Animal	2	—	2	—	—	—
Oils, Mineral	2	1	1	—	1	2
Oils, Vegetable	2	1	1	X	—	2
Oleic Acid	2	1	1	X	1	—
Oleum (Fuming Sulfuric Acid)			Use Chemical Hoses			
Olive Oil	2	2	2	X	—	—

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES					
	G	Z	Y	E	U	O
O-Continued						
OS 45 Hydraulic Fluid (Silicate Ester Base)	—	1	2	—	2	—
Oxalic Acid			Use Chemical Hoses			
Oxygen	X	—	—	1	—	X
Ozone	1	1	2	—	1	2
P						
Pacemaker Types 150T, 300T 500T (Citgo)	2	1	1	—	2	2
Paint	—	1	—	—	—	—
Paint Solvents (Oil Base)	—	2	2	—	—	—
Paints (Oil Base)	—	1	—	—	—	—
Palm Oil	—	1	1	—	—	—
Palmitic Acid	—	1	1	X	1	—
Paraffin (Petroleum)	—	1	1	—	—	X
Paraformaldehyde	1	1	2	1	2	—
Peanut Oil	2	1	1	—	—	2
Pennant Motor Oils	2	1	1	—	2	2
Pentachlorophenol in Oil	—	—	—	—	—	—
Pentane			Use 20BHB Only			
Perchloric Acid			Use Chemical Hoses			
Perchloroethylene	X	—	X	—	—	X
Pentasol	2	—	2	—	—	2
Petroleum Oils	2	1	1	—	2	2
Petroleum Oils (Sour)	2	—	2	X	—	2
Petroleum Oils (Refined)	2	1	1	—	2	2
Phenol (Carbolic Acid)			Use Chemical Hoses			
Phenolates	2	2	2	—	2	2
Phorone	—	—	—	—	—	—
Phosphate Esters (to 150°F)	—	1	1	—	—	—
Phosphate Esters (above 150°F)	—	2	2	—	—	—
Phosphoric Acid			Use Chemical Hoses			
Photographic, Developers	—	—	—	—	—	—
Photographic, Emulsions	—	—	—	—	—	—
Photographic, Fixing Solutions	—	—	—	—	—	—
Phthalic Acid			Use Chemical Hoses			
Picric Acid (Water Solution)	1	2	2	—	—	—
Pine Oil	—	—	—	—	—	—
Pinene	—	—	2	—	—	—
Piperazine Hydrochloride Solution (34%)	—	—	—	—	—	—
Pitch	X	—	2	—	—	X
Plating Solution (Chrome)			Use Chemical Hoses			
Polyester Resin	—	2	2	—	—	—
Polyurethane (to 125°F)	—	—	—	—	—	—
Potassium Acetate	1	—	—	—	—	—
Potassium Bromide	1	1	1	—	2	2
Potassium Bicarbonate	1	1	1	—	—	2
Potassium Bisulphite	1	—	1	—	—	2
Potassium Bromate	1	—	1	—	—	2
Potassium Carbonate	1	1	1	1	2	2
Potassium Chlorate	1	2	1	1	2	2
Potassium Chromate	1	2	—	—	—	2
Potassium Chloride	1	1	1	1	2	1
Potassium Cuprocyanide	1	2	1	—	—	—
Potassium Dichromate	1	2	2	2	—	—
Potassium Ferrocyanide	1	—	2	2	—	2
Potassium Fluoride	1	—	2	—	—	—
Potassium Hydroxide (10%)			Use Chemical Hoses			
Potassium Hydroxide (30%)			Use Chemical Hoses			
Potassium Hydroxide (50%)			Use Chemical Hoses			
Potassium Iodide	1					
Potassium Nitrate	1	1	1	—	1	2
Potassium Permanganate	X	X	X	—	—	X
Potassium Permanganate (5%)	X	X	X	—	—	X
Potassium Persulfate	1	—	—	—	—	2
Potassium Phosphate	—	—	—	—	—	—
Potassium Sulfate	1	1	1	—	1	1

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES					
	G	Z	Y	E	U	Q
P-Continued						
Potassium Sulfide	1	—	1	—	—	2
Potassium Sulfite	2	—	—	—	—	2
Potassium Thiosulfate	1	—	—	—	—	2
Powerlube (Carter)	2	1	1	—	2	2
Primatol A. S. P (Agric Spray)	—	—	2	—	—	—
Propane Gas		Use 20BHB Only				
Propionic Acid		Use Chemical Hoses				
Propyl Acetate	—	—	—	—	—	—
Propyl Alcohol (Propanol)	2	1	1	—	2	2
Propylene Glycol	—	2	2	—	—	—
Purina Insecticide	—	2	2	—	—	—
Puropale RX Oils	2	1	1	—	2	2
Pydraul F-9	—	2	2	—	2	—
Pydraul 50E	X	1	1	—	2	X
Pydraul 150	X	2	2		2	X
Pydraul A-200	X	X	X		X	X
Pydraul 280	X	2	2		2	X
Pydraul 312	X	1	1		2	X
Pydraul 540	X	X	X	X	X	X
Pydraul 625	X	2	2		2	X
Pydraul 10E 29E LT, 30E, 65E, 11-SE	X	—	X	—	—	X
Pydraul, 135	—	2	2	—	—	—
Pyrene (Carbon Tetrachloride)	X	—	X	—	—	X
Pyrethrum	1	—	—	—	1	2
Pyridine (50%)	X	—	X	2	1	X
Pyrogard 51, 53, 55	—	—	2	—	—	—
Pyrogard 160, 230, 630	—	—	—	—	—	—
Pyrogard C, D	2	1	1	—	2	2
Pyronal (Transformer Oil)	—	—	—	—	—	—
R						
Ramrod (Ag. Spray)	—	1	2	—	—	—
Rando Oils	—	1	1	—	2	—
Rape Seed Oil	—	2	—	—	—	—
Red Oil (Comm. Oleic Acid)	—	1	1	—	—	—
Refined Wax (Petroleum)	—	1	1	—	2	—
Regal Oils (R & O)	2	1	1	—	2	2
Ritchfield "A" Weed Killer	2	—	2	—	—	2
Rosin (Light)	2	1	1	1	—	—
Rubilene Oils	2	1	1	—	2	2
S						
Safetytex 215	—	—	X	—	—	—
Salicylic Acid	—	—	X	—	—	—
Salt Water (Sea Water)	1	1	1	1	1	1
Santosafe W-G15, W-G20, W-G30	2	1	1	—	2	2
Sauerkraut	2	—	—	1	—	2
SCC 7204 (Stauffer)	—	—	—	—	—	—
Sevin	—	1	1	—	—	—
Sewage	2	2	2	—	—	X
SFR Fluid B (Shell)	—	—	2	—	—	—
SFR Fluid C (Shell)	—	—	2	—	—	—
Shellac	—	1	1	—	—	—
Silicone Grease	2	1	1	—	—	2
Silicone Oils	2	1	1	—	—	2
Silver Cyanide	1	—	—	—	—	2
Silver Nitrate	2	1	1	2	—	2
Skydrol 500 A & 7000	X	1	2	—	—	X
Soap Solutions	1	1	1	2	1	1
Soda Ash (Sodium Carbonate)	1	1	1	1	1	1
Soda Water	1	1	1	1	1	1
Sodium Acetate	1	1	1	—	2	2
Sodium Benzoate	1	—	—	—	—	—
Sodium Bicarbonate	1	1	1	1	1	1
Sodium Bisulfate (Niter Cake)	1	1	1	1	1	1
Sodium Bisulfite	1	1	1	1	1	1
Sodium Borate	1	1	1	1	1	1
Sodium Carbonate	1	1	1	1	1	1
Sodium Chlorate	1	1	1	2	1	1
Sodium Chloride	1	1	1	1	1	1
Sodium Cyanide	1	1	1	1	1	1

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES					
	G	Z	Y	E	U	Q
S-Continued						
Sodium Dichromate	1	—	1	—	—	1
Sodium Ferricyanide	1	—	2	—	—	1
Sodium Ferrocyanide	1	—	2	—	—	1
Sodium Fluoride (70%)	1	—	2	—	—	1
Sodium Hydrosulfide	1	—	—	—	—	1
Sodium Hydrosulfite	2	—	—	—	—	2
Sodium Hydroxide (10%)			Use Chemical Hoses			
Sodium Hydroxide (40%)			Use Chemical Hoses			
Sodium Hydroxide (50%, 115°F)			Use Chemical Hoses			
Sodium Hydroxide (50%, 180°F)			Use Chemical Hoses			
Sodium Hydroxide (60%)			Use Chemical Hoses			
Sodium Hypochlorite (5%)	1	1	2	1	X	2
Sodium Hypochlorite (20%)	1	2	—	—	X	2
Sodium Hyposulfate	1	—	—	—	—	1
Sodium Metaphosphate	1	1	1	—	—	2
Sodium Nitrate	1	1	1	1	1	1
Sodium Perborate	—	2	1	1	—	—
Sodium Peroxide	1	X	—	—	—	2
Sodium Phosphates	1	1	1	1	1	1
Sodium Silicate	1	1	1	1	1	1
Sodium Sulfate	1	1	1	1	1	1
Sodium Sulfide	1	1	1	1	1	1
Sodium Sulfite	1	1	1	2	1	1
Sodium Thiosulfate (HPO)	1	1	1	1	1	1
Sodium Tripolyphosphate (STPP)	—	—	—	—	—	—
Solnus Oils	1	1	1	—	2	2
Solvac 1535 G	2	1	1	—	—	2
Soybean Oil	2	1	1	—	—	2
Stannic Chloride	2	X	2	—	—	1
Stannous Chloride	1	2	1	—	1	2
Stanoil No. 15, 18, 25, 31, 35, 51	2	1	1	—	2	2
Starch	1	1	1	1	1	1
Staysol FR	2	1	1	—	2	2
Stearic Acid	1	—	1	X	1	2
Stearin	—	2	1	—	1	—
Stoddard Solvent	2	2	X	—	X	X
Straight Synthetic Oils (phosphate ester, phosphate ester base)	2	1	1	—	2	2
Styrene (Monomer)			Use Chemical Hoses			
Sulfamic Acid			Use Chemical Hoses			
Sulfate Liquors	1	1	1	1	1	1
Sulfur (200%F)			Contact Gates			
Sulfur Chloride	2	2	—	—	—	—
Sulfur Dioxide (Dry)	1	X	X	1	—	—
Sulfur Dioxide (Liquid)	X	—	—	—	—	X
Sulfur Dioxide (Moist)	X	—	—	—	—	X
Sulfur Hexaflouride (Gas)	2	1	1	—	—	2
Sulfur Trioxide (Dry)	1	—	1	—	—	2
Sulfuric Acid			Use Chemical Hoses			
Sulfurous Acid			Use Chemical Hoses			
Sun R & O Oils	2	1	1	—	2	2
Sunsafe F	2	1	1	—	2	2
Suntrac HP Oils	2	1	1	—	2	2
Suntac WR Oils	2	1	1	—	2	2
Sunvis Oils (700, 800, 900)	2	1	1	—	2	2
Super Hydraulic Oils	2	1	1	—	2	2
303 Fluid (Conoco)	2	1	1	—	2	2
Synthetic Oil (Citgo)	2	1	1	—	2	2
T						
Tall Oil	—	—	2	—	—	—
Tallow	2	1	1	—	—	2
Tannic Acid (10%)	1	1	2	X	—	2
Tar (Bituminous)	—	—	2	—	—	—
Tar Oil	2	1	1	—	2	—
Tartaric Acid	1	1	1	—	—	—
Tellus Oils	2	2	1	—	—	2
Tenol Oils	2	1	1	—	2	2
Terpineol	2	2	1	—	—	—

(continued)

TABLE 1.70: VARIOUS THERMOPLASTIC POLYMERS FOR HOSE STOCKS—GATES RUBBER (continued)

CHEMICAL	HOSE POLYMER TYPES					
	G	Z	Y	E	U	Q
T-Continued						
Terresstic	2	1	1	—	—	2
Tetraethyllead (TEL)	—	2	2	—	—	—
Tetrahydrofuran (THF)	2	1	2	X	—	2
Tetralin	—	2	2	X	—	—
Thiopen	—	—	2	X	—	—
Toluene (Toluol)	—	1	2	—	—	—
Toluene Diisocyanate	Use Chemical Hoses					
Transformer Oil (Petroleum Type)	2	1	1	—	2	2
Transformer Oil (Askarel Types)	Use Chemical Hoses					
Transmission Fluid (Type A)	—	2	2	—	—	—
Tributoxyethyl Phosphate	—	2	2	—	—	—
Tributyl Phosphate	—	—	2	—	X	—
Trichloroethylene	Use Chemical Hoses					
Tricresyl Phosphate (Skydrol)	—	2	2	—	—	—
Triethanolamine (TEA)	2	—	X	—	—	—
Tripolyphosphate (STPP)	—	—	—	—	—	—
Tung Oil	—	—	X	—	—	—
Turpentine	1	1	1	X	1	2
Tycol Avalon 50, 51, 60	2	1	1	—	2	2
Tycol A Turbio 37, 50, 58, 60	2	1	1	—	2	2
U						
Ucon MI	2	1	1	—	2	2
Ucon Hydrolube Types 150CP, 200CP, 275CP, 300CP, 550CP, 900CP, 150DB, 275DB, 150LT, 200LT, 275LT, 300LT, 200NM, 300NM	2	1	1	—	2	2
Union C-2 Fluid	2	1	1	—	2	2
Union C-P Oil	2	1	1	—	2	2
Union ATF Dexron	2	1	1	—	2	2
Union ATF Type F	2	1	1	—	2	2
Union Hydraulic Oil AW	2	1	1	—	2	2
Union Hydraulic Tractor Fluid	2	1	1	—	2	2
Urea Solution	2	2	1	—	2	2
V						
Varnish	—	1	2	—	—	—
Vegetable Oils	2	1	2	—	2	2
Versilube F-50, F-44	2	1	1	—	2	2
Vinegar	1	—	—	—	—	1
Vinyl Acetate	Use Chemical Hoses					
Vinyl Chloride (Monomer)	X	—	1	—	—	X
Vitrea Oils	2	1	1	—	2	2
W						
Water	1	1	1	1	1	1
Water (Potable)*	1	1	1	1	1	1
Water (Brine)	1	1	1	1	1	1
Water (Demineralized)	Contact Gates					
Water (Distilled)	1	1	1	1	1	1
Water Glycols	1	1	1	1	1	1
Water in Oil Emulsions	1	1	1	—	2	2
White & Bagley No. 2190 Cutting Oil	—	—	2	—	—	—
Wood Oil	1	1	1	—	1	2
X						
Xylene (Xylol)	X	2	2	X	2	X
Z						
Zeric	2	2	1	—	2	2
Zinc Acetate	1	X	2	—	—	—
Zinc Chloride Solutions	2	1	2	—	—	2
Zinc Hydrate	1	—	2	—	2	—
Zinc Oxide	1	—	—	—	—	2
Zinc Sulfate Solutions	2	2	2	—	—	2

*FDA Hoses Required

Rubbers and Elastomers

TABLE 2.1: ACRYLIC ELASTOMER—AMERICAN CYANAMID

CYANACRYL is especially noted for its ability to withstand most lubricating oils at 350°F (176°C), including those sulfur modified lubricants, essential in the performance of hot running modern cars. Other petroleum based oils, such as high and low aniline point lubricating aliphatic hydrocarbons offer opportunities for outstanding performance by CYANACRYL. Resistance to chlorinated hydrocarbons, degreasers, LP gases, fuel oils, animal and vegetable oils and silicate esters is very good. Aromatic hydrocarbons, such as toluol, have some moderate to severe effects but ketones, some alcohols and oxgenated solvents can cause severe swelling. Nonpetroleum based brake fluid, phosphate ester, and diester synthetic lubricants can have a severe effect so CYANACRYL should be tested in these environments before using. CYANACRYL shows "fair" resistance to dilute and concentrated acids and bases. Therefore, caution or a "test first" method is suggested when considering it for this type of application.

Fluid Resistance Data for CYANACRYL Acrylic Elastomer (Volume Change, %)

Fluid	Room Temp.		212°F(100°C)			250°F(121°C)		300°F(149°C)	
	24 hrs	1 wk	7 hrs	1 wk	2 wks	70 hrs	1 wk	70 hrs	1 wk
Ethyl Acetate	118								
Amyl Acetate	193								
MEK	110								
Varsol	1.8								
Toluene	212								
Kerosene	0.85								
Naphtha	5.9								
Acetone	90								
Trichlorethylene	196								
Perchlorethylene	167								
Reference Fuel A	3.3								
Reference Fuel B	45								
Reference Fuel C	80								
Leaded gasoline	28								
Lead free gasoline	332								
Water		7 to 14		27					
Freon # 12		8.0							
# 2 Diesel Fuel		21.9							
Silicone Fluids		0 to -5.0							
Ethylene glycol				30				26	
Elco # 28 Oil (SAE 140)						10	14		
Texaco TL 3450 (ATF)						12	11		
Wheel Bearing Grease						1	5		
Regular SAE # 20 Oil								1.2	1.5
Premium SAE # 20 Oil								1.2	1.7
Premium 10W - 30 Oil								2.3	3.5
Premium Outboard Motor Oil								2.0	2.0
ATF - Type A								0.5	3.0
ATF - Type C									3.0
Hydraulic Fluid								−1.5	2.0
Mil O-6081								13.0	
Hytran Tractor Fluid								6.6	
ATF Chrysler MS4228								6.7	
Anti-Freeze								28	
Lubrizol GL-5 (SAE 140)							3		
Jet II Hydrocarbon Fluid					60			75	

NOTE: All values in this table are (+) unless otherwise noted.

TABLE 2.2: FLUOROELASTOMER–ELKHART RUBBER

In many applications, AFLAS outperforms other elastomers because of the following characteristics: (1) High temperature resistance (400°F long term; 550+°F shorter term); (2) Resistance to a wide range of chemicals (including acids, bases, steam, sour (H_2S) oil and gas with amine corrosion inhibitors, oils and lubricants, hydraulic fluids of all types, brake fluids, bleaches, oxidizing agents, alcohol, etc.); (3) Durable physical properties; (4) Excellent electrical resistance–Dielectric constant at 60 Hz of 2.5.

There are three grades of AFLAS. All provide essentially the same heat and chemical resistance but they differ in molecular weight (which can affect processing and physical properties). AFLAS 150E is the lowest molecular weight, AFLAS 150P is intermediate weight, and AFLAS 100H is the highest molecular weight. AFLAS 100H is generally recommended for optimal extrusion, gas blistering, and compression set resistance.

The following chart provides an indication of the chemical resistance of AFLAS. Since temperature, concentrations, mixtures, and elastomer compound selection can affect performance, this chart provides guidelines only. Unless otherwise noted, the tests were run on a 75 Shore A carbon black filled AFLAS 150P formulation with the following properties:

Original Properties of Test Formulation

Shore A Hardness	Tensile Strength (psi)	Elongation @ Break
75	2500	120%

Where available, the chart shows the change in hardness (in Shore A points) and volume as well as the percentage of original tensile strength and elongation retained after immersion in the test fluid under the time and temperature conditions denoted. In other instances, volume change only is shown.

MEDIA RESISTANCE GUIDELINES

Acids	E	Amines	G to E
Animal and Vegetable Oils	E	Oils and Lubricants (incl. synthetics. SF CD, etc.)	G to E
Bases	E	Oxidizing Agents	G to E
Brake Fluids	E	Sour (H_2S) Oil and Gas with Corrosion Inhibitors	G to E
Hydraulic Fluids (incl. phosphate esters, Mil-H-5606, water/glycol, etc.)	E	Benzene, Xylene, etc.	F to G
Steam/Water/Brine	E	Fuels	F to G
Radiation	E	Ketones	F
Weathering/Ozone	E	Chloroform	P
Alcohol	G to E		

E - Excellent G - Good F - Fair P - Poor

CHEMICAL	Test Condition: Temp °F	Test Condition: Time Days	Property Retention After Test: Retained Tensile Strength (%)	Retained Elongation (%)	Hardness Change Shore A (Points)	Volume Change (%)
Acetic Acid	73	7				71.0
Acetic acid/10% Sodium chlorite	212	1	67	105	-16	24.0
Acetone	73	7				50.0
Acetyl acetone	73	3				54.0
Aeroshell Grease #7*	176	2				8.0
Amine Corrosion Inhibitors (see Oil-field Media)						
Ammonia (28%)	158	3				3.2
	73	90				1.0
Ammonium hydroxide (28%)	73	7				1.0
	73	180				2.5
	158	3	82	116	-1	3.2
Aniline	73	7				.7
ASTM Oil #1	212	3				1.8
	350	3				4.1
ASTM Oil #3	212	3				7.9
	350	3	70	100	-9	13.0
Benzene	73	7				31.0
Benzene/Methanol 30/70	73	7				12.0
50/50	73	7				21.0
Bleaching powder 10% ($CaCl_2O$)	212	7	112	89	-2	0.0
Bromine	73	7	54	136	not measured	6.2
Bromine 32%/ Hydrochloric acid 18%/Sulfuric acid 25%	212	1	66	112	-8	6.0
Calcium hypochlorite 10%	212	7				0
Caproic acid	73	7				16.8
Carbon tetrachloride	73	7				86.0
Castrol 325*	176	2				6.0

(continued)

TABLE 2.2: FLUOROELASTOMER–ELKHART RUBBER (continued)

CHEMICAL	Test Condition: Temp °F	Test Condition: Time Days	Property Retention After Test: Retained Tensile Strength (%)	Retained Elongation (%)	Hardness Change Shore A (Points)	Volume Change (%)
Chlorine solution (saturated)	Test in progress					
Chlorine solution (Sat.)/ 35% Sodium chloride/ 10% Sodium hypochlorite	212	2.5	69	78	-9	5.9
Chloroform	73	7				112.0
Chromic acid (62%)	73	7	90	98	-2	1.7
Chromic acid (46%)/ Sulfuric acid (25%)	73	7	115	117	-1	2.6
Cyclohexane	73	7				13.0
Cyclohexanone	73	7				22.0
Diesel Fuel #2	212	3	75	103	-18	9.0
95 Shore A Compound	302	3	70	121	-5	20.2
Diethyl ether	73	1				42.0
Dioctyl Cebacate	212	3				8.8
	350	3				20.0
Dioxane	73	3				57.0
Dowtherm 209*	212	3				6.3
Ethyl acetate	73	7				88.0
Ethyl benzene	73	7				22.0
Ethyl benzoate	73	7				26.7
Ethylene Chlorohydrin	73	7				0.0
Ethylene glycol/Water/ Nalcool 2000* 50/50/ 4 oz. per gallon	100H/150P blend compound					
	324	14	106	106	+2	1.1
Exxon Caloria HT43*	500	4	58	164	-8	11.0
Freon TF	Dissolves Aflas 150P					
Fuel B	73	7				58.0
Gasoline	73	7				25.0
Hydrochloric acid (37%)	73	7	100	107	-1	.2
	73	180				4.5
	158	3	57	112	-2	7.0
Hydrochloric acid (20%)	158	3	58	85	-6	7.4
Hydrofluoric acid (50%)	73	7	63	117	+1	1.5
	73	180				4.1
Hydrogen peroxide (30%)	212	7	105	99	0	-1.1
Isoamyl alcohol	73	7				0.0
Iso-Octane	73	7				19.0
Kerosene	73	7				2.0
KF/HF (1/1.8)	185	3	94	111	-3	.4
Lacquer thinner	73	7				53.3
Light oil	73	7				5.0
Lithium Bromide (58%)	320	11	106	106	+1	-0.3
Lithium chromate	392	11	99	110	+1	-0.3
Methyl alcohol	73	7				0.2
Methyl cellosolve	73	7				1.4
Methyl chloroform	73	7				125.0
Methyl ether ketone	73	7				58.0
Mil-H-5606	212	3				12.0
Mil-L-7808	212	3				6.0
Mobil 1 5W-30*	400	3	82	111	-6	8.4
Mobil Super 10W-40*	400	3	84	107	-6	10.1
n-hexane	73	7				24.0
Naphtha	73	7				4.0
Nitric acid fuming	73	7	42	126	-7	19.0
	73	180				15.0
Nitric acid (98%)	73	30				21.0
Nitric acid (60%)	73	7	94	95	-1	0.0
	73	180				5.1
	158	3	44	107	-3	10.0
Nitric acid (20%)	73	7	105	114	-1	0.0
	158	3	42	90	-13	25.0
Nitrobenzene	73	7				5.6
OILFIELD MEDIA						
Amine corrosion inhibitors (mineral/black filled compound)	NOTE: Aflas remained elastomeric and did not embrittle in Oilfield Media tests					
1% KW44* in water	212	3	90	150	-1	1.8
10% KW44* in water	212	3	81	144	-4	6.8
1% NACE A in water	324	14	56	194	-4	7.7
Sour gas, wet (35% H_2S, 50% CH_4, 15% CO_2, 10 ml H_2O)	400	4	69	86	-3	3.0
Sour oil, wet with 5% NACE B corrosion inhibitor	350	6	40	111	-15	8.6
(47.5% ASTM #1 oil, 47.5% H_2O, 5% NACE B: Mixed gas 35% H_2S 15% CO_2, 50% CH_4 under pressure)						
Skydrol 500*	176	2				14.6
Skydrol 500B*	212	3				14.0
Skydrol 500 B4*	176	2				17.2
Sodium chloride (35%)/ Sodium hypochlorite (10%) Saturated chlorine solution	212	2.5	69	78	-9	5.9
Sodium chlorite (10%)	212	7	80	93	-12	22.0
Sodium hydroxide 50%	73	7	108	116	+2	1.2
	212	3	101	116	-1	1.1
Sodium hydroxide 20%	73	7	85	104	-1	-0.3
	212	3	95	117	-3	2.0
Sodium hypochlorite (10%)	212	7	100	95	-1	1.0
Sour (H_2S) gas and oil (See Oilfield Media)						
Stauffer 7700*	350	3	80	120	-10	18.0
Steam (90 Shore A cmpd)	320	7	91	84	-3	4.6
	392	10	73	97	-4	1.6
	392	30	62	100	-5	1.3
	550	4	65	145	-1	1.6
Sulfur dioxide (5%)	104	2	69	84	-4	7.8
Sulfuric acid fuming	73	7	76	98	-2	4.2
	73	180				7.4
Sulfuric acid (96%)	73	7	98	99	-3	0.4
	73	180				2.3
	212	3	99	101	-3	4.4
Sulfuric acid (60%)	73	7	103	98	-1	0.1
	212	3	107	104	+1	0.4
Sulfuric acid (20%)	73	7	102	105	-1	0.5
	212	3	99	98	-3	0.4
Toluene	73	7				41.0
Trichloroethylene	73	7				95.0
Trichlorotrifluoroethane	73	7				249.0
Wagner 21B* brake fluid	300	3	87	120	-8	9.0
Water	212	3	89	117	0	1.1
Xylene	73	7				30.0

** The above information was obtained from published technical literature.*

TABLE 2.3: FLUOROSILICONE RUBBERS—DOW CORNING

FLUID RESISTANCE OF SILASTIC LS-53U FLUOROSILICONE RUBBER*

Fluids	Immersion Conditions	Durometer, Points Change	Tensile Strength, Percent Change	Elongation, Percent Change	Volume Swell, Percent Change
ASTM Reference Fuel B	1 day/23 C (73 F)	-9	-42	-36	+22
	1 week/23 C (73 F)	-9	-37	-36	+22
	4 weeks/23 C (73 F)	-8	-39	-38	+22
ASTM Reference Fuel C	1 day/23 C (73 F)	-10	-43	-38	+25
	1 week/23 C (73 F)	-11	-38	-38	+25
	4 weeks/23 C (73 F)	-8	-38	-38	+25
	1 day/Reflux	-11	-42	-44	+29
10% Methanol/90% No-Lead Gas	1 day/23 C (73 F)	-12	-57	-49	+26
	1 week/23 C (73 F)	-13	-57	-38	+25
10% Ethanol/90% No-Lead Gas	1 day/23 C (73 F)	-11	-49	-31	+23
	1 week/23 C (73 F)	-11	-48	-33	+22
ASTM No. 1 Oil	70 hrs/150 C (302 F)	-4	0	—	0
ASTM No. 3 Oil	70 hrs/150 C (302 F)	-6	-30	—	+4
Jet Fuel, JP-4	70 hrs/23 C (73 F)	-5	-35	—	+12
Jet Fuel, JP-8	1 day/23 C (73 F)	-7	-9	-3	+6
	1 week/23 C (73 F)	-7	-7	-5	+7
MIL-H-5606 (PQ4226)	70 hrs/135 C (275 F)	-7	-13	—	+10
MIL-L-7808F (Brayco 880 G)	70 hrs/150 C (302 F)	-14	-33	—	+13
Di-2-ethylhexyl sebacate with 0.5% phenothiazine	48 hrs/150 C (302 F)	-7	-70	—	+8
Skydrol† 500A	70 hrs/121 C (250 F)	-26	-80	—	+28

*Obtained by adding 1.0 phr Varox to SILASTIC LS-53U fluorosilicone rubber. Slabs 0.075 inch thick were press cured 10 min/171 C (340 F) and post cured 4 hrs/200 C (392 F) prior to testing.
†Skydrol is a registered trademark of Monsanto Industrial Chemical Company.

FLUID RESISTANCE OF SILASTIC LS-63U FLUOROSILICONE RUBBER*

Fluids	Immersion Conditions	Durometer, Points Change	Tensile Strength, Percent Change	Elongation, Percent Change	Volume Swell, Percent Change
ASTM Reference Fuel B	1 day/23 C (73 F)	-14	-17	-10	+18
	1 week/23 C (73 F)	-13	-21	-13	+20
	4 weeks/23 C (73 F)	-14	-17	-13	+20
ASTM Reference Fuel C	1 day/23 C (73 F)	-16	-23	-16	+22
	1 week/23 C (73 F)	-16	-27	-19	+22
	4 weeks/23 C (73 F)	-13	-20	-16	+22
	1 day/Reflux	-14	-23	-33	+27
10% Methanol/90% No-Lead Gas	1 day/23 C (73 F)	-19	-47	-35	+28
	1 week/23 C (73 F)	-19	-49	-26	+26
10% Ethanol/90% No-Lead Gas	1 day/23 C (73 F)	-18	-37	-19	+22
	1 week/23 C (73 F)	-16	-37	-16	+21
ASTM No. 1 Oil	70 hrs/150 C (302 F)	+1	-3	-10	+1
ASTM No. 3 Oil	70 hrs/150 C (302 F)	-4	-27	-13	+4
Jet Fuel, JP-4	70 hrs/23 C (73 F)	-6	-25	-20	+10
Jet Fuel, JP-8	1 day/23 C (73 F)	-9	-8	-0	+4
	1 week/23 C (73 F)	-9	-13	-6	+5
MIL-H-5606 (PQ-4226)	70 hrs/135 C (275 F)	-7	+5	-10	+7
MIL-L-7808G (Stauffer Jet 1)	70 hrs/150 C (302 F)	-10	-25	-25	+10
Skydrol† 500A	70 hrs/70 C (158 F)	-15	-22	-7	+18

*Obtained by adding 1.0 phr Varox to SILASTIC LS-63U fluorosilicone rubber. Slabs 0.075 inch thick were press cured 10 min/171 C (340 F) and post cured 4 hrs/200 C (392 F) prior to testing.
†Skydrol is a registered trademark of Monsanto Industrial Chemicals Company.

FLUID RESISTANCE OF SILASTIC LS-70 FLUOROSILICONE RUBBER*

Fluids	Immersion Conditions	Durometer, Points Change	Tensile Strength, Percent Change	Elongation, Percent Change	Volume Swell, Percent Change
ASTM Reference Fuel B	1 day//23 C (73 F)	-12	-12	-10	+17
	1 week/23 C (73 F)	-12	-13	-10	+17
	4 weeks/23 C (73 F)	-10	-16	-14	+18
ASTM Reference Fuel C	1 day/23 C (73 F)	-10	-16	-14	+17
	1 week/23 C (73 F)	-13	-16	-14	+19
	4 weeks/23 C (73 F)	-15	-20	-19	+20
	1 day/Reflux	-10	-29	-33	+27
10% Methanol/90% No-Lead Gas	1 day/23 C (73 F)	-19	-42	-33	+22
	1 week/23 C (73 F)	-17	-41	-19	+21
10% Ethanol/90% No-Lead Gas	1 day/23 C (73 F)	-16	-37	-19	+18
	1 week/23 C (73 F)	-15	-35	-14	+17
Jet Fuel, JP-8	1 day/23 C (73 F)	-5	-4	-0	+3
	1 week/23 C (73 F)	-4	-2	+10	+5

*Obtained by adding 1.0 phr Varox to SILASTIC LS-70 fluorosilicone rubber. Slabs 0.075 inch thick were press cured 10 min/171 C (340 F) and post cured 4 hrs/200 C (392 F) prior to testing.

FLUID RESISTANCE OF SILASTIC LS-2249U FLUOROSILICONE RUBBER*

Fluids	Immersion Conditions	Durometer, Points Change	Tensile Strength, Percent Change	Elongation, Percent Change	Volume Swell, Percent Change
ASTM Reference Fuel B	1 day/23 C (73 F)	-17	-29	-19	+15
	1 week/23 C (73 F)	-15	-29	-19	+14
	4 weeks/23 C (73 F)	-16	-29	-19	+15
ASTM Reference Fuel C	1 day/23 C (73 F)	-18	-33	-20	+17
	1 week/23 C (73 F)	-16	-40	-20	+16
	4 weeks/23 C (73 F)	-15	-37	-20	+15
	1 day/Reflux	-16	-53	-41	+20
10% Methanol/90% No-Lead Gas	1 day/23 C (73 F)	-23	-63	-37	+26
	1 week/23 C (73 F)	-20	-54	-24	+20
10% Ethanol/90% No-Lead Gas	1 day/23 C (73 F)	-18	-54	-30	+19
	1 week/23 C (73 F)	-17	-45	-20	+14
ASTM No. 1 Oil	70 hrs/150 C (302 F)	-1	-0	-2	+0
ASTM No. 3 Oil	70 hrs/150 C (302 F)	-82	-28	-22	+3
Jet Fuel, JP-4	70 hrs/23 C (73 F)	-10	-9	-0	+8
Jet Fuel, JP-8	1 day/23 C (73 F)	-8	-6	-0	+3
	1 week/23 C (73 F)	-9	-8	-7	+4
MIL-H-5606 (Univis† J-43)	70 hrs/135 C (275 F)	-6	-11	-11	+9
MIL-L-7808 (Turbo Oil No. 15)	70 hrs/177 C (350 F)	-19	-60	-22	+12
Di-2-ethylhexyl sebacate with 0.5% phenothiazine	48 hrs/150 C (302 F)	-12	-14	-18	+8

*Obtained by adding 1.0 phr Varox to SILASTIC LS-2249U fluorosilicone rubber. Slabs 0.075 inch thick were press cured 10 min/171 C (340 F) and post cured 4 hrs/200 C (392 F) prior to testing.
†Univis is a registered trademark of Humble Oil and Refining Company.

(continued)

TABLE 2.3: FLUOROSILICONE RUBBERS—DOW CORNING (continued)

FLUID RESISTANCE OF SILASTIC LS-2311U FLUOROSILICONE RUBBER*

Fluids	Immersion Conditions	Durometer, Points Change	Tensile Strength, Percent Change	Elongation, Percent Change	Volume Swell, Percent Change
ASTM Reference Fuel B	1 day/23 C (73 F)	-12	-14	-7	+14
	1 week/23 C (73 F)	-11	-14	-14	+14
	4 weeks/23 C (73 F)	-9	-16	-21	+14
ASTM Reference Fuel C	1 day/23 C (73 F)	-12	-15	-7	+17
	1 week/23 C (73 F)	-13	-17	-0	+17
	4 weeks/23 C (73 F)	-10	-15	-14	+17
	1 day/Reflux	-15	-15	-7	+20
10% Methanol/90% No-Lead Gas	1 day/23 C (73 F)	-15	-40	-29	+20
	1 week/23 C (73 F)	-17	-45	-29	+20
10% Ethanol/90% No-Lead Gas	1 day/23 C (73 F)	-12	-31	-0	+16
	1 week/23 C (73 F)	-13	-29	-0	+17
ASTM No. 1 Oil	70 hrs/150 C (302 F)	-2	+2	-8	+1
ASTM No. 3 Oil	70 hrs/150 C (302 F)	-2	+5	-17	+3
Jet Fuel, JP-4	70 hrs/23 C (73 F)	-10	-10	-17	+7
Jet Fuel, JP-8	1 day/23 C (73 F)	-4	-10	+7	+2
	1 week/23 C (73 F)	-7	-13	+7	+3
MIL-H-5606 (Univis† J-43)	70 hrs/137 C (275 F)	-5	+10	-17	+7
MIL-H-7808 (Turbo Oil No. 15)	70 hrs/177 C (350 F)	-6	-9	-17	+7
Di-2-ethylhexyl sebacate with 0.5% phenothiazine	48 hrs/150 C (302 F)	-5	+4	-8	+6
Skydrol** 500A	70 hrs/121 C (250 F)	-39	-74	-17	+7

*Obtained by adding 1.0 phr Varox to SILASTIC LS-2311U fluorosilicone rubber. Slabs 0.075 inch thick were press cured 10 min/171 C (340 F) and post cured 4 hrs/200 C (392 F) prior to testing.
†Univis is a registered trademark of Humble Oil and Refining Company.
**Skydrol is a registered trademark of Monsanto Industrial Chemicals Company.

FLUID RESISTANCE OF SILASTIC LS-2332U FLUOROSILICONE RUBBER*

Fluids	Immersion Conditions	Durometer, Points Change	Tensile Strength, Percent Change	Elongation, Percent Change	Volume Swell, Percent Change
ASTM Reference Fuel B	1 day/23 C (73 F)	-19	-3	-2	+17
	1 week/23 C (73 F)	-19	-2	-2	+17
	4 weeks/23 C (73 F)	-18	-1	-6	+17
ASTM Reference Fuel C	1 day/23 C (73 F)	-21	-3	-2	+19
	1 week/23 C (73 F)	-20	-4	-0	+18
	4 weeks/23 C (73 F)	-20	-4	-2	+18
	1 day/Reflux	-22	-33	-22	+25
10% Methanol/90% No-Lead Gas	1 day/23 C (73 F)	-23	-27	-11	+21
	1 week/23 C (73 F)	-28	-29	-3	+20
10% Ethanol/90% No-Lead Gas	1 day/23 C (73 F)	-21	-10	-2	+17
	1 week/23 C (73 F)	-21	-10	-5	+18
ASTM No. 1 Oil	70 hrs/150 C (302 F)	-0	—	—	+0
ASTM No. 3 Oil	70 hrs/150 C (302 F)	-0	—	—	+4
Jet Fuel, JP-4	70 hrs/23 C (73 F)	-6	—	—	+10
Jet Fuel, JP-8	1 day/23 C (73 F)	-8	-0	+5	+3
	1 week/23 C (73 F)	-11	-2	+3	+4
MIL-H-5606 (Univis† J-43)	70 hrs/57 C (135 F)	-4	—	—	+8
MIL-L-7808 (Turbo Oil No. 15)	70 hrs/150 C (302 F)	-12	—	—	+8
Di-2-ethylhexyl sebacate with 0.5% phenothiazine	48 hrs/150 C (302 F)	-7	—	—	+9

*Obtained by adding 1.0 phr Varox to SILASTIC LS-2332U fluorosilicone rubber. Slabs 0.075 inch thick were press cured 10 min/171 C (340 F) and post cured 4 hrs/200 C (392 F) prior to testing.
†Univis is a registered trademark of Humble Oil and Refining Company.

FLUID RESISTANCE OF SILASTIC LS-2323 FLUOROSILICONE BASE*

Fluids	Immersion Conditions	Durometer, Points Change	Tensile Strength, Percent Change	Elongation, Percent Change	Volume Swell, Percent Change
ASTM Reference Fuel B	1 day/23 C (73 F)	-12	-14	-7	+14
	1 week/23 C (73 F)	-11	-14	-14	+14
	4 weeks/23 C (73 F)	-9	-16	-21	+14
ASTM Reference Fuel C	1 day/23 C (73 F)	-12	-15	-7	+17
	1 week/23 C (73 F)	-13	-17	-0	+17
	4 weeks/23 C (73 F)	-10	-15	-14	+17
	1 day/Reflux	-15	-15	-7	+20
10% Methanol/90% No-Lead Gas	1 day/23 C (73 F)	-15	-40	-29	+20
	1 week/23 C (73 F)	-17	-45	-29	+20
10% Ethanol/90% No-Lead Gas	1 day/23 C (73 F)	-12	-31	-0	+16
	1 week/23 C (73 F)	-13	-29	-0	+17
ASTM No. 1 Oil	70 hrs/150 C (302 F)	-2	+2	-8	+1
ASTM No. 3 Oil	70 hrs/150 C (302 F)	-2	+5	-17	+3
Jet Fuel, JP-4	70 hrs/23 C (73 F)	-10	-10	-17	+7
Jet Fuel, JP-8	1 day/23 C (73 F)	-4	-10	+7	+2
	1 week/23 C (73 F)	-7	-13	+7	+3
MIL-H-5606 (Univis† J-43)	70 hrs/135 C (275 F)	-5	+10	-17	+7
MIL-H-7808 (Turbo Oil No. 15)	70 hrs/177 C (350 F)	-6	-9	-17	+7
Di-2-ethylhexyl sebacate with 0.5% phenothiazine	48 hrs/150 C (302 F)	-5	+4	-8	+6
Skydrol** 500A	70 hrs/121 C (250 F)	-39	-74	-17	+7

*Obtained by adding 1.0 phr Varox to SILASTIC LS-2323 fluorosilicone base. Slabs 0.075 inch thick were press cured 10 min/171 C (340 F) and post cured 4 hrs/200 C (392 F) prior to testing.
†Univis is a registered trademark of Humble Oil and Refining Company.
**Skydrol is a registered trademark of Monsanto Industrial Chemicals Company.

FLUID RESISTANCE OF SILASTIC LS-2380U FLUOROSILICONE RUBBER*

Fluids	Immersion Conditions	Durometer, Points Change	Tensile Strength, Percent Change	Elongation, Percent Change	Volume Swell, Percent Change
ASTM Reference Fuel B	1 day/23 C (73 F)	-11	-16	-18	+15
	1 week/23 C (73 F)	-10	-16	-18	+15
	4 weeks/23 C (73 F)	-9	-14	-24	+14
ASTM Reference Fuel C	1 day/23 C (73 F)	-11	-23	-24	+17
	1 week/23 C (73 F)	-11	-22	-18	+18
	4 weeks/23 C (73 F)	-10	-16	-24	+17
	1 day/Reflux	-12	-28	-29	+21
10% Methanol/90% No-Lead Gas	1 day/23 C (73 F)	-14	-46	-41	+21
	1 week/23 C (73 F)	-15	-59	-41	+19
10% Ethanol/90% No-Lead Gas	1 day/23 C (73 F)	-11	-37	-18	+12
	1 week/23 C (73 F)	-10	-37	-18	+15
ASTM No. 1 Oil	70 hrs/150 C (302 F)	+1	-1	+18	+1
ASTM No. 3 Oil	70 hrs/150 C (302 F)	-1	-16	-13	+4
Jet Fuel, JP-4	70 hrs/23 C (73 F)	-7	-14	-9	+7
Jet Fuel, JP-8	1 day/23 C (73 F)	-6	+2	-6	+3
	1 week/23 C (73 F)	-6	+1	-0	+3
MIL-H-5606 (PQ4226)	70 hrs/150 C (302 F)	-7	-16	-17	+8
MIL-L-7808G (Stauffer Jet 1)	70 hrs/150 C (302 F)	-6	-29	-25	+8
MIL-L-23699 (Mobil Jet II)	70 hrs/150 C (302 F)	-9	-39	-29	+9
ATF-Dextron (AMOCO)	70 hrs/150 C (302 F)	+1	-6	-21	+1
Crude Oil API 315	70 hrs/135 C (275 F)	-4	-26	-29	+6

* Obtained by adding 1.0 phr Varox to SILASTIC LS-2380U fluorosilicone rubber. Slabs 0.075-inch-thick were press cured 10 min/171 C (340 F) and post cured 4 hrs/200 C (392 F) prior to testing.

(continued)

TABLE 2.3: FLUOROSILICONE RUBBERS—DOW CORNING (continued)

FLUID RESISTANCE OF SILASTIC LS-2840 FLUOROSILICONE RUBBER*

Fluids	Immersion Conditions	Durometer, Points Change	Tensile Strength, Percent Change	Elongation, Percent Change	Volume Swell, Percent Change
ASTM Reference Fuel B	1 day/23 C (73 F)	−13	−40	−27	+18
	1 week/23 C (73 F)	−13	−40	−23	+18
ASTM Reference Fuel C	1 day/23 C (73 F)	−13	−43	−28	+20
	1 week/23 C (73 F)	−13	−42	−27	+21
	1 day/Reflux	−19	−57	−39	+26
10% Methanol/90% No-Lead Gas	1 day/23 C (73 F)	−14	−53	−29	+19
	1 week/23 C (73 F)	−14	−50	−27	+22
10% Ethanol/90% No-Lead Gas	1 day/23 C (73 F)	−13	−42	−21	+16
	1 week/23 C (73 F)	−12	−36	−17	+17
ASTM No. 1 Oil	70 hrs/150 C (302 F)	+1	−7	−13	+1
ASTM No. 3 Oil	70 hrs/150 C (302 F)	0	−27	−22	+3
Jet Fuel, JP-4	70 hrs/23 C (73 F)	−8	−20	−6	+11
MIL-H-5606 (PQ-4226)	70 hrs/150 C (302 F)	−5	−16	−11	+9
MIL-L-7808G (Stauffer Jet 1)	70 hrs/150 C (302 F)	−13	−84	−62	+8
Skydrol®† 500A	70 hrs/70 C (158 F)	−19	−55	−23	+23
Skydrol LD	70 hrs/23 C (73 F)	−26	−89	−73	+88

*Obtained by adding 1.0 phr Varox DBPH-50 and 1.0 phr SILASTIC HT-1 modifier to SILASTIC LS-2840 fluorosilicone rubber. Slabs 0.075 inch thick were press cured 10 min/171 C (340 F) and post cured 4 hrs/200 C (392 F) prior to testing.

†Skydrol is a registered trademark of Monsanto Industrial Chemicals Company

RESISTANCE OF SILASTIC 1125U SILICONE RUBBER TO IMMERSION IN SOLVENTS AND LIQUID FOODS*

Immersion Liquid	Test Conditions	Properties† Durometer Hardness, Shore A-2, points change	Tensile Strength, percent change	Elongation, percent change	Volume, percent change
Water	14 days/100 C (212 F)	+3	+8	+7	+1
Detergent, 3% in water	14 days/82 C (180 F)	+2	+2	-9	-1
Steam	3 days/20psi	+5	-4	-9	nil
Coffee	7 days/82 C (180 F)	+3	nil	-2	+2
Vegetable Oil	7 days/150 C (302 F)	+2	-24	-35	+1
Lard	7 days/150 C (302 F)	+2	-29	-41	+1
Whiskey	14 days/23 C (73 F)	-2	+6	+10	+1
Cola Syrup	14 days/23 C (73 F)	-1	-10	-6	nil
Vinegar	7 days/23 C (73 F)	-1	-3	-2	nil

*Specimens vulcanized with 1.0 parts Cadox TS-50 per 100 parts rubber by weight, press molded into 0.075-in-thick ASTM slabs (1.91mm) for 5 minutes/116 C (240 F), and oven cured for 4 hours/200 C (392 F).

†Original values: durometer hardness — 54 points; tensile strength — 1200 psi; elongation — 580 percent.

TABLE 2.4: POLYSULFIDE RUBBER—MORTON THIOKOL

ST polysulfide rubber is a millable gum elastomer prepared from bis (2-chloroethyl) formal and sodium polysulfide. Vulcanizates exhibit outstanding resistance to a broac' spectrum of oils and solvents, to gas permeability, low temperature, ozone and weathering. Typical uses include gas meter diaphragms, rollers, printing blankets, o-rings, and many specialty molded items.

All of the solvent immersion tests were run with the following recipe:

Ingredients	Parts by weight
ST polysulfide rubber	100
Stearic acid	1
Sterling S	60
Zinc peroxide	5
Calcium hydroxide	1
	167

Cure 30 minutes at 310°F

SOLVENT RESISTANCE AT ELEVATED TEMPERATURE, 140°F

Solvent	Volume Swell, % 1 week	1 month
Xylene	45	58
Iso-octane	6	6
Butyl acetate	46	46
Methyl isobutyl ketone	37	67
Water	21	41

RESISTANCE TO WATER (DISTILLED AND SALT)

	Original Properties	Immersed 14 days at 80°F		Immersed 14 days at 158°F	
		Distilled Water	4% NaCl Water	Distilled Water	4% NaCl Water
Tensile, psi	1090	1065	1100	665	1050
Elongation, %	215	215	215	150	215
Hardness, Shore A	73	71	72	67	70
Volume Swell, %	–	2	1	12	2

(continued)

TABLE 2.4: POLYSULFIDE RUBBER–MORTON THIOKOL (continued)

SOLVENT RESISTANCE
(30-Day Immersion at 80°F – ASTM-D471-66, Method B)

SOLVENT	VOLUME INCREASE, %	CONDITION
Aliphatic and Aromatic Hydrocarbons		
Mineral oil	–2	OK
Benzene	110	Tender
Toluene	70	Swollen but OK
Xylene	41	OK
Halogenated Hydrocarbons		
Carbon tetrachloride	46	OK
Ethylene dichloride	230	Very tender
Trichloroethylene	159	Tender
Perchlorethylene	28	OK
Dowtherm A	127	Tender
Monochlorobenzene	161	Tender
Aliphatic and Aromatic Fuels, Oils and Solvents		
SR-6 (60% diisobutylene, 40% aromatics)	14	OK
SR-10 (diisobutylene)	1	OK
ASTM Reference Fuel A[(a)]	2	OK
ASTM Reference Fuel B[(b)]	10	OK
73 octane gasoline	3	OK
100 octane gasoline	2	OK
ASTM oil No. 1	–4	OK
ASTM oil No. 3	–2	OK
Turpentine	4	OK
Motor oil (Esso)	0	OK
Circo light process oil	–2	OK
Diesel oil	3	OK
Circosol 2XH	–2	OK
Paint thinner (Duco)	23	OK
Drip oil	62	Slightly tender
Gulf motor oil	–3	OK
Pydraul F-9	37	OK
Skydrol	24	OK
Sovaloid C	30	OK
Sovaloid N	2	OK
Sundex 53	–1	OK
Tetrahydrofuran	175	Very tender
JP-3	–2	OK
JP-4	1	OK
Houghto-Safe No. 271	2	OK
Organic Acids		
10% acetic acid	9	OK
50% acetic acid	26	OK
Glacial acetic acid	18	OK
Cresylic acid	123	Tender
Ketones		
Acetone	37	OK
Methyl ethyl ketone	35	OK
Methyl isobutyl ketone	24	OK

SOLVENT	VOLUME INCREASE, %	CONDITION
Esters		
Ethyl acetate	35	OK
Butyl acetate	30	OK
Tributoxy ethyl phosphate	4	OK
Dibutyl phthalate	10	OK
Plasticizer SC	6	OK
TP-90B® Plasticizer	12	OK
TP-95® Plasticizer	28	OK
Dibutyl sebacate	2	OK
Dioctyl phthalate	–2	OK
Flexol 3 G O	1	OK
Tricresyl phosphate	7	OK
Adipol BCA	20	OK
Ethers		
"Cellosolve" Solvent	14	OK
Butyl "Cellosolve"	11	OK
Dibenzyl ether	30	Very tender
Butyl "Carbitol"	13	OK
Vegetable and Wood Oils		
Linseed oil	–2	OK
Cottonseed oil	–2	OK
Castor oil	–3	OK
Corn oil	–4	OK
White pine oil	14	OK
Crude soya bean oil	–4	OK
Hydroxy Compounds		
Ethyl alcohol (denatured)	2	OK
Butyl alcohol	2	OK
Isopropyl alcohol	0	OK
Diacetone alcohol	18	OK
Prestone	3	OK
Methyl alcohol	6	OK
Ethylene glycol	0	OK
Gasohol	5	OK
Glycerine	1	OK
2-ethyl hexanol	1	OK
Inorganic Compounds	2	
10% Sulfuric acid	–2	OK
20% Sulfuric acid	–	Slightly soft
50% Sulfuric acid	–	Deteriorated 2 wks
100% Sulfuric acid	–	Deteriorated 1 day
10% Nitric acid	–	Deteriorated 2 wks
50% Nitric acid	3	Deteriorated 1 day
10% Hydrochloric acid	3	OK
50% Hydrochloric acid	–	Tender
100% Hydrochloric acid	2	Deteriorated 1 day
10% Sodium hydroxide	2	OK
20% Sodium hydroxide	3	OK
3% Sodium chloride solution	3	OK
10% Sodium chloride	5	OK
10% Copper sulfate	2	OK
10% Zinc chloride	5	OK
Water		OK

(a) Reference Fuel A has the same composition as Type I test fluid in Mil-H-3136 (1950), i.e., fuel is 100% iso-octane.
(b) Reference Fuel B has the same composition as Type III test fluid in Mil-H-3136 (1950), i.e., fuel is 70% iso-octane, 30% toluene (by volume).

(continued)

TABLE 2.4: POLYSULFIDE RUBBER—MORTON THIOKOL (continued)

EFFECT OF HALOGENATED HYDROCARBONS

	VS	T	M	E	H
Original Physical Properties	–	1100	950	240	70
Dichloromethane					
1 week	285	1180	930	240	72
1 month	260	1200	910	290	71
Dibromomethane					
1 week	328	1110	820	270	64
1 month	307	1100	620	320	63
Diiodomethane					
1 week		Decomposed			
1 month		Decomposed			
Trichloromethane					
1 week	318	1160	810	280	68
1 month	320	1200	850	280	65
Tetrachloromethane					
1 week	54	1020	950	220	64
1 month	54	1000	740	250	64
1,2-Dichloroethane					
1 week	235	1100	800	250	67
1 month	240	1140	810	260	65
1,1,2-Trichloroethane					
1 week	285	410	–	120	67
1 month	295	730	–	200	69
1,1,2,2-Tetrachloroethane					
1 week	340	1030	800	260	64
1 month	N.A.	1010	750	280	61
Pentachloroethane					
1 week		Decomposed			
1 month		Decomposed			
Original Physical Properties	–	1100	950	240	70
Trichloroethylene					
1 week	153	1210	920	270	69
1 month	156	1290	960	290	70
Tetrachloroethylene					
1 week	34	1180	920	250	68
1 month	32	1085	850	250	68
2-Chloropropane					
1 week	25	990	820	230	67
1 month	26	1040	1000	230	68
1,2,3-Trichloropropane					
1 week	306	800	570	300	53
1 month	–	840	360	400	54
Chlorobenzene					
1 week	159	1200	1000	250	70
1 month	164	1150	950	280	67
1,2-Dichlorobenzene					
1 week	159	1100	880	250	67
1 month	166	950	750	250	58
1,2,4-Trichlorobenzene					
1 week	135	300	–	160	48
1 month	146	600	–	180	50
1-Chlorobutane					
1 week	32	1050	900	250	70
1 month	32	1110	1000	235	70

VS— volume swell
E— Elongation, %
T— tensile strength, psi
H— Hardness, Shore A
M— 200% modulus, psi
N.A.— not available

RESISTANCE TO KEROSENE AND BUNKER C FUEL OIL

	Original Properties	Immersed 1 week at 80°F		Immersed 1 week at 158°F	
		Kerosene	Bunker C	Kerosene	Bunker C
100% Modulus, psi	420	420	420	260	410
200% Modulus, psi	890	860	880	590	870
Tensile, psi	1200	1140	1180	790	1120
Elongation, %	280	270	270	260	260
Hardness, Shore A	72	71	69	67	69
Volume Swell, %	–	1.2	4.0	4.0	4.8

TABLE 2.5: POLYSULFIDE SYNTHETIC RUBBER SEALANT—STONHARD

STONLAST is a heavy-duty, two-component synthetic rubber sealant. It adheres tenaciously to just about all building materials currently in use, and is unaffected by exposure to water or most corrosive gases. STONLAST's great flexibility allows the material to expand and contract to compensate for movement, vibration, etc., and it retains those properties over a wide range of temperatures (-65° to +215°F).

The purpose of this "guide" is to aid in determining the potential value of Stonlast sealant when exposed to the damaging effects of erosive chemical spillages.

The test procedure used was to totally immerse cured samples of Stonlast in the chemicals listed for a period of 30 days at normal room temperature per ASTM D471-62T, Method B. (This is an exceptionally severe test, since most areas subject to chemical spillages such as these are "flushed down" periodically with water as part of the normal maintenance operation.)

The resultant resistance of Stonlast to the various chemicals is related using the symbols listed below. (It is assumed that normal "good housekeeping procedures" are used, including a daily flushing down with clean water.)

RATING CODE

E — Excellent F — Fair
G — Good NR — Not Recommended

The (number) which appears next to each rating is the percent volume swell.

ACIDS

Hydrochloric — 10%	E	(1%)
Hydrochloric — 30%	E	(6%)
Hydrochloric — 37%	NR	
Nitric — 10%	NR	
Nitric — 50%	NR	
Sulfuric — 10%	E	(1%)
Sulfuric — 20%	E	(1%)
Sulfuric — 50%	NR	
Sulfuric — 100%	NR	

ALKALIES AND SALTS

Copper Sulfate — 10%	E	(3%)
Copper Sulfate — 14%	E	(5%)
Sodium Chloride — 3%	E	(1%)
Sodium Chloride — 10%	E	(1%)
Sodium Chloride — 36%	E	(1%)
Sodium Hydroxide — 10%	E	(0%)
Sodium Hydroxide — 20%	E	(1%)
Sodium Hydroxide — 50%	E	(1%)

SOLVENTS AND OTHER CHEMICALS

(Aromatic Hydrocarbons)

Benzene	NR	(314%)
Toluene	NR	(138%)
Xylene	G	(61%)

(Halogenated Hydrocarbons)

Carbon Tetrachloride	F	(78%)
Ethylene Dichloride	NR	(605%)
Monochlorobenzene	NR	(474%)
Perchloroethylene	E	(43%)
Trichloroethylene	NR	(401%)

(Hydroxy Compounds)

Butyl Alcohol	E	(–2%)
Diacetone Alcohol	E	(10%)
Ethyl Alcohol (denatured)	E	(2%)
2-Ethyl Hexanol	E	(1%)
Ethylene Glycol	E	(4%)
Glycerol	E	(1%)
Isopropyl Alcohol	E	(2%)
Methyl Alcohol	E	(3%)

(Aliphatic and Aromatic Fuels, Oils and Solvent)

ASTM Oil No. 1	E	(1%)
ASTM Oil No. 2	E	(12%)
ASTM Reference Fuel A	E	(–1%)
ASTM Reference Fuel B	E	(12%)
JP-5	E	(2%)
Motor Oil	E	(–1%)
Skydrol™	G	(59%)
SR-6	E	(21%)
SR-10	E	(11%)
Turpentine	E	(11%)

(Ketones and Ethers)

Acetone	G	(50%)
Butyl "Carbitol"™	E	(19%)
Butyl "Cellosolve"™	E	(8%)
Dibutyl Ether	NR	(605%)
Ethyl "Cellosolve"™	E	(28%)
Methyl Ethyl Ketone	F	(87%)
Methyl Isobutyl Ketone	E	(36%)

(Esters and Plasticizers)

Butyl Acetate	G	(48%)
Butyl "Cellosolve"™ Adipate	E	(36%)
Dibutyl Phthalate	G	(55%)
Dibutyl Sebacate	E	(8%)
Dioctyl Adipate	E	(0%)
Dioctyl Phthalate	E	(33%)
Ethyl Acetate	G	(64%)
Propylene Glycol Ricinoleate	E	(5%)
TP-90B™ Plasticizer	E	(26%)
TP-95™ Plasticizer	G	(51%)
Tributoxy Ethyl Phosphate	E	(17%)

(Vegetable and Wood Oils)

Castor Oil	E	(–2%)
Corn Oil	E	(–4%)
Cottonseed Oil	E	(–3%)
Linseed Oil	E	(0%)
Soya Bean Oil	E	(0%)
White Pine Oil	E	(17%)

TABLE 2.6: SILICONE ELASTOMER LININGS–HURON CHEMICALS LTD

CORROSION RESISTANCE DATA FOR SILIGLAS® LININGS*

	Concentration	Temperature Conditions [°C]	Test Duration [Days]	Corrosive Effect Noted
Acids				
Hydrochloric Acid (HCl)	1.2%	20°	68	.4 mils/yr loss
	1.2%	90-100°	28	.04% weight gain
	30%	20°	40	24 mils/yr loss
Nitric Acid (HNO_3)	7%	20°	68	.2 mils/yr loss
	25%	20°	40	1.3 mils/yr loss
	50%	20°	40	10 mils/yr loss
	Reagent Grade	20°	40	4.4 mils/yr loss
Sulphuric Acid (H_2SO_4)	10%	20°	68	1 mil/yr loss
	50%	20°	30	2 mils/yr loss
	50%	60°	45	18 mils/yr loss
	50%	85°	24	15 mils/yr loss
Phosphoric Acid (H_2PO_3)	5%	85°	48	5mils/yr loss
Bases				
Ammonium Hydroxide (NH_4OH)	10%	85°	48	4% weight gain
	Reagent Grade	60°	45	1.18% weight gain
Potassium Hydroxide (KOH)	50%	85°	48	33 mils/yr loss
Sodium Hydroxide (NaOH)	10%	20°	42	1.4 mils/yr loss
	10%	90-100°	28	11.6 mils/yr loss
	20%	60°	45	15 mils/yr loss
	30%	RT°	40	5 mils/yr loss
	50%	RT°	42	17 mils/yr loss

(continued)

TABLE 2.6: SILICONE ELASTOMER LININGS—HURON CHEMICALS LTD (continued)

	Concentration	Temperature Conditions [°C]	Test Duration [Days]	Corrosive Effect Noted
Salt Solutions				
Potassium Chloride (KCl)	100 gpl	65°	30	10 mils/yr loss
Sodium Chloride (NaCl)	30 gpl	20°	68	1 mil/yr loss
	30 gpl	90-100°	28	.1% weight gain
	300 gpl	20°	68	.5 mil/yr loss
	300 gpl	90-100°	40	.18% weight gain
Oxidizing Environments				
Electrolytic Sodium Chlorate Production Cell NaCl, 50-250 gpl $NaClO_3$, 100-600 gpl NaOCl, 1.5-2.0 gpl pH=7		90°	700+	4 mils/yr loss
Hydrogen Peroxide (H_2O_2)	5%	85°	48	.2% weight gain
Hypotower Simulation (No over-chlorination) pH- 14→ 10		20-50°	147	2 mils/yr
Hypotower Simulation (50 over-chlorinations) pH- 14→ 5		20-80°	70	7 mils/yr
Sodium Hypochlorite (NaOCl-6%) pH 13		20°	42	2 mils/yr
		60°	45	7 mils/yr

NOTE: 1mil = .001 inches.

* Siliglas lining material is a silicone elastomer on a glass fiber backing.

TABLE 2.7: URETHANE–AMERICAN CYANAMID

	CYANAPRENE A-8 CYANASET M 90%		CYANAPRENE D-5 CYANASET M 90%	
	Shore A	% V.C.*	Shore A	% V.C.*
Acids				
Acetic acid 5%	-3	6.25	-5	3.7
Hydrochloric 10%	0	4.9	-3	3.3
Nitric acid 10%	–	–	–	–
Sulfuric acid 3%	-1	6.9	-2	5.7
Sulfuric acid 30%	0	0.3	-2	0.8
Alkalies				
Ammonium hydroxide 10%	-3	0.75	-4	2.5
Detergent heavy duty	-1	0	0	-0.25
Sodium carbonate 2%	+9	4.2	-3	1.7
Sodium carbonate 20%	+7	3.6	-5	0.8
Sodium hydroxide 1%	-8	0	-4	0.3
Sodium hydroxide 10%	-4	-1.2	-2	-0.4
Soap solution 1%	-2	3.4	-3	1.5
Solvents				
Acetone	-29	105.2	-20	67.4
Benzene	-13	76.4	-11	45.25
Carbon tetrachloride	-7	27.5	0	-0.25
Dimethyl formamide	–	–	–	–
Ethyl acetate	-15	40.4	-9	31.4
Ethyl alcohol	-3	17.8	-5	13.9
Methyl alcohol	0	11.4	0	14.6
Toluene	-7	37.8	-5	21.3
Turpentine	-2	3.2	-2	0.3
Water	0	1.4	-1	1.3
Oils, Fuels				
ASTM #1	–	–	–	–
ASTM #3	–	–	–	–
Heptane	0	1.7	-2	0.3
Isooctane	0	1.7	-3	1.3
Kerosine	+3	0.9	-1	1.0
Mineral oil	0	0.5	0	0.5
Toluene	-7	37.8	-5	21.3
Transformer oil	+2	-0.3	0	-1.0
Other Media				
Aniline	-38	367.9	-35	239.5
Ethylene dichloride	-30	109	-14	53.9
Hydrogen peroxide 28%	0	5.9	-3	3.8
Sodium chloride 10%	-3	-0.04	0	1.3

*% volume change. ASTM Test Method: ASTM D-543-60T

TABLE 2.8: URETHANE–DEVCON

Devcon FLEXANE is a two-component room-temperature curing urethane for forming abrasion resistant linings, repairing rubber parts or equipment, and forming flexible molds and parts. FLEXANE is available in putty and liquid form in two durometers. A FLEXANE flexibilizer can be used to produce urethane of any desired durometer.

Chemical Resistance of Flexane—Immersion Sample Size: ½"x½"x1" Cure: 7 Days @ Room Temperature Immersion: 30 days

Product Name	Hydrochloric Acid 10%	Sulphuric Acid 10%	Water	Saturated Salt Solution	Ammonia	Sodium Hydroxide 10%	Gasoline	Kerosene	Mineral Spirits	ASTM #3 Oil	Methanol	Propylene Glycol	Chlorinated Solvent	MEK	Toluene
Flexane 80 (Liquid & Putty)	VG	VG	VG	VG	VG	VG	U	F	F	U	U	U	U	U	U
Flexane 94 (Liquid & Putty)	VG	VG	VG	VG	VG	VG	U	F	F	U	U	U	U	U	U
Flexane High Performance Putty	U	U	VG	VG	VG	U	VG	VG	F	F	U	U	U	U	U
Flexane Brushable Urethane	VG	VG	VG	VG	VG	VG	U	U	F	U	U	U	U	U	U
Flexane BRK	U	U	VG	VG	VG	U	VG	VG	F	F	U	U	U	U	U

Key: VG—Very Good; F—Fair; U—Unsatisfactory

TABLE 2.9: URETHANE MEMBRANE–STERNSON LIMITED

LIQUATHANE is a high performance elastomeric urethane rubber membrane. Applied as a liquid, LIQUATHANE is designed to protect concrete and steel from corrosive attack as well as exhibiting excellent resistance when used as a waterproofing/liquidproofing or between slab membrane.

CHEMICAL RESISTANCE GUIDELINES	
Exposure	**Resistance**
Acids	Good resistance to common industrial strength acids (0% to 15%), such as sulphuric, hydrochloric, phosphoric, lactic, dilute oxidizing agents.
Alkalis	Good resistance to common industrial strength caustics (0% to 15%), such as sodium hydroxide, many chloride, sulfate and nitrate salts, saturated salt solutions.
Fresh Water/ Sea Water	Excellent resistance.

TABLE 2.10: VARIOUS ELASTOMERS—AMERICAN CYANAMID

Test Formulas

	CYANACRYL® R	CYANACRYL® L	CYANACRYL® C	NBR	EAE	SI
CYANACRYL R Polyacrylate	100					
CYANACRYL L Polyacrylate		100				
CYANACRYL C Polyacrylate			100			
Chemigum HR 665				100		
Vamac B-124					124	
General Electric SE-3724						100
N-550 (FEF) Carbon Black	55	60	60		40	
N-990 (MT) Carbon Black				15		
Hi-Sil 215 Precipitated Silica				40		
Maglite D				10		
Hercoflex 600				5		
Dioctyl Sebacate					10	
Paraplex G-25					5	
Silane A-189				0.4		
Zinc Oxide				3		
Stearic Acid	2	2	2	1	2	
TE-80 Petrolatum				2		
Armeen 18-D					0.5	
NPS Red Oil Soap	3.5	3.5				
Curative C-50			8			
Spider Sulfur	0.3	0.3	0.3	0.3		
CYURAM® DS				2		
Morfax				1		
Diak No. 1					1.2	
DPG					4	
Total Parts	160.8	165.8	170.3	179.7	186.7	100.0

Immersion in Synthetic Fluids for 168 Hours at 300°F

	CYANACRYL® R	CYANACRYL® L	CYANACRYL® C	NBR	EAE	SI
Valvoline ESP (Blend)						
Hardness Change, points	+ 1	- 2	0	+10	- 2	-16
Tensile Change, %	-28	-36	- 5	-67	-21	-20
Elongation Change, %	-45	-47	- 8	-49	-33	-12
Volume Change, %	+ 5	+ 7	+ 7	+ 1	+12	+28
Mobil 1 (LAOO)						
Hardness Change, points	- 3	- 6	- 2	+16	- 5	-13
Tensile Change, %	-31	-35	-12	-78	-27	-15
Elongation Change, %	-40	-41	-11	-86	-36	- 4
Volume Change, %	+ 9	+11	+10	+ 1	+18	+25
Polar Start DN-600 (LAB)						
Hardness Change, points	0	- 4	- 3	+12	- 7	-15
Tensile Change, %	-14	-21	-12	-71	-14	-24
Elongation Change, %	-52	-52	-12	-53	-20	-12
Volume Change, %	+ 7	+10	+10	+ 2	+15	+28
Chemlube (DAE)						
Hardness Change, points	- 7	-13	-12	+ 8	-20	-16
Tensile Change, %	- 6	-30	-22	-77	-39	-25
Elongation Change, %	-25	-35	- 2	-62	-41	-18
Volume Change, %	+13	+20	+19	+ 6	+42	+28
Ultron E-11 (DAE)						
Hardness Change, points	- 9	-17	-16	+13	-19	-16
Tensile Change, %	- 8	-24	-34	-80	-50	-29
Elongation Change, %	-12	-15	- 3	-100	-49	-13
Volume Change, %	+18	+28	+26	+ 8	+69	+24

CYANACRYL	acrylic elastomer	LAOO	linear alpha olefin oligomer
NBR	nitrile polymer	LAB	linear alkylated benzene
EAE	ethylene acrylic	DAE	dibasic acid ester
SI	silicone		

TABLE 2.11: VARIOUS ELASTOMERS AND RUBBERS—DU PONT

Chemical Resistance *

RATING KEY A—Fluid has little or no effect
B—Fluid has minor to moderate effect
C—Fluid has severe effect
T—No data—likely to be compatible
X—No data—not likely to be compatible
Blanks indicate no evaluation has been attempted.

Chemical	HYPALON®	HYTREL®	Neoprene	NORDEL®	VAMAC®	VITON®
Acetaldehyde	C	—	C	A	B	C
Acetic acid, 20%	A	A	A	A	A	C
Acetic acid, 30%	A	A	A	A	A	C
Acetic acid, glacial	A-B	A	C	B	C	C
Acetic acid, glacial	—	B (100°F)	—	—	—	—
Acetic anhydride	A	T	A	T	—	C
Acetone	B	B	B	A	C	C
Acetylene	B	A	B	A	—	A
Aluminum chloride solutions	A	T	A	A	A	A
Aluminum sulfate solutions	A (250°F)	T	A (158°F)	A	A	A
Ammonia, anhydrous	B	—	A	T	—	C
Ammonium chloride solutions	A	A	A	A	A	A
Ammonium hydroxide solutions	A (200°F)	T	A (158°F)	A	—	A
Ammonium sulfate solutions	A (200°F)	A	A (158°F)	A	A	A
Amyl acetate	C	B	C	A	C	C
Amyl alcohol	A (200°F)	A	A (158°F)	A	B-C	A (212°F)
Aniline	B	C	C	A-B	X	A-B
Aniline	C (100°F)	—	—	—	—	B (158°F)
Aniline	—	—	—	—	—	C (300°F)
ASTM oil #1	A	A (300°F)	A	C	(350°F)	A (300°F)
ASTM oil #3	B (158°F)	A (300°F)	B (158°F)	C	(300°F)	A (350°F)
ASTM reference fuel A	A	A (158°F)	A	C	A	A
ASTM reference fuel B	C	A (158°F)	C	C	B-C	A
ASTM reference fuel C	C	A	C	C	C	A
ASTM reference fuel C	—	B (158°F)	—	—	—	—
Asphalt	B	T	B	X	T	A (400°F)
Barium hydroxide solutions	A (200°F)	T	A (158°F)	A	T	A
Beer	A	A	A	A	T	A
Benzaldehyde	C	—	C	B	C	C
Benzene	C	B	C	C	C	B (158°F)
Benzoyl chloride	C	—	C	C	X	B
Borax solutions	A (200°F)	A	A (158°F)	A	(212°F)	A
Boric acid solutions	A (200°F)	A	A (158°F)	A	T	A
Bromine, anhydrous liquid	B	X	C	C	—	B (212°F)
Butane	A	A	A	B	T	A
Butyl acetate	C	B	C	X	X	C
Butyraldehyde	B-C	—	B-C	B	C	C
Butyric acid	B-C	T	C	X	X	T
Calcium bisulfite solutions	A (200°F)	—	A (158°F)	T	T	A
Calcium chloride solutions	A	A	A	A	T	A
Calcium hydroxide solutions	A (200°F)	T	A (158°F)	A	—	A
Calcium hypochlorite, 5%	A	A	B	A	T	A
Calcium hypochlorite, 20%	A (200°F)	—	B	A	T	B (158°F)
Carbon bisulfide	C	—	C	T	X	A
Carbon dioxide	A (200°F)	A	A	T	A (450°F)	A
Carbon monoxide	A (200°F)	A	A	T	—	T
Carbon tetrachloride	C	B-C	C	C	X	A (158°F)
Castor oil	A (158°F)	B	A (158°F)	B	—	A
Chlorine gas, dry	B	X	B	X	—	A (212°F)
Chlorine gas, wet	B	X	C	X	—	B
Chloroacetic acid	A	X	A	A	X	C
Chlorobenzene	X	X	X	X	C	A
Chloroform	C	C	C	C	X	A
Chlorosulfonic acid	C	C	C	C	X	C
Chromic acid, 10-50%	A (158°F)	X	C	C	—	A
Citric acid solutions	A	A	A	A	—	A
Copper chloride solutions	A	A	A	A	A	A
Copper sulfate solutions	A	A	A	A	T	A
Cottonseed oil	A	A	A	A-B	A	A (300°F)
Creosote oil	C	—	C	C	X	A (212°F)
Cyclohexane	C	A	C	C	B	A
Dibutyl phthalate	C	A	C	A	C	B
Diethyl sebacate	B	A	C	B	X	B
Dioctyl phthalate	C	A	C	B	X	B
DOWTHERM A	B	—	B	C	—	A (212°F)
DOWTHERM A	—	—	—	—	—	B (400°F)
Epichlorohydrin	T	X	—	B	—	C (122°F)
Ethyl acetate	C	B	C	A	C	C
Ethyl acetate	—	—	—	B (158°F)	X (158°F)	—
Ethyl alcohol	A (200°F)	A	A (158°F)	A	B	A
Ethyl chloride	C	C	C	B	C	A
Ethyl ether	C	—	C	C	B	C

(continued)

TABLE 2.11: VARIOUS ELASTOMERS AND RUBBERS—DU PONT (continued)

Chemical	HYPALON*	HYTREL*	Neoprene	NORDEL*	VAMAC*	VITON*
Ethylene dichloride	C (120°F)	C	C (120°F)	B (120°F)	X	A-B (120°F)
Ethylene glycol	A (200°F)	A	A (158°F)	A	A (212°F)	A (250°F)
Ethylene oxide	X	A	X	X	X	C (158°F)
Exxon 2380 turbo oil (lubricant)	—	T	—	X	—	A (392°F)
Ferric chloride solutions	A (200°F)	T	A	A	T	A
Fluosilicic acid	A (250°F)	T	A (158°F)	T	T	T
Formaldehyde, 40%	A	B	A	A	—	A
Formaldehyde, 40%	C (158°F)	—	C (158°F)	—	—	—
Formic acid	A	B	A	A	T	C (158°F)
FREON*-11	A	A	A-B	C	B	A-B
FREON-11	T (130°F)	—	B (130°F)	—	—	T (130°F)
FREON-12	A	A	A	B	A-B	A-B
FREON-12	A (130°F)	—	A (130°F)	—	—	B (130°F)
FREON-22	A	—	A	C	C	C
FREON-22	A (130°F)	—	A (130°F)	—	—	X (130°F)
FREON-113	A	A	A	C	B	A
FREON-113	A (130°F)	A (130°F)	A (130°F)	—	—	T (130°F)
FREON-114	A	A	A	C	—	B
FREON-114	T (130°F)	—	T (130°F)	—	—	—
Furfural	B	—	B	B	C	C (158°F)
Fyrquel 220 (hydraulic fluid)	—	T	—	—	—	A (212°F)
Gasoline	B	A	B	B-C	B-C	A
Glue	A (200°F)	A	A (158°F)	A	—	A
Glycerin	A (200°F)	A	A (158°F)	A	T	A (250°F)
n-Hexane	A	A	A	C	—	A
Hydrazine	—	C	—	A	—	C
Hydrochloric acid, 20%	A	B	A	T	A	A
Hydrochloric acid, 20%	A (158°F)	—	—	—	—	A (230°F)
Hydrochloric acid, 37%	A (122°F)	C	A	A-B	—	A (158°F)
Hydrochloric acid, 37%	B (158°F)	—	—	—	—	—
Hydrochloric acid, 37%	C (200°F)	—	C (200°F)	—	—	B (230°F)
Hydrocyanic acid	A	T	A	A	—	A
Hydrofluoric acid, 48%	A (158°F)	X	A	B	—	A
Hydrofluoric acid, 75%	A	X	B	C	—	B (158°F)
Hydrofluoric acid, anhydrous	A	X	B	C	—	A
Hydrogen	A	A	A	A	T	A
Hydrogen peroxide, 90%	A	—	B	T	—	A
Hydrogen peroxide, 90%	—	—	—	—	—	C (270°F)
Hydrogen sulfide	A	A	A	A	A (450°F)	B (270°F)
Isooctane	A	A	A	X	T	A
Isopropyl alcohol	A (200°F)	A	A	T	T	A
Isopropyl ether	B	—	C	C	X	C
JP-4	C	A (100°F)	C	C	—	A (400°F)
JP-5	C	—	C	C	—	A (400°F)
JP-6	C	—	C	C	—	A (100°F)
JP-6	—	—	—	—	—	C (550°F)
Kerosene	B	A	C	C	B	A (158°F)
Kerosene	—	—	—	—	—	B (400°F)
Lacquer solvents	C	B	C	C	X	C
Lactic acid	A	T	A	A	—	A
Linseed oil	A	T	A	B	—	A
Lubricating oils	B (158°F)	A	B (158°F)	C	A (300°F)	A (158°F)
Magnesium chloride solutions	A (220°F)	T	A (158°F)	A	T	A
Magnesium hydroxide solutions	A (200°F)	T	A (158°F)	A	—	A
Mercuric chloride solutions	A	T	A	A	T	A
Mercury	A	A	A	A	T	A
Methyl alcohol	A	A	A (158°F)	A	A	B
Methyl ethyl ketone	C	A	C	A	C	C
Methylene chloride	C	C	C (100°F)	B	C	B (100°F)
Mineral oil	A	A	A	C	T	A
Mobil XRM 206A (aircraft eng. lube)	—	T	—	—	—	A (350°F)
Naphtha	C	A	C	C	X	A (158°F)
Naphthalene	C	B	C (176°F)	C	—	A (176°F)
Nitric acid, –10%	A	B-C	B	B	T	A
Nitric acid, 30%	A	C	C	B	A	A
Nitric acid, 30%	C (158°F)	—	—	C (158°F)	—	—
Nitric acid, 60%	B	C	C	C	—	A
Nitric acid, 70%	C	C	C	C	X	A
Nitric acid, 70%	—	—	—	—	—	B (100°F)
Nitric acid, red fuming	C	C	C	C	X	B
Nitric acid, red fuming	—	—	—	—	—	C (158°F)
Nitrobenzene	C	C	C	A	X	B
Oleic acid	B	A	B	B	—	B
Oleum, 20-25%	B	C	C	C	X	A
Palmitic acid	B	A	B (158°F)	B	—	A
Perchloroethylene	C	C	C	C	X	A (212°F)
Phenol	C	C	C	B	X	A (212°F)
Phenol	—	—	—	—	—	*B (300°F)*
Phosphoric acid, 20%	A (200°F)	—	A	A	T	A
Phosphoric acid, 60%	A (200°F)	X	A	A	—	A (212°F)

(continued)

TABLE 2.11: VARIOUS ELASTOMERS AND RUBBERS—DU PONT (continued)

Chemical	HYPALON®	HYTREL®	Neoprene	NORDEL®	VAMAC®	VITON®
Phosphoric acid, 70%	A (200°F)	X	A	A	—	A
Phosphoric acid, 85%	A (200°F)	X	A	A	—	A
Pickling solution (20% nitric acid, 4% HF)	A	X	C	C	X	A
Pickling solution (17% nitric acid, 4% HF)	A (150°F)	X	C	C	X	A
Pickling solution (17% nitric acid, 4% HF)	—	—	—	—	—	C (225°F)
Picric acid	A	T	A	B	—	A
Potassium dichromate solutions	A (200°F)	T	A	A	—	A
Potassium hydroxide, dilute solutions	A (200°F)	A-B	A (158°F)	A	—	A
Pydraul 312C	C	A	C	C	—	A
Pyridine	C	X	C	B	X	C
OFI-2023 (silicone brake fluid)	—	T	—	—	T	A (392°F)
SAE #10 oil	C	A	C	C	A	A
Sea water	A	A	A	A	A	A
Shell turbine oil 307	T	T	T	X	—	B (392°F)
Silicone grease	A	A	A	A	A (158°F)	A
SKYDROL 500	C	A	C	A (250°F)	C (250°F)	C
SKYLUBE 450	—	—	—	—	—	C (392°F)
Soap solutions	A (200°F)	A	A (158°F)	A (212°F)	T	A
Sodium chloride solutions	A	A	A	A	A	A
Sodium dichromate, 20%	A (200°F)	T	B	A	—	A
Sodium hydroxide, 20%	A (200°F)	A-B	A	A	A	A
Sodium hydroxide, 46½%	A	B	A	A	—	A
Sodium hydroxide, 46½%	—	—	A (158°F)	—	—	C (100°F)
Sodium hydroxide, 50%	A (285°F)	—	A	A	—	C
Sodium hydroxide, 73%	A (280°F)	X	A	A	C	C
Sodium hypochlorite, 5%	A	A	A	A	A	A
Sodium hypochlorite, 20%	A (158°F)	T	B	A	A	B (158°F)
Sodium peroxide solutions	A (200°F)	—	A	A	—	A
Soybean oil	A	T	A	C	T	A (250°F)
Stannic chloride	B	—	B	—	T	A
Stannous chloride, 15%	A (200°F)	T	A (158°F)	B	T	A
Steam (see water)	A	B (212°F)	A	A (350°F)	A (212°F)	B (300°F)
Steam	—	C (230°F)	—	—	—	—
Stearic acid	B (158°F)	T	B (158°F)	B	—	T
Styrene	C	X	C	C	C	A
Sulfur, molten	A	T	A	A	T	A (250°F)
Sulfur dioxide, gas	A	T	A	A	T	T
Sulfur dioxide, liquid	A	T	A	A	T	T
Sulfur trioxide	C	X	C	B	—	T
Sulfuric acid, up to 5%	A	A	A	A	A	A
Sulfuric acid, 5-10%	A	B	A	A	A	A
Sulfuric acid, 10-50%	A (250°F)	C	A (158°F)	B	A-B	A
Sulfuric acid, 50-80%	A (158°F)	C	B-C	C	X	A
Sulfuric acid, 60%	A	C	B	C	X	A (250°F)
Sulfuric acid, 90%	A	C	C	C	C	A (158°F)
Sulfuric acid, 95%	A-B	C	C	C	X	A
Sulfuric acid, 95%	B (122°F)	—	—	—	—	A (158°F)
Sulfuric acid, fuming (20% oleum)	B-C	C	C	C	X	A
Sulfurous acid	A (158°F)	B	C	C	—	C
Sunoco XS-820 (EP lubricant)	—	T	—	X	T	A (300°F)
Tannic acid, 10%	A	A	A	A	T	A
Tartaric acid	A (200°F)	T	A (158°F)	B	T	A
Tetrahydrofuran	C	—	C	C	C	C
Toluene	C	B	C	C	C	B (100°F)
Tributyl phosphate	C	—	C	C	X	C (212°F)
Trichloroethylene	C	C	C	C	C	A
Trichloroethylene	—	—	—	—	C	B (158°F)
Tricresyl phosphate	C	—	C	A (212°F)	B	A (300°F)
Triethanolamine	A (158°F)	C	A (158°F)	A	A (158°F)	C
Trisodium phosphate solutions	A	A	A	A	A	A
Tung oil	A	T	A	C	T	A
Turpentine	C	—	C	C	B-C	A (158°F)
Water	A (158°F)	A (158°F)	A (158°F)	A (158°F)	A (212°F)	A (158°F)
Water	A (212°F)	A (212°F)	A (212°F)	A (212°F)	—	A (212°F)
Xylene	C	A-B	C	C	C	A
Xylene	—	—	—	—	—	B (158°F)
Zinc chloride solutions	A (200°F)	A	A	A	T	A

*Unless otherwise noted, concentration of aqueous solutions are saturated. All ratings are at room temperature unless specified.

HYPALON — chlorosulfinated polyethylene
HYTREL — polyethylene
NEOPRENE — polychloroprene
NORDEL — synthetic rubber
VAMAC — ethylene acrylic
VITON — fluoroelastomer

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS

Exxon butyl rubber and its chlorinated analog, chlorobutyl rubber are isobutylene-isoprene copolymers. They are basically inert, nonpolar, stable elastomers which exhibit outstanding resistance to attack by a great many different chemicals.

VISTALON elastomers are classified generically as either ethylene-propylene copolymers (EPM) or ethylene-propylene terpolymers (EPDM). All grades of VISTALON EPM have a completely saturated hydrocarbon chain which makes them highly resistant to attack by chemical agents such as oxygen, ozone, acids, and the like that seek to react at the site of a double bond.

Exxon elastomers offer good resistance to water, inorganic salt solutions, bases, synthetic hydraulic fluids, ethylene glycol base antifreeze formulations, and to most inorganic acids. When immersed in organic compounds, Exxon elastomers show good resistance to attack by acids, amines, and oxygenated compounds–alcohols, aldehydes, esters, ethers, and ketones. Resistance to detergents and soaps is excellent whether in concentrated form (as purchased) or in 1% solutions which approximate the concentrations of these materials commonly used in household applications.

Exxon elastomers display good resistance to attack by animal or vegetable oils. However, they are like other petroleum derived synthetic polymers in that their resistance to the attack of hydrocarbons, oils, and other petroleum based chemicals is low. Only VISTALON 6505 blends with nitrile and polychloroprene rubbers maintain good physical properties after prolonged exposure to these materials.

CHEMICAL RESISTANCE OF COMPOUND BASED ON INTERMEDIATE UNSATURATION BUTYL RUBBER

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
WATER					
Distilled Water	+0.78	95.8	81.8	+1	Unchanged
Sea Water–Atlantic	+0.56	98.8	90.2	+2	Unchanged
Sea Water–Pacific	+1.04	95.8	88.8	+2	Unchanged
INORGANIC ACIDS					
Boric Acid (10%)	+0.93	103.0	94.1	+1	Unchanged
Chlorosulfonic Acid (10%)	Disintegrated				
Chromic Acid (10%)	+6.60	83.1	75.1	−2	Unchanged
Chromic Acid (Conc.)	+19.6	63.9	68.6	−3	V. Brittle
Hydrochloric Acid (10%)	+3.70	96.4	78.4	−2	Sl. Tacky
Hydrochloric Acid (Conc.)	+15.9	81.9	109.8	−8	Unchanged
Hydrofluoric Acid (Conc.)	−1.94	89.0	58.2	−3	Unchanged
Nitric Acid (10%)	+9.09	—	—	—	—
Nitric Acid (Conc.)	Disintegrated				
Phosphoric Acid (Conc.)	−0.46	102.4	93.5	+1	Unchanged
Sulfuric Acid (10%)	+0.24	94.0	82.4	+2	Unchanged
Sulfuric Acid (Conc.)	Disintegrated				
INORGANIC BASES					
Ammonium Hydroxide (10%)	+1.89	95.8	86.3	−1	Unchanged
Ammonium Hydroxide (Conc.)	+1.88	105.4	96.1	−3	Sl. Tacky
Barium Hydroxide (Conc.)	−0.45	98.8	86.9	+2	Unchanged
Calcium Hydroxide (10%)	+1.16	97.0	82.4	0	Unchanged
Potassium Hydroxide (10%)	+2.85	98.2	88.2	−2	Unchanged
Sodium Hydroxide (10%)	+1.92	101.8	91.2	−2	Sl. Tacky
Sodium Hydroxide (Conc.)	+0.11	99.4	88.2	0	Unchanged
INORGANIC SALTS (25% Solutions)					
Aluminum Chloride	+0.50	89.2	78.4	−2	Unchanged
Aluminum Sulfate	+0.51	97.0	83.7	+1	Unchanged
Ammonium Chloride	+0.13	94.0	83.7	+1	Unchanged
Ammonium Nitrate	+0.21	95.2	85.0	0	Unchanged
Ammonium Phosphate	+0.57	96.4	82.4	+2	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Barium Chloride	+0.17	95.8	82.4	+1	Unchanged
Barium Sulfide	+0.39	94.0	82.9	0	Unchanged
Calcium Chloride	−0.46	89.8	77.1	0	Unchanged
Calcium Hypochlorite	+0.69	98.8	80.4	−2	Unchanged
Cupric Chloride	+0.48	98.2	84.9	+1	Unchanged
Cupric Sulfate	+0.94	91.6	80.4	+1	Unchanged
Ferric Chloride	+1.50	95.2	76.5	0	Unchanged
Ferric Nitrate	+3.65	97.6	93.0	−4	V. Tacky
Ferrous Sulfate	+0.48	92.8	81.8	+1	Sl. Tacky
Magnesium Chloride	+0.31	94.6	84.3	+2	Sl. Tacky
Magnesium Sulfate	+0.82	94.0	81.0	+1	Sl. Tacky
Nickel Sulfate	+0.79	94.0	84.3	+1	Sl. Tacky
Potassium Chloride	−0.07	90.4	82.4	+1	Unchanged
Potassium Permanganate	+0.58	93.4	84.3	−6	Sl. Brittle
Potassium Bisulfite	+1.41	92.8	83.3	0	Unchanged
Potassium Dichromate	+0.61	91.6	77.1	0	Unchanged
Sodium Borate (Borax)	+0.34	94.6	84.9	−1	Unchanged
Sodium Bicarbonate	+0.52	94.6	84.3	+1	Sl. Tacky
Sodium Chloride	0.00	100.0	82.4	−1	Unchanged
Zinc Chloride	+0.73	94.0	80.4	0	Unchanged
Zinc Nitrate	+0.24	94.6	80.9	+2	Unchanged
ORGANIC ACIDS					
Acetic Acid (10%)	+10.9	88.0	73.9	−6	Unchanged
Acetic Acid (Glacial)	+14.7	79.5	67.2	−3	Unchanged
Chloracetic Acid (10%)	+9.90	86.7	72.0	−3	Unchanged
Citric Acid (10%)	+0.69	97.0	85.7	+2	Sl. Tacky
Formic Acid (10%)	+12.3	86.0	68.6	−4	Unchanged
Lactic Acid (10%)	+6.12	90.4	74.5	0	Unchanged
Oleic Acid (100%)	+82.2	28.3	50.4	−38	Unchanged
Oxalic Acid (10%)	+2.36	97.6	81.8	+1	Unchanged
Phenol (10%)	+2.82	103.6	94.1	−4	Sl. Tacky
Phenol (100%)	−7.54	116.3	110.4	−7	Sl. Tacky
Picric Acid (10%)	+14.6	78.3	61.4	−5	Unchanged
Stearic Acid (100%)	+92.8	111.5	105.3	−4	Unchanged
Tannic Acid (10%)	−0.76	96.4	86.3	0	Sl. Tacky
Tartaric Acid (10%)	+1.44	97.0	88.2	+2	Unchanged
ALCOHOLS					
Benzyl Alcohol	+3.19	106.6	98.0	−9	Unchanged
Ethyl Alcohol	+2.04	91.0	82.9	−3	Unchanged
Isopropyl Alcohol	+2.44	89.8	91.6	−3	Sl. Tacky
Methyl Alcohol	+0.63	98.2	91.6	+2	Sl. Tacky
Ethylene Glycol	+0.36	100.0	84.9	+2	Unchanged
Glycerol	−0.52	98.8	86.3	+2	Unchanged
1-Hexanol	+17.8	95.8	104.6	−23	Sl. Tacky
Resorcinol	+0.50	103.6	91.6	+3	Unchanged
ALDEHYDES					
Benzaldehyde	+12.3	94.6	102.0	−19	Unchanged
Butyraldehyde	+24.9	69.9	90.2	−25	Sl. Tacky
Furfural	+4.37	108.4	101.4	−8	Sl. Tacky
AMINES					
Aniline	+7.97	98.2	109.2	−15	Unchanged
Triethanolamine	−11.1	100.6	88.8	+2	Tacky
UDMH	+13.7	54.2	79.8	−18	Unchanged
ESTERS					
Amyl Acetate	+67.2	31.3	46.5	−35	Unchanged
Dibutyl Sebacate	+43.7	51.2	78.4	−33	Unchanged
Dioctyl Phthalate	+22.5	88.0	83.7	−22	Unchanged
Ethyl Acetate	+14.7	60.2	67.3	−17	Unchanged
Tricresyl Phosphate	+1.80	112.1	103.3	−6	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
ETHERS					
Dibenzyl Ether	+20.6	99.4	111.8	−25	Unchanged
Diethylene Glycol Monobutyl Ether	+4.89	110.8	104.9	−12	Sl. Tacky
Ethyl Ether	+54.8	28.9	30.0	−34	Sl. Tacky
Ethylene Glycol Monoethyl Ether	+5.01	94.0	89.6	−12	Unchanged
HYDROCARBONS					
Benzene	+125.6	19.9	24.1	−37	Sl. Tacky
Cyclohexane	+243.5	18.1	17.7	−37	Sl. Tacky
Ethylbenzene	+190.2	15.7	26.1	−43	Unchanged
Heptane	+144.1	15.7	22.2	−35	Unchanged
Hexane	+94.4	22.3	22.2	−32	Sl. Tacky
Naphthalene	+108.8	83.1	75.9	+12	Sl. Tacky
Toluene	+198.0	10.2	26.1	−51	Unchanged
Xylene	+206.8	16.3	25.5	−45	Unchanged
HALOGENATED HYDROCARBONS					
Benzyl Chloride	Disintegrated				
Bromobenzene	Disintegrated				
Carbon Tetrachloride	+225.8	18.1	20.2	−38	Unchanged
Chloroform	+85.2	21.1	21.6	−32	Sl. Tacky
Ethylene Dichloride	+37.9	39.8	45.7	−24	Sl. Tacky
Perchloroethylene	+194.3	12.7	17.1	−46	Tacky
OTHER SUBSTITUTED HYDROCARBONS					
Carbon Disulfide	+144.9	21.7	21.0	−30	Sl. Tacky
Nitrobenzene	+11.9	101.2	106.9	−20	Unchanged
KETONES					
Acetone	+7.92	85.5	88.8	−11	Sl. Tacky
Methyl Ethyl Ketone	+15.7	48.8	53.5	−18	Unchanged
Methyl Isobutyl Ketone	+61.4	35.5	49.0	−32	Sl. Tacky
DETERGENTS & OTHER CLEANING PRODUCTS					
Calgonite (1%)	+1.76	102.4	92.2	+1	Unchanged
Clorox (1%)	+1.13	103.0	88.8	+1	Unchanged
Clorox (Conc.)	+1.20	103.0	88.2	+11	Unchanged
Joy (1%)	+2.08	102.4	91.6	+1	Unchanged
Joy (Conc.)	−0.13	100.0	90.2	+1	Unchanged
Lestoil (1%)	+2.94	100.6	96.1	−1	Unchanged
Lux Flakes (1%)	+1.78	105.4	96.7	0	Unchanged
Rinse Dry (1%)	+1.18	101.8	88.8	+2	Unchanged
Rinse Dry (Conc.)	+1.34	95.2	86.3	+2	Unchanged
Tide (1%)	+1.38	100.0	93.1	−1	Unchanged
NATURAL FATS & OILS					
Butter	+23.1	66.9	97.7	−21	Unchanged
Castor Oil	−1.25	89.8	86.9	0	Unchanged
Cottonseed Oil	+19.2	71.1	94.1	−18	Unchanged
Lard	+28.9	75.9	104.5	−22	Unchanged
Oleomargarine	+15.3	81.9	102.6	−17	Unchanged
Olive Oil	+24.8	71.1	99.4	−21	Unchanged
White Mineral Oil	+100.6	28.9	31.4	−33	Unchanged
OILS & FUELS					
A.S.T.M. No. 1 Oil	+64.3	38.0	56.3	−34	Sl. Tacky
A.S.T.M. No. 2 Oil	+88.2	33.1	59.4	−36	Sl. Tacky
A.S.T.M. No. 3 Oil	+173.4	16.3	40.6	−46	Unchanged
A.S.T.M. Fuel A	+159.0	18.1	25.5	−40	Unchanged
A.S.T.M. Fuel B	+199.5	13.3	22.9	−45	Sl. Tacky
A.S.T.M. Fuel C	+232.7	13.3	21.0	−47	Sl. Tacky
Heating Fuel Oil	+224.1	13.3	22.9	−45	Unchanged
Jet Aircraft Engine Oil	+92.3				
Kerosine	+262.0	13.3	22.2	−47	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
AUTOMOTIVE PRODUCTS					
Chassis Grease	+44.8	40.0	45.7	−35	——
Motor Oil (10W-30)	+157.6	17.5	30.8	−56	Sl. Tacky
Gasoline* (RON 94)	+200.8	15.7	21.6	−43	Unchanged
Gasoline* (RON 99)	+181.9	15.7	20.2	−39	Unchanged
Gasoline* (RON 102)	+202.5	14.5	20.2	−43	Unchanged
Gasoline,** unleaded	+162.0	12.7	18.2	−43	Unchanged
HYDRAULIC FLUIDS					
Oronite 8200	+13.4	69.9	79.9	−15	Unchanged
Pydraul F-9	+27.7	74.7	102.0	−26	Unchanged
Pydraul 60	+9.79	98.2	103.9	−18	Unchanged
Skydrol	+14.1	92.2	107.3	−24	Unchanged
Skydrol 500	+12.3	88.6	103.3	−22	Unchanged
MISCELLANEOUS					
Gelatin (sat. sol'n.)	+2.39	100.6	83.7	+2	Unchanged
Glucose (sat. sol'n.)	+0.12	101.9	86.9	+2	Tacky
Tincture of Iodine	+1.11	101.2	88.8	+2	Unchanged
Prestone antifreeze	−0.23	97.0	88.2	−1	Unchanged
Dowgard antifreeze	−0.12	93.4	82.4	+3	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
WATER					
Distilled Water	−0.11	100.0	97.5	+3	Unchanged
Sea Water—Atlantic	+0.32	102.4	100.6	+3	Sl. Tacky
Sea Water—Pacific	+0.25	97.6	94.1	+3	Sl. Tacky
INORGANIC ACIDS					
Boric Acid (10%)	−0.11	103.0	98.6	+3	Sl. Tacky
Chlorosulfonic Acid (10%)	Disintegrated				
Chromic Acid (10%)	+0.93	99.4	100.6	+3	Sl. Tacky
Chromic Acid (Conc.)	+43.7	10.2	86.9	−34	Tacky
Hydrochloric Acid (10%)	−0.65	98.8	95.5	+4	Sl. Tacky
Hydrochloric Acid (Conc.)	+2.67	98.2	110.4	0	Sl. Tacky
Hydrofluoric Acid (Conc.)	+0.62	98.8	98.6	+1	Tacky
Nitric Acid (10%)	+0.63	103.0	97.5	+1	Sl. Tacky
Nitric Acid (Conc.)	+14.8	28.9	103.9	−28	V. Tacky
Phosphoric Acid (Conc.)	−0.33	98.8	99.4	+3	Sl. Tacky
Sulfuric Acid (10%)	−1.22	98.2	99.4	+3	Sl. Tacky
Sulfuric Acid (Conc.)	Disintegrated				
INORGANIC BASES					
Ammonium Hydroxide (10%)	+0.69	103.6	102.0	+2	Unchanged
Ammonium Hydroxide (Conc.)	+0.75	103.6	102.0	−3	Unchanged
Barium Hydroxide (Conc.)	+0.13	99.4	96.7	+3	Unchanged
Calcium Hydroxide (10%)	+0.35	101.2	102.0	+3	Unchanged
Potassium Hydroxide (10%)	+0.11	97.0	93.5	+3	Sl. Tacky
Sodium Hydroxide (10%)	+0.23	94.6	88.8	+3	Unchanged
Sodium Hydroxide (Conc.)	+0.11	106.0	98.0	+2	Unchanged
INORGANIC SALTS (25% Solutions)					
Aluminum Chloride	+0.34	100.0	91.6	+3	Unchanged
Aluminum Sulfate	+0.80	99.4	95.5	+3	Unchanged
Ammonium Chloride	−0.48	97.0	94.7	+4	Unchanged
Ammonium Nitrate	+0.42	96.4	96.1	+3	Unchanged
Ammonium Phosphate	+0.26	101.8	99.4	+3	Unchanged
Barium Chloride	−0.83	97.6	97.5	+3	Unchanged
Barium Sulfide	−1.29	98.8	98.0	+3	Unchanged
Calcium Chloride	+1.43	101.2	99.4	+3	Unchanged
Calcium Hypochlorite	+0.73	100.0	95.5	+2	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Cupric Chloride	−1.00	98.8	93.5	+3	Unchanged
Cupric Sulfate	+0.48	95.8	96.1	+2	Unchanged
Ferric Chloride	−0.11	98.8	97.5	+3	Unchanged
Ferric Nitrate	+0.68	101.2	101.4	+2	Unchanged
Ferrous Sulfate	+0.70	89.2	93.5	+2	Unchanged
Magnesium Chloride	+1.66	98.8	97.5	+2	Unchanged
Magnesium Sulfate	−0.12	97.6	93.5	+2	Unchanged
Nickel Sulfate	0.00	96.4	97.5	+2	Unchanged
Potassium Chloride	−0.56	95.8	94.7	+3	Unchanged
Potassium Permanganate	+4.09	83.1	78.4	+2	Brittle
Potassium Bisulfite	+0.23	101.2	100.0	+2	Unchanged
Potassium Dichromate	+0.63	98.8	97.5	+3	Unchanged
Sodium Borate (Borax)	+0.37	97.6	98.0	+3	Unchanged
Sodium Bicarbonate	+0.25	95.2	93.5	+3	Unchanged
Sodium Chloride	−0.37	100.0	100.0	+3	Unchanged
Zinc Chloride	−0.12	96.4	93.5	+3	Unchanged
Zinc Nitrate	0.00	96.4	96.7	+4	Unchanged
ORGANIC ACIDS					
Acetic Acid (10%)	+1.88	105.4	105.3	+3	Sl. Tacky
Acetic Acid (Glacial)	+3.90	97.6	102.5	−2	Sl. Tacky
Chloracetic Acid (10%)	+1.24	105.4	105.9	+3	Sl. Tacky
Citric Acid (10%)	−1.28	97.0	97.5	+4	Sl. Tacky
Formic Acid (10%)	+0.38	96.4	94.7	+3	Sl. Tacky
Lactic Acid (10%)	0.00	98.2	95.5	+4	Sl. Tacky
Oleic Acid (100%)	+43.7	69.3	81.0	−16	Unchanged
Oxalic Acid (10%)	+0.23	98.8	98.0	+3	Sl. Tacky
Phenol (10%)	+0.94	109.7	108.4	+1	Sl. Tacky
Phenol (100%)	+0.59	105.4	108.4	−2	Sl. Tacky
Picric Acid (10%)	+0.46	105.4	102.6	+2	Sl. Tacky
Stearic Acid (100%)	+6.14	106.6	109.8	−1	Unchanged
Tannic Acid (10%)	−0.13	96.4	92.8	+3	Unchanged
Tartaric Acid (10%)	−0.36	98.8	96.1	+5	Sl. Tacky
ALCOHOLS					
Benzyl Alcohol	+0.36	103.0	100.6	−1	Tacky
Ethyl Alcohol	+0.39	94.6	99.4	−8	Sl. Tacky
Isopropyl Alcohol	0.00	94.6	98.0	+1	Sl. Tacky
Methyl Alcohol	+0.25	100.0	102.6	−1	Sl. Tacky
Ethylene Glycol	0.00	85.5	85.7	+3	Sl. Tacky
Glycerol	−1.04	98.8	99.4	+3	Tacky
1-Hexanol	+3.39	101.2	103.3	−3	Sl. Tacky
Resorcinol	+0.32	100.0	98.0	+3	Sl. Tacky
ALDEHYDES					
Benzaldehyde	+10.4	102.4	106.9	−15	Sl. Tacky
Butyraldehyde	+21.6	66.3	81.4	−20	Sl. Tacky
Furfural	+0.11	106.6	106.5	−5	Tacky
AMINES					
Aniline	+5.07	110.8	108.4	−6	Sl. Tacky
Triethanolamine	+0.13	101.2	100.0	+4	Sl. Tacky
UDMH	+10.5	59.0	82.4	−13	Unchanged
ESTERS					
Amyl Acetate	+46.4	39.2	45.1	−23	Unchanged
Dibutyl Sebacate	+22.8	80.1	96.1	−17	Sl. Tacky
Dioctyl Phthalate	+1.85	101.2	103.9	−1	Sl. Tacky
Ethyl Acetate	+24.2	95.3	86.9	−13	Tacky
Tricresyl Phosphate	−0.13	101.2	103.9	+2	Tacky
ETHERS					
Dibenzyl Ether	+12.1	100.6	106.5	−16	Unchanged
Diethylene Glycol Monobutyl Ether	+1.32	102.4	107.8	−2	Tacky
Ethyl Ether	+58.7	30.7	65.5	−24	Tacky
Ethylene Glycol Monoethyl Ether	+1.29	103.0	105.3	−2	Tacky

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
HYDROCARBONS					
Benzene	+71.4	26.5	27.5	−27	Unchanged
Cyclohexane	+206.3	22.9	18.2	−28	Sl. Tacky
Ethylbenzene	+167.4	24.7	23.5	−31	Sl. Tacky
Heptane	+136.6	22.9	21.0	−27	Sl. Tacky
Hexane	+160.8	23.5	21.0	−27	Sl. Tacky
Naphthalene	+75.5	92.8	82.9	−13	Sl. Tacky
Toluene	+123.6	23.5	22.9	−29	Tacky
Xylene	+182.0	22.3	20.2	−30	Sl. Tacky
HALOGENATED HYDROCARBONS					
Benzyl Chloride	+12.8	57.2	77.5	−20	Tacky
Bromobenzene	+123.1	24.9	26.1	−31	Sl. Tacky
Carbon Tetrachloride	+192.0	22.9	18.2	−29	Unchanged
Chloroform	+158.1	21.7	19.7	−30	Sl. Tacky
Ethylene Dichloride	+25.6	50.0	62.8	−18	Sl. Tacky
Perchloroethylene	+207.3	19.9	15.7	−32	Sl. Tacky
OTHER SUBSTITUTED HYDROCARBONS					
Carbon Disulfide	+123.5	23.5	21.0	−28	Sl. Tacky
Nitrobenzene	+7.64	105.4	105.3	−13	Sl. Tacky
KETONES					
Acetone	+6.07	88.0	93.5	−10	Sl. Tacky
Methyl Ethyl Ketone	+10.2	82.5	87.7	−13	Sl. Tacky
Methyl Isobutyl Ketone	+23.3	57.8	74.5	−18	Sl. Tacky
DETERGENTS & OTHER CLEANING PRODUCTS					
Calgonite (1%)	−0.38	101.1	102.5	+3	Unchanged
Clorox (1%)	+0.64	104.2	103.9	+3	Tacky
Clorox (Conc.)	+2.09	102.4	101.0	+2	Tacky
Joy (1%)	+0.13	98.8	98.6	+3	Tacky
Joy (Conc.)	−11.1	101.8	99.4	+4	Tacky
Lestoil (1%)	+1.55	101.8	104.5	+2	Sl. Tacky
Lux Flakes (1%)	+0.35	107.2	106.5	+3	Unchanged
Rinse Dry (1%)	+0.36	100.0	97.5	+3	Tacky
Rinse Dry (Conc.)	0.00	95.8	93.5	+3	Tacky
Tide (1%)	+0.26	100.0	101.4	+2	Tacky
NATURAL FATS & OILS					
Butter	+2.12	97.0	102.6	−3	Unchanged
Castor Oil	−0.39	98.2	98.0	+4	Tacky
Cottonseed Oil	+2.49	99.4	102.6	+1	Sl. Tacky
Lard	+3.77	95.2	103.3	−3	Unchanged
Oleomargarine	+2.51	104.2	105.9	−3	Unchanged
Olive Oil	+2.38	101.2	106.5	−1	Sl. Tacky
White Mineral Oil	+13.1	54.2	58.8	−13	Unchanged
OILS & FUELS					
A.S.T.M. No. 1 Oil	+9.10	83.1	88.8	−5	Sl. Tacky
A.S.T.M. No. 2 Oil	+9.88	81.9	84.3	−6	Sl. Tacky
A.S.T.M. No. 3 Oil	+39.4	47.0	44.5	−19	Unchanged
A.S.T.M. Fuel A	+84.2	27.1	23.5	−27	Unchanged
A.S.T.M. Fuel B	+143.8	22.3	20.2	−31	Unchanged
A.S.T.M. Fuel C	+155.6	21.7	19.0	−31	Unchanged
Heating Fuel Oil	+59.6	25.3	23.0	−31	Unchanged
Jet Aircraft Engine Oil	+17.2	86.1	100.6	−13	Sl. Tacky
Kerosine	+163.0	25.9	21.6	−32	Unchanged
AUTOMOTIVE PRODUCTS					
Chassis Grease	+13.3	75.9	77.8	−7	Sl. Tacky
Motor Oil (10W-30)	+21.8	50.6	51.0	−18	Unchanged
Gasoline* (RON 94)	+137.9	23.5	19.6	−31	Unchanged
Gasoline* (RON 99)	+145.7	21.1	19.6	−31	Unchanged
Gasoline* (RON 102)	+158.4	22.3	21.0	−31	Unchanged
Gasoline,** unleaded	+181.6	23.5	20.2	−31	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
HYDRAULIC FLUIDS					
Oronite 8200	+2.81	101.8	100.0	−1	Unchanged
Pydraul F-9	+3.97	103.0	103.3	−1	Sl. Tacky
Pydraul 60	−3.04	105.4	104.5	+2	Sl. Tacky
Skydrol	+1.01	112.1	111.2	−2	Sl. Tacky
Skydrol 500	+0.54	107.2	108.4	−2	Sl. Tacky
MISCELLANEOUS					
Gelatin (sat. sol'n.)	+1.24	99.4	96.7	+3	Sl. Tacky
Glucose (sat. sol'n.)	+0.23	96.4	96.1	+2	Sl. Tacky
Tincture of Iodine	+6.44	93.4	85.7	+1	Sl. Tacky
Prestone antifreeze	+0.50	98.8	100.0	+3	Sl. Tacky
Dowgard antifreeze	+0.73	98.2	97.5	+4	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
WATER					
Distilled Water	+0.11	103.0	100.0	+3	Sl. Tacky
Sea Water—Atlantic	+0.32	102.4	101.4	+3	Unchanged
Sea Water—Pacific	+0.37	98.8	96.1	+2	Sl. Tacky
INORGANIC ACIDS					
Boric Acid (10%)	−0.11	94.0	93.5	+2	Sl. Tacky
Chlorosulfonic Acid (10%)	Disintegrated				
Chromic Acid (10%)	+6.52	80.7	88.8	−2	Unchanged
Chromic Acid (Conc.)	+47.4	1.8	13.5	−33	V. Tacky
Hydrochloric Acid (10%)	−0.65	95.2	97.5	+3	Sl. Tacky
Hydrochloric Acid (Conc.)	+11.8	77.7	115.7	−3	Sl. Tacky
Hydrofluoric Acid (Conc.)	+1.42	98.8	98.6	−2	Unchanged
Nitric Acid (10%)	+0.88	96.4	95.5	0	Tacky
Nitric Acid (Conc.)	Disintegrated				
Phosphoric Acid (Conc.)	+0.11	100.0	99.4	+3	Sl. Tacky
Sulfuric Acid (10%)	+0.74	98.2	96.1	+4	Sl. Tacky
Sulfuric Acid (Conc.)	Disintegrated				
INORGANIC BASES					
Ammonium Hydroxide (10%)	+2.42	108.4	102.0	+3	Sl. Tacky
Ammonium Hydroxide (Conc.)	+2.88	109.0	102.6	−2	Sl. Tacky
Barium Hydroxide (Conc.)	+1.21	98.8	93.5	+4	Unchanged
Calcium Hydroxide (10%)	+0.93	101.2	101.4	+3	Unchanged
Potassium Hydroxide (10%)	0.00	102.4	99.4	+3	Unchanged
Sodium Hydroxide (10%)	+0.23	98.8	95.5	+2	Unchanged
Sodium Hydroxide (Conc.)	+0.55	104.2	98.6	−2	Unchanged
INORGANIC SALTS (25% Solutions)					
Aluminum Chloride	−0.12	99.4	94.1	+3	Sl. Tacky
Aluminum Sulfate	+0.13	102.4	101.4	+3	Unchanged
Ammonium Chloride	−0.24	98.2	98.0	+4	Unchanged
Ammonium Nitrate	−0.13	98.8	101.4	+3	Sl. Tacky
Ammonium Phosphate	−0.13	96.4	98.6	+5	Sl. Tacky
Barium Chloride	−1.30	97.0	96.1	+4	Unchanged
Barium Sulfide	−0.91	99.4	96.1	+3	Unchanged
Calcium Chloride	+0.36	98.8	96.1	+4	Unchanged
Calcium Hypochlorite	+1.09	98.8	98.0	+3	Unchanged
Cupric Chloride	−1.13	104.8	102.5	+4	Sl. Tacky
Cupric Sulfate	+0.24	100.0	101.4	+4	Unchanged
Ferric Chloride	0.00	97.6	96.1	+6	Sl. Tacky
Ferric Nitrate	+0.68	102.4	100.6	+4	Sl. Tacky
Ferrous Sulfate	+0.93	97.6	96.1	+3	Unchanged
Magnesium Chloride	−0.26	97.6	97.5	+4	Unchanged
Magnesium Sulfate	+0.46	103.0	94.7	+3	Unchanged
Nickel Sulfate	+0.33	103.6	103.3	+4	Unchanged
Potassium Chloride	−0.32	98.8	99.4	+5	Unchanged
Potassium Permanganate	+2.90	78.9	77.1	−3	Brittle

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Potassium Bisulfite	+2.29	106.6	107.8	+1	Unchanged
Potassium Dichromate	0.00	101.2	100.0	+4	Unchanged
Sodium Borate (Borax)	0.00	96.4	97.5	+4	Unchanged
Sodium Bicarbonate	−0.12	100.0	98.0	+4	Unchanged
Sodium Chloride	−0.49	100.0	98.6	+5	Unchanged
Zinc Chloride	−0.12	97.0	98.0	+5	Sl. Tacky
Zinc Nitrate	0.00	97.6	96.7	+5	Sl. Tacky
ORGANIC ACIDS					
Acetic Acid (10%)	+2.58	99.4	102.6	0	Sl. Tacky
Acetic Acid (Glacial)	+8.20	89.2	101.0	−9	Sl. Tacky
Chloracetic Acid (10%)	+3.34	107.8	99.4	+2	Sl. Tacky
Citric Acid (10%)	0.00	98.8	100.0	+3	Sl. Tacky
Formic Acid (10%)	+1.76	103.0	100.0	+3	Sl. Tacky
Lactic Acid (10%)	+0.68	100.0	98.0	+3	Sl. Tacky
Oleic Acid (100%)	+90.3	48.8	59.4	−26	Unchanged
Oxalic Acid (10%)	+0.35	101.2	98.0	+3	Sl. Tacky
Phenol (10%)	+2.97	107.8	111.2	−3	Sl. Tacky
Phenol (100%)	+8.26	104.2	119.0	−17	Sl. Tacky
Picric Acid (10%)	+0.81	97.6	94.7	+1	Sl. Tacky
Stearic Acid (100%)	+13.9	106.6	107.8	−2	Unchanged
Tannic Acid (10%)	0.00	102.4	101.4	+2	Sl. Tacky
Tartaric Acid (10%)	−0.12	93.4	90.2	+3	Sl. Tacky
ALCOHOLS					
Benzyl Alcohol	−0.96	100.0	98.6	−4	Sl. Tacky
Ethyl Alcohol	0.00	97.6	100.6	−1	Sl. Tacky
Isopropyl Alcohol	+0.36	97.6	100.0	−1	Sl. Tacky
Methyl Alcohol	−0.36	92.7	90.8	0	Sl. Tacky
Ethylene Glycol	−0.37	92.8	94.1	+3	Sl. Tacky
Glycerol	−0.25	100.0	94.1	+5	Sl. Tacky
1-Hexanol	+7.24	86.8	97.5	−11	Tacky
Resorcinol	+0.76	100.7	98.6	+3	Sl. Tacky
ALDEHYDES					
Benzaldehyde	+9.66	91.6	100.9	−17	Sl. Tacky
Butyraldehyde	+21.7	57.8	78.4	−18	Sl. Tacky
Furfural	+2.57	105.4	103.9	−7	Sl. Tacky
AMINES					
Aniline	+11.8	95.2	101.9	−13	Sl. Tacky
Triethanolamine	+0.57	101.2	99.4	+3	Unchanged
UDMH	+7.90	57.2	74.5	−12	Unchanged
ESTERS					
Amyl Acetate	+47.2	40.4	47.7	−22	Unchanged
Dibutyl Sebacate	+23.5	89.8	103.3	−17	Unchanged
Dioctyl Phthalate	+5.36	106.0	107.8	−3	Sl. Tacky
Ethyl Acetate	+10.9	78.9	88.2	−12	Sl. Tacky
Tricresyl Phosphate	+0.75	102.4	103.3	+3	Sl. Tacky
ETHERS					
Dibenzyl Ether	+11.6	103.0	107.8	−13	Unchanged
Diethylene Glycol Monobutyl Ether	+2.56	107.8	113.1	−7	Sl. Tacky
Ethyl Ether	+57.4	30.1	32.8	−25	Unchanged
Ethylene Glycol Monoethyl Ether	+2.05	97.0	98.0	−5	Sl. Tacky
HYDROCARBONS					
Benzene	+101.9	25.9	25.5	−28	Unchanged
Cyclohexane	+230.2	21.7	17.7	−28	Unchanged
Ethylbenzene	+176.0	19.3	20.2	−31	Sl. Tacky
Heptane	+178.0	23.5	20.9	−28	Sl. Tacky
Hexane	+169.0	22.9	22.6	−27	Sl. Tacky
Naphthalene	+50.4	89.8	80.4	−7	Sl. Tacky
Toluene	+114.8	23.5	22.9	−29	Sl. Tacky
Xylene	+154.5	22.3	21.0	−30	Sl. Tacky

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
HALOGENATED HYDROCARBONS					
Benzyl Chloride	+25.1	57.8	79.8	−20	Sl. Tacky
Bromobenzene	+114.4	24.7	25.5	−32	Sl. Tacky
Carbon Tetrachloride	+199.5	20.5	17.7	−31	Unchanged
Chloroform	+137.7	18.7	20.2	−30	Sl. Tacky
Ethylene Dichloride	+25.2	48.8	60.2	−18	Sl. Tacky
Perchloroethylene	+212.4	18.7	15.7	−30	Sl. Tacky
OTHER SUBSTITUTED HYDROCARBONS					
Carbon Disulfide	+183.4	19.3	20.2	−30	Sl. Tacky
Nitrobenzene	+4.77	86.1	98.6	−12	Sl. Tacky
KETONES					
Acetone	+6.14	89.2	97.5	−9	Sl. Tacky
Methyl Ethyl Ketone	+19.7	86.8	94.1	−12	Unchanged
Methyl Isobutyl Ketone	+22.2	56.0	70.0	−17	Sl. Tacky
DETERGENTS & OTHER CLEANING PRODUCTS					
Calgonite (1%)	+0.50	98.8	103.3	+3	Unchanged
Clorox (1%)	+1.28	101.2	103.9	+2	Sl. Tacky
Clorox (Conc.)	+1.48	106.0	103.9	−1	Tacky
Joy (1%)	+0.63	96.7	98.0	+3	Sl. Tacky
Joy (Conc.)	−11.32	98.8	102.6	+1	Tacky
Lestoil (1%)	+2.74	102.4	105.9	−1	Sl. Tacky
Lux Flakes (1%)	+0.71	98.8	97.5	+2	Unchanged
Rinse Dry (1%)	+0.72	95.2	96.6	+2	Sl. Tacky
Rinse Dry (Conc.)	−0.36	93.4	96.6	+3	Sl. Tacky
Tide (1%)	+0.65	101.2	103.3	−2	Sl. Tacky
NATURAL FATS & OILS					
Butter	+8.92	101.2	102.0	−7	Unchanged
Castor Oil	−0.65	95.2	94.1	−4	Sl. Tacky
Cottonseed Oil	+5.18	95.8	100.6	−6	Sl. Tacky
Lard	+7.00	97.0	103.3	−4	Unchanged
Oleomargarine	+6.52	106.6	106.5	−3	Sl. Tacky
Olive Oil	+7.87	94.8	100.6	−7	Sl. Tacky
White Mineral Oil	+53.6	41.0	42.6	−26	Unchanged
OILS & FUELS					
A.S.T.M. No. 1 Oil	+20.0	74.1	82.9	−8	Unchanged
A.S.T.M. No. 2 Oil	+18.9	74.1	78.4	−9	Unchanged
A.S.T.M. No. 3 Oil	+103.2	34.9	33.9	−27	Unchanged
A.S.T.M. Fuel A	+162.9	25.9	24.2	−28	Unchanged
A.S.T.M. Fuel B	+185.5	22.3	21.6	−29	Unchanged
A.S.T.M. Fuel C	+197.8	22.3	21.6	−30	Sl. Tacky
Heating Fuel Oil	+190.0	22.9	22.2	−32	Unchanged
Jet Aircraft Engine Oil	+27.0	66.9	88.2	−19	Unchanged
Kerosine	+197.2	22.3	21.6	−31	Unchanged
AUTOMOTIVE PRODUCTS					
Chassis Grease	+19.8	54.4	59.4	−13	Sl. Tacky
Motor Oil (10W-30)	+93.0	37.8	39.2	−37	Unchanged
Gasoline* (RON 94)	+189.0	21.7	20.2	−31	Sl. Tacky
Gasoline* (RON 99)	+182.4	21.1	22.2	−31	Sl. Tacky
Gasoline* (RON 102)	+189.6	19.9	21.0	−32	Sl. Tacky
Gasoline,** unleaded	+196.9	20.5	20.2	−32	Sl. Tacky
HYDRAULIC FLUIDS					
Oronite 8200	+4.55	97.0	99.4	−2	Unchanged
Pydraul F-9	+6.08	107.8	112.3	−4	Sl. Tacky
Pydraul 60	+1.39	106.0	105.9	−3	Sl. Tacky
Skydrol	+4.32	110.2	105.3	−3	Sl. Tacky
Skydrol 500	+1.67	112.0	109.8	−3	Sl. Tacky

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
MISCELLANEOUS					
Gelatin (sat. sol'n.)	0.00	104.2	104.9	+3	Sl. Tacky
Glucose (sat. sol'n.)	+0.23	100.0	95.5	+3	Sl. Tacky
Tincture of Iodine	+12.5	78.9	66.1	−2	Unchanged
Prestone antifreeze	+1.44	101.2	100.0	−1	Sl. Tacky
Dowgard antifreeze	+1.33	97.6	95.5	+3	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
WATER					
Distilled Water	+0.90	101.2	102.6	+4	Unchanged
Sea Water—Atlantic	+0.32	105.4	104.5	+4	Unchanged
Sea Water—Pacific	+0.25	105.4	100.6	+3	Unchanged
INORGANIC ACIDS					
Boric Acid (10%)	−0.23	98.8	103.3	+2	Sl. Tacky
Chlorosulfonic Acid (10%)	Disintegrated				
Chromic Acid (10%)	+12.4	66.9	77.8	−6	Tacky
Chromic Acid (Conc.)	+48.3	2.41	9.8	−27	V. Tacky
Hydrochloric Acid (10%)	−0.52	97.6	96.7	+2	Sl. Tacky
Hydrochloric Acid (Conc.)	+8.52	54.8	103.9	−8	Sl. Tacky
Hydrofluoric Acid (Conc.)	+2.36	87.4	80.4	−2	Sl. Tacky
Nitric Acid (10%)	+1.13	95.8	93.5	+1	V. Tacky
Nitric Acid (Conc.)	Disintegrated				
Phosphoric Acid (Conc.)	+0.11	102.4	100.6	+3	Tacky
Sulfuric Acid (10%)	+0.61	99.4	101.4	+4	Tacky
Sulfuric Acid (Conc.)	Disintegrated				
INORGANIC BASES					
Ammonium Hydroxide (10%)	+4.61	111.5	103.9	+2	Unchanged
Ammonium Hydroxide (Conc.)	+5.14	108.4	96.7	−3	Sl. Tacky
Barium Hydroxide (Conc.)	+0.89	101.2	97.5	+4	Unchanged
Calcium Hydroxide (10%)	+0.82	101.2	95.5	+4	Unchanged
Potassium Hydroxide (10%)	+0.68	101.2	96.7	+3	Unchanged
Sodium Hydroxide (10%)	+0.35	109.6	97.5	+3	Unchanged
Sodium Hydroxide (Conc.)	+1.33	106.6	100.6	−2	Unchanged
INORGANIC SALTS (25% Solutions)					
Aluminum Chloride	+0.81	96.4	90.2	+2	Sl. Tacky
Aluminum Sulfate	+1.21	95.8	83.7	+2	Unchanged
Ammonium Chloride	−0.61	94.0	92.8	+3	Sl. Tacky
Ammonium Nitrate	0.00	96.4	95.5	+2	Sl. Tacky
Ammonium Phosphate	0.00	98.2	98.0	+3	Sl. Tacky
Barium Chloride	+0.47	88.6	86.9	+3	Unchanged
Barium Sulfide	+0.26	97.6	95.5	+2	Unchanged
Calcium Chloride	+1.45	95.8	96.7	+2	Unchanged
Calcium Hypochlorite	+1.58	110.8	103.9	−2	Sl. Tacky
Cupric Chloride	+0.37	96.4	96.1	+2	Sl. Tacky
Cupric Sulfate	+0.84	94.6	92.8	+3	Unchanged
Ferric Chloride	+0.22	100.6	101.4	+3	Unchanged
Ferric Nitrate	+1.23	100.0	99.4	+1	Tacky
Ferrous Sulfate	+1.16	98.8	96.1	+2	Unchanged
Magnesium Chloride	+0.26	96.4	96.1	+3	Unchanged
Magnesium Sulfate	+1.04	101.8	94.7	+2	Unchanged
Nickel Sulfate	+0.66	100.0	101.4	+2	Unchanged
Potassium Chloride	+0.22	94.6	94.7	+1	Sl. Tacky
Potassium Permanganate	+8.47	85.5	88.2	−2	Brittle
Potassium Bisulfite	+5.51	111.5	108.4	−3	Unchanged
Potassium Dichromate	+1.02	96.4	95.5	+3	Unchanged
Sodium Borate (Borax)	+0.85	94.0	96.1	+2	Unchanged
Sodium Bicarbonate	+0.76	96.4	93.5	+2	Unchanged
Sodium Chloride	+0.25	94.6	95.5	+2	Sl. Tacky
Zinc Chloride	+0.47	94.6	92.2	+3	Sl. Tacky
Zinc Nitrate	+0.36	101.8	103.3	+4	Sl. Tacky

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
ORGANIC ACIDS					
Acetic Acid (10%)	+4.58	104.2	101.4	+1	Sl. Tacky
Acetic Acid (Glacial)	+8.44	87.4	96.1	−9	Sl. Tacky
Chloracetic Acid (10%)	+4.08	114.5	103.9	+2	Sl. Tacky
Citric Acid (10%)	+0.38	98.2	92.2	+5	Sl. Tacky
Formic Acid (10%)	+3.14	103.0	101.4	+3	Sl. Tacky
Lactic Acid (10%)	+0.68	101.8	99.4	+3	Sl. Tacky
Oleic Acid (100%)	+93.9	43.4	57.5	−26	Unchanged
Oxalic Acid (10%)	+1.15	101.2	102.6	+3	Sl. Tacky
Phenol (10%)	+5.69	108.4	109.8	−7	Sl. Tacky
Phenol (100%)	+6.16	105.4	113.7	−15	Sl. Tacky
Picric Acid (10%)	+3.34	106.0	104.5	+2	Sl. Tacky
Stearic Acid (100%)	+17.9	101.8	101.4	−2	Unchanged
Tannic Acid (10%)	+0.65	100.6	97.5	+3	Sl. Tacky
Tartaric Acid (10%)	+0.60	98.8	98.0	+3	Sl. Tacky
ALCOHOLS					
Benzyl Alcohol	+3.70	104.8	103.9	−6	Sl. Tacky
Ethyl Alcohol	+0.51	89.8	96.7	−2	Sl. Tacky
Isopropyl Alcohol	+1.23	89.2	90.8	−6	Sl. Tacky
Methyl Alcohol	+1.19	97.0	100.0	−1	Sl. Tacky
Ethylene Glycol	−0.24	92.8	90.2	+4	Sl. Tacky
Glycerol	0.00	95.8	89.6	+3	Unchanged
1-Hexanol	+6.92	91.6	102.0	−10	Tacky
Resorcinol	+2.46	97.0	93.5	+2	Sl. Tacky
ALDEHYDES					
Benzaldehyde	+7.10	86.1	94.1	−13	Sl. Tacky
Butyraldehyde	+21.6	99.4	103.9	−18	Unchanged
Furfural	+2.83	108.4	106.5	−8	Tacky
AMINES					
Aniline	+10.6	98.8	103.9	−14	Sl. Tacky
Triethanolamine	+2.38	97.0	88.2	+3	Sl. Tacky
UDMH	+4.89	51.2	66.7	−9	Sl. Tacky
ESTERS					
Amyl Acetate	+45.6	42.2	51.6	−23	Unchanged
Dibutyl Sebacate	+21.6	93.4	104.5	−18	Unchanged
Dioctyl Phthalate	+6.14	109.6	117.6	−7	Sl. Tacky
Ethyl Acetate	+11.8	81.3	90.8	−12	Unchanged
Tricresyl Phosphate	+0.87	105.4	104.5	+2	Tacky
ETHERS					
Dibenzyl Ether	+9.92	108.4	101.1	−13	Unchanged
Diethylene Glycol Monobutyl Ether	+3.71	102.4	105.3	−9	Unchanged
Ethyl Ether	+52.6	29.5	33.9	−35	Unchanged
Ethylene Glycol Monoethyl Ether	+3.33	101.2	101.4	−7	Sl. Tacky
HYDROCARBONS					
Benzene	+112.2	27.1	29.4	−30	Unchanged
Cyclohexane	+205.9	22.3	17.7	−31	Sl. Tacky
Ethylbenzene	+140.0	20.4	21.6	−31	Unchanged
Heptane	+141.2	25.3	22.9	−28	Sl. Tacky
Hexane	+129.3	21.7	21.0	−28	Tacky
Naphthalene	+41.8	81.3	77.1	+2	Sl. Tacky
Toluene	+139.5	21.7	22.2	−32	Tacky
Xylene	+164.2	21.7	21.0	−31	Sl. Tacky
HALOGENATED HYDROCARBONS					
Benzyl Chloride	+27.3	57.3	78.4	−21	Tacky
Bromobenzene	+115.6	24.7	26.1	−32	Sl. Tacky
Carbon Tetrachloride	+213.3	21.7	19.0	−31	Unchanged
Chloroform	+170.1	19.9	21.0	−32	Sl. Tacky
Ethylene Dichloride	+26.7	56.0	70.6	−18	Sl. Tacky
Perchloroethylene	+220.0	19.9	18.2	−33	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
OTHER SUBSTITUTED HYDROCARBONS					
Carbon Disulfide	+118.0	21.7	20.2	−30	Sl. Tacky
Nitrobenzene	+4.59	103.0	104.5	−9	Tacky
KETONES					
Acetone	+5.29	84.3	89.6	−8	Unchanged
Methyl Ethyl Ketone	+9.22	82.5	86.9	−11	Sl. Tacky
Methyl Isobutyl Ketone	+22.4	59.6	74.5	−16	Sl. Tacky
DETERGENTS & OTHER CLEANING PRODUCTS					
Calgonite (1%)	+0.88	106.6	105.9	+5	Sl. Tacky
Clorox (1%)	+2.43	107.2	100.6	+3	Sl. Tacky
Clorox (Conc.)	+1.85	108.4	105.3	+2	Sl. Tacky
Joy (1%)	+1.79	104.2	104.5	+3	Sl. Tacky
Joy (Conc.)	−11.3	98.8	98.0	+3	Sl. Tacky
Lestoil (1%)	+2.86	104.2	102.5	+2	Sl. Tacky
Lux Flakes (1%)	+1.30	104.2	102.5	+3	Unchanged
Rinse Dry (1%)	+1.20	95.2	95.5	+3	Sl. Tacky
Rinse Dry (Conc.)	−0.50	100.0	96.1	+3	Sl. Tacky
Tide (1%)	+0.92	97.6	96.7	+3	Sl. Tacky
NATURAL FATS & OILS					
Butter	+12.6	105.4	104.5	−12	Unchanged
Castor Oil	−0.92	96.4	95.5	+3	Tacky
Cottonseed Oil	+6.41	106.6	107.8	−4	Sl. Tacky
Lard	+11.8	106.6	109.2	−11	Unchanged
Oleomargarine	+8.06	107.8	107.8	−7	Unchanged
Olive Oil	+12.0	99.4	105.9	−12	Sl. Tacky
White Mineral Oil	+95.1	36.8	33.3	−26	Sl. Tacky
OILS & FUELS					
A.S.T.M. No. 1 Oil	+30.8	56.0	67.3	−16	Unchanged
A.S.T.M. No. 2 Oil	+34.6	54.2	63.3	−17	Unchanged
A.S.T.M. No. 3 Oil	+146.5	30.1	28.8	−30	Unchanged
A.S.T.M. Fuel A	+161.5	23.5	23.5	−28	Unchanged
A.S.T.M. Fuel B	+189.7	20.5	21.6	−33	Sl. Tacky
A.S.T.M. Fuel C	+200.9	19.9	21.6	−32	Sl. Tacky
Heating Fuel Oil	+195.0	20.5	21.0	−32	Unchanged
Jet Aircraft Engine Oil	+41.7	60.8	84.3	−21	Unchanged
Kerosine	+211.2	22.3	21.6	−32	Unchanged
AUTOMOTIVE PRODUCTS					
Chassis Grease	+38.0	50.0	52.0	−21	Sl. Tacky
Motor Oil (10W-30)	+118.4	31.9	32.8	−31	Unchanged
Gasoline* (RON 94)	+192.5	19.9	21.6	−32	Sl. Tacky
Gasoline* (RON 99)	+176.9	18.7	21.6	−33	Sl. Tacky
Gasoline* (RON 102)	+192.0	16.9	20.2	−33	Sl. Tacky
Gasoline,** unleaded	+201.9	21.1	21.0	−32	Sl. Tacky
HYDRAULIC FLUIDS					
Oronite 8200	+11.6	99.4	104.5	−7	Unchanged
Pydraul F-9	+7.89	112.7	115.1	−7	Sl. Tacky
Pydraul 60	+2.01	101.2	103.3	−3	Sl. Tacky
Skydrol	+4.98	106.0	108.4	−8	Sl. Tacky
Skydrol 500	+3.24	103.6	105.9	−6	Sl. Tacky
MISCELLANEOUS					
Gelatin (sat. sol'n.)	+1.85	98.8	96.1	+2	Sl. Tacky
Glucose (sat. sol'n.)	+0.23	98.8	94.1	+3	Tacky
Tincture of Iodine	+16.2	53.6	40.6	−5	Unchanged
Prestone antifreeze	+1.67	99.4	100.0	0	Unchanged
Dowgard antifreeze	+0.39	94.8	92.8	+3	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
WATER					
Distilled Water	+0.78	95.2	96.1	+3	Unchanged
Sea Water—Atlantic	+0.43	100.6	102.5	+4	Unchanged
Sea Water—Pacific	−0.25	98.8	96.1	+4	Unchanged
INORGANIC ACIDS					
Boric Acid (10%)	−1.95	98.8	106.5	+3	Tacky
Chlorosulfonic Acid (10%)	Disintegrated				
Chromic Acid (10%)	+20.2	56.6	77.8	−10	Tacky
Chromic Acid (Conc.)	+49.6	5.42	12.3	−21	V. Tacky
Hydrochloric Acid (10%)	+0.37	104.8	102.0	+2	Tacky
Hydrochloric Acid (Conc.)	+11.2	56.0	88.8	−11	Sl. Tacky
Hydrofluoric Acid (Conc.)	+2.18	90.4	67.2	0	Sl. Tacky
Nitric Acid (10%)	+1.64	101.2	101.4	0	V. Tacky
Nitric Acid (Conc.)	Disintegrated				
Phosphoric Acid (Conc.)	+0.11	98.8	101.4	+3	Tacky
Sulfuric Acid (10%)	−0.12	95.2	95.5	+4	Tacky
Sulfuric Acid (Conc.)	Disintegrated				
INORGANIC BASES					
Ammonium Hydroxide (10%)	+5.88	106.0	96.1	−1	Unchanged
Ammonium Hydroxide (Conc.)	+7.39	101.2	89.6	−3	Sl. Tacky
Barium Hydroxide (Conc.)	+1.02	100.6	99.4	+3	Unchanged
Calcium Hydroxide (10%)	+1.05	96.4	98.6	+3	Unchanged
Potassium Hydroxide (10%)	+0.23	100.0	96.1	+3	Unchanged
Sodium Hydroxide (10%)	+0.93	104.8	99.4	+1	Unchanged
Sodium Hydroxide (Conc.)	+1.77	104.8	101.4	−4	Unchanged
INORGANIC SALTS (25% Solutions)					
Aluminum Chloride	+0.34	98.2	97.5	+2	Sl. Tacky
Aluminum Sulfate	+1.34	103.6	105.3	+3	Unchanged
Ammonium Chloride	+0.12	95.2	99.4	+3	Sl. Tacky
Ammonium Nitrate	+0.13	98.2	99.4	+3	Sl. Tacky
Ammonium Phosphate	+1.03	101.8	103.9	+3	Sl. Tacky
Barium Chloride	+0.47	104.8	105.9	+4	Unchanged
Barium Sulfide	+0.51	98.2	91.6	+2	Unchanged
Calcium Chloride	+1.55	95.8	94.1	+1	Unchanged
Calcium Hypochlorite	+1.82	107.8	107.8	−1	Sl. Tacky
Cupric Chloride	+0.13	94.0	96.1	+4	Sl. Tacky
Cupric Sulfate	+1.80	96.4	99.4	+4	Unchanged
Ferric Chloride	+0.44	98.8	98.0	+3	Unchanged
Ferric Nitrate	+1.25	93.4	98.0	+1	Tacky
Ferrous Sulfate	+0.81	97.0	95.5	+3	Unchanged
Magnesium Chloride	+0.38	94.0	96.7	+3	Unchanged
Magnesium Sulfate	+0.69	94.6	96.7	+4	Unchanged
Nickel Sulfate	+0.11	94.6	99.4	+3	Unchanged
Potassium Chloride	+0.56	98.8	100.0	+1	Unchanged
Potassium Permanganate	+8.34	80.7	87.7	−3	Brittle
Potassium Bisulfite	+7.80	113.3	102.0	−4	Unchanged
Potassium Dichromate	+0.63	98.8	99.4	+3	Unchanged
Sodium Borate (Borax)	+0.73	100.6	103.9	+3	Unchanged
Sodium Bicarbonate	+0.12	98.8	100.0	+2	Unchanged
Sodium Chloride	−0.99	93.4	96.7	+3	Unchanged
Zinc Chloride	+0.23	98.2	100.0	+3	Sl. Tacky
Zinc Nitrate	+0.24	93.4	94.7	+4	Sl. Tacky
ORGANIC ACIDS					
Acetic Acid (10%)	+5.63	103.0	103.9	−1	Sl. Tacky
Acetic Acid (Glacial)	+10.7	88.6	92.2	−9	Sl. Tacky
Chloracetic Acid (10%)	+5.45	133.1	99.0	−1	Sl. Tacky
Citric Acid (10%)	+0.38	98.8	101.4	+3	Sl. Tacky
Formic Acid (10%)	+4.15	107.2	105.9	+2	Sl. Tacky
Lactic Acid (10%)	+0.45	98.8	100.0	+2	Sl. Tacky
Oleic Acid (100%)	+95.7	45.8	59.4	−27	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Oxalic Acid (10%)	+0.12	105.4	104.9	+4	Sl. Tacky
Phenol (10%)	+7.35	115.1	112.4	−11	Sl. Tacky
Phenol (100%)	+4.50	98.8	109.8	−14	Sl. Tacky
Picric Acid (10%)	+2.07	101.2	99.4	+2	Sl. Tacky
Stearic Acid (100%)	+18.6	108.4	108.4	+2	Unchanged
Tannic Acid (10%)	+1.05	100.0	96.1	−1	Sl. Tacky
Tartaric Acid (10%)	+1.08	100.6	103.9	+3	Tacky
ALCOHOLS					
Benzyl Alcohol	+2.79	104.8	103.9	−8	Sl. Tacky
Ethyl Alcohol	+0.89	94.0	96.1	−2	Sl. Tacky
Isopropyl Alcohol	+1.53	92.2	96.1	−2	Sl. Tacky
Methyl Alcohol	+1.64	97.6	96.1	−2	Sl. Tacky
Ethylene Glycol	−0.36	94.6	92.2	+4	Sl. Tacky
Glycerol	+1.26	95.2	89.6	+2	Unchanged
1-Hexanol	+6.60	84.3	96.7	−11	Sl. Tacky
Resorcinol	+12.0	108.4	99.4	+1	Sl. Tacky
ALDEHYDES					
Benzaldehyde	+7.28	92.2	98.6	−13	Sl. Tacky
Butyraldehyde	+17.4	91.6	102.6	−18	Unchanged
Furfural	+5.34	103.6	103.3	−9	Tacky
AMINES					
Aniline	+7.33	98.8	103.9	−13	Unchanged
Triethanolamine	+0.77	94.0	90.2	+3	Sl. Tacky
UDMH	+7.00	58.4	77.8	−9	Unchanged
ESTERS					
Amyl Acetate	+45.7	39.8	48.4	−24	Unchanged
Dibutyl Sebacate	+19.3	85.5	103.3	−17	Unchanged
Dioctyl Phthalate	+9.13	104.8	109.2	−12	Sl. Tacky
Ethyl Acetate	+8.75	78.3	88.2	−12	Unchanged
Tricresyl Phosphate	+0.49	101.8	102.6	+2	Tacky
ETHERS					
Dibenzyl Ether	+9.56	106.6	103.9	−13	Unchanged
Diethylene Glycol Monobutyl Ether	+3.85	96.4	106.5	−10	Unchanged
Ethyl Ether	+60.2	31.3	35.3	−27	Unchanged
Ethylene Glycol Monoethyl Ether	+4.35	101.2	103.9	−7	Sl. Tacky
HYDROCARBONS					
Benzene	+84.0	20.5	26.9	−30	Unchanged
Cyclohexane	+218.5	16.3	17.1	−32	Sl. Tacky
Ethylbenzene	+142.9	21.7	24.9	−32	Unchanged
Heptane	+142.0	19.3	21.0	−30	Sl. Tacky
Hexane	+125.5	21.1	23.5	−28	Sl. Tacky
Naphthalene	+41.9	89.2	79.0	+2	Sl. Tacky
Toluene	+128.5	18.7	26.1	−31	Sl. Tacky
Xylene	+142.5	19.9	21.6	−31	Sl. Tacky
HALOGENATED HYDROCARBONS					
Benzyl Chloride	+26.1	56.0	79.8	−21	Tacky
Bromobenzene	+118.0	22.9	26.1	−32	Sl. Tacky
Carbon Tetrachloride	+207.1	19.9	19.6	−32	Unchanged
Chloroform	+169.5	19.3	22.2	−33	Sl. Tacky
Ethylene Dichloride	+25.8	52.4	62.7	−18	Sl. Tacky
Perchloroethylene	+200.5	16.3	18.2	−33	Unchanged
OTHER SUBSTITUTED HYDROCARBONS					
Carbon Disulfide	+87.0	16.9	21.0	−31	Sl. Tacky
Nitrobenzene	+3.36	94.6	101.4	−11	Tacky
KETONES					
Acetone	+6.07	86.7	90.8	−8	Sl. Tacky
Methyl Ethyl Ketone	+8.60	83.1	88.8	−11	Sl. Tacky
Methyl Isobutyl Ketone	+22.0	56.6	75.1	−17	Sl. Tacky

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
DETERGENTS & OTHER CLEANING PRODUCTS					
Calgonite (1%)	+0.63	102.4	103.9	+3	Sl. Tacky
Clorox (1%)	+2.30	106.0	103.9	+2	Unchanged
Clorox (Conc.)	+1.85	109.6	107.8	+1	Unchanged
Joy (1%)	+1.41	98.2	105.3	+2	Sl. Tacky
Joy (Conc.)	−10.6	97.0	98.0	+3	Sl. Tacky
Lestoil (1%)	+3.34	101.2	105.3	−1	Sl. Tacky
Lux Flakes (1%)	+1.53	101.8	100.6	+3	Unchanged
Rinse Dry (1%)	+0.96	98.8	105.3	+3	Unchanged
Rinse Dry (Conc.)	−0.74	97.6	98.0	+4	Sl. Tacky
Tide (1%)	+1.77	100.7	99.0	+3	Tacky
NATURAL FATS & OILS					
Butter	+28.4	88.6	100.0	−16	Sl. Tacky
Castor Oil	−1.31	98.2	103.3	+3	Tacky
Cottonseed Oil	+11.1	116.9	115.1	−13	Sl. Tacky
Lard	+17.8	99.4	109.2	−13	Unchanged
Oleomargarine	+27.9	101.2	105.3	−16	Unchanged
Olive Oil	+18.3	101.2	107.8	−14	Sl. Tacky
White Mineral Oil	+108.5	34.3	38.6	−33	Sl. Tacky
OILS & FUELS					
A.S.T.M. No. 1 Oil	+45.8	43.4	56.9	−23	Unchanged
A.S.T.M. No. 2 Oil	+50.6	50.0	54.3	−22	Sl. Tacky
A.S.T.M. No. 3 Oil	+151.8	31.3	30.0	−32	Unchanged
A.S.T.M. Fuel A	+128.4	22.9	24.2	−29	Unchanged
A.S.T.M. Fuel B	+156.1	13.9	22.9	−32	Sl. Tacky
A.S.T.M. Fuel C	+140.0	18.1	21.0	−33	Sl. Tacky
Heating Fuel Oil	+176.0	20.5	22.9	−33	Unchanged
Jet Aircraft Engine Oil	+44.7	54.2	77.8	−23	Unchanged
Kerosine	+139.8	18.1	20.2	−32	Unchanged
AUTOMOTIVE PRODUCTS					
Chassis Grease	+53.6	38.6	43.1	−26	Unchanged
Motor Oil (10W-30)	+149.8	32.5	38.6	−33	Unchanged
Gasoline* (RON 94)	+160.9	17.5	21.0	−34	Sl. Tacky
Gasoline* (RON 99)	+183.4	18.7	21.6	−31	Sl. Tacky
Gasoline* (RON 102)	+203.7	17.5	21.0	−36	Sl. Tacky
Gasoline,** unleaded	+151.7	18.1	19.6	−33	Sl. Tacky
HYDRAULIC FLUIDS					
Oronite 8200	+13.7	101.8	104.5	−9	Unchanged
Pydraul F-9	+11.2	103.0	110.4	−10	Tacky
Pydraul 60	+6.70	104.8	106.5	−6	Tacky
Skydrol	+7.30	106.6	110.4	−7	Sl. Tacky
Skydrol 500	+3.37	110.2	110.4	−10	Sl. Tacky
MISCELLANEOUS					
Gelatin (sat. sol'n.)	0.00	95.8	96.1	+2	Sl. Tacky
Glucose (sat. sol'n.)	+1.99	98.8	94.7	0	Tacky
Tincture of Iodine	+19.4	53.0	41.2	−5	Unchanged
Prestone antifreeze	+1.47	96.4	99.4	−1	Sl. Tacky
Dowgard antifreeze	−0.79	94.0	97.5	+3	Unchanged

*Conventional motor fuels containing tetraethyl lead additive. Approximate Research Octane Numbers indicated.
**Motor fuel of "premium" grade containing no tetraethyl lead.

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF COMPOUND BASED ON LOW UNSATURATION BUTYL RUBBER

	72 Hours Immersion at 212°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+6.62	97.8	99.4	−14	Unchanged
Benzaldehyde	+11.0	103.8	94.6	−21	Unchanged
Dioctyl Phthalate	+28.9	97.8	98.6	−27	Unchanged
Distilled Water	+1.20	96.8	88.1	+2	Unchanged
Ethyl Alcohol	+1.46	90.3	88.7	−3	Unchanged
Ethyl Ether	+56.7	28.0	46.3	−28	Sl. Tacky
Hexane	+147.9	16.7	24.1	−36	Sl. Tacky
Hydrochloric Acid (10%)	+4.57	102.2	80.6	−4	Tacky
Lard	+36.2	87.1	100.0	−32	Unchanged
Methyl Ethyl Ketone	+13.4	82.8	87.3	−20	Unchanged
Perchloroethylene	+339.1	64.5	17.7	−48	Tacky
Potassium Permanganate (25%)	+1.47	94.1	79.9	+2	Unchanged
Skydrol 500	+13.8	86.6	96.2	−27	Unchanged
Sodium Chloride (25%)	+0.12	101.1	87.0	−1	Unchanged
Sodium Hydroxide (10%)	+2.67	102.7	94.1	−8	Tacky
Toluene	+309.3	69.9	26.9	−53	Unchanged
Tide (1%)	+1.27	90.9	87.3	0	Sl. Tacky

	One Month Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+10.0	112.9	103.3	−13	Tacky
Benzaldehyde	+6.22	110.2	110.8	−17	Tacky
Dioctyl Phthalate	+3.09	104.8	103.7	−1	Tacky
Distilled Water	−0.71	95.2	94.3	+4	Unchanged
Ethyl Alcohol	+0.36	90.3	96.2	+2	Tacky
Ethyl Ether	+61.4	26.9	51.9	−29	Sl. Tacky
Hexane	+166.9	21.0	27.9	−33	Sl. Tacky
Hydrochloric Acid (10%)	−0.38	105.9	99.4	+3	Sl. Tacky
Lard	+4.02	105.4	105.7	−4	Sl. Tacky
Methyl Ethyl Ketone	+10.1	91.4	93.8	−16	Sl. Tacky
Perchloroethylene	+251.5	14.5	18.4	−37	Tacky
Potassium Permanganate (25%)	+0.38	88.7	84.9	+5	Brittle
Skydrol 500	+1.89	104.3	99.4	−4	Sl. Tacky
Sodium Chloride (25%)	−0.12	98.4	95.2	+2	Unchanged
Sodium Hydroxide (10%)	−0.12	104.3	96.6	+5	Unchanged
Toluene	+171.6	16.1	25.5	−36	Tacky
Tide (1%)	0.00	99.5	99.0	+6	Tacky

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+9.00	98.4	101.4	−12	Sl. Tacky
Benzaldehyde	+6.74	103.8	97.2	−17	Tacky
Dioctyl Phthalate	+5.06	100.0	99.0	−7	Tacky
Distilled Water	−0.83	109.7	99.0	+5	Unchanged
Ethyl Alcohol	+0.11	90.3	97.2	−1	Unchanged
Ethyl Ether	+57.5	31.2	50.5	−27	Unchanged
Hexane	+162.4	18.3	25.9	−32	Sl. Tacky
Hydrochloric Acid (10%)	+0.38	98.4	97.6	+2	Unchanged
Lard	+9.72	111.3	103.3	−8	Unchanged
Methyl Ethyl Ketone	+7.55	93.6	94.3	−14	Sl. Tacky
Perchloroethylene	+264.2	14.0	19.4	−38	Sl. Tacky
Potassium Permanganate (25%)	+4.30	95.7	89.1	+5	Unchanged
Skydrol 500	+4.40	104.8	101.4	−12	Unchanged
Sodium Chloride (25%)	−0.97	101.1	94.8	+6	Unchanged
Sodium Hydroxide (10%)	+1.16	97.3	96.6	+4	Unchanged
Toluene	+187.4	17.2	27.3	−37	Tacky
Tide (1%)	0.00	102.2	98.6	+2	Sl. Tacky

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+4.15	103.8	100.0	−12	Sl. Tacky
Benzaldehyde	+1.87	97.9	99.4	−15	Tacky
Dioctyl Phthalate	+8.42	102.2	99.4	−9	Tacky
Distilled Water	−0.71	101.1	96.2	+4	Unchanged
Ethyl Alcohol	−0.24	89.3	97.6	−2	Sl. Tacky
Ethyl Ether	+54.5	33.3	48.5	−28	Unchanged
Hexane	+162.5	18.8	26.9	−36	Tacky
Hydrochloric Acid (10%)	+0.38	100.0	88.7	+3	Unchanged
Lard	+12.0	116.1	101.8	−16	Sl. Tacky
Methyl Ethyl Ketone	+8.65	91.9	91.5	−13	Sl. Tacky
Perchloroethylene	+256.5	14.5	20.2	−39	Tacky
Potassium Permanganate (25%)	+7.06	96.2	88.7	−3	Sl. Brittle
Skydrol 500	+5.73	101.1	99.0	−13	Unchanged
Sodium Chloride (25%)	+0.24	97.3	96.6	+5	Unchanged
Sodium Hydroxide (10%)	+0.58	103.2	95.8	+4	Unchanged
Toluene	+166.3	18.3	28.7	−37	Tacky
Tide (1%)	+0.37	103.8	104.2	+3	Sl. Tacky

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+6.00	96.2	100.4	−12	Sl. Tacky
Benzaldehyde	+4.65	97.9	98.6	−15	Sl. Tacky
Dioctyl Phthalate	+11.6	102.7	112.7	−18	Tacky
Distilled Water	+0.12	102.2	99.7	+3	Unchanged
Ethyl Alcohol	+0.97	93.6	100.0	−2	Sl. Tacky
Ethyl Ether	+48.8	29.0	46.3	−31	Unchanged
Hexane	+123.2	15.1	28.7	−37	Sl. Tacky
Hydrochloric Acid (10%)	−0.13	104.3	97.6	+1	Unchanged
Lard	+21.8	111.3	103.3	−23	Sl. Tacky
Methyl Ethyl Ketone	+7.93	100.5	92.9	−12	Sl. Tacky
Perchloroethylene	+262.1	15.1	18.8	−41	Tacky
Potassium Permanganate (25%)	+7.95	89.3	87.7	+4	Sl. Brittle
Skydrol 500	+4.81	101.6	99.4	−12	Unchanged
Sodium Chloride (25%)	+0.48	96.8	97.2	+2	Unchanged
Sodium Hydroxide (10%)	+0.81	100.0	94.8	+5	Unchanged
Toluene	+131.9	13.4	28.7	−38	Tacky
Tide (1%)	+1.73	103.8	98.6	+5	Sl. Tacky

CHEMICAL RESISTANCE OF CHLOROBUTYL 1066 COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+7.86	95.0	93.4	−3	Unchanged
A.S.T.M. No. 1 Oil	+78.8	47.0	62.8	−27	Sl. Tacky
A.S.T.M. No. 3 Oil	+168.1	28.3	51.1	−34	Sl. Tacky
Benzaldehyde	+50.8	67.2	57.2	−14	Sl. Tacky
Dioctyl Phthalate	+29.0	75.3	68.9	−16	Unchanged
Distilled Water	+6.96	98.0	74.6	0	Sl. Tacky
Ethyl Alcohol	+4.92	92.4	72.9	−1	Unchanged
Ethyl Ether	+62.6	38.9	40.7	−20	Sl. Tacky
Gasoline (RON 99)	+167.1	21.7	28.9	−34	Unchanged
Hexane	+129.0	29.8	28.9	−25	Unchanged
Hydrochloric Acid (10%)	+4.07	102.0	84.0	+1	Sl. Tacky
Lard	+27.2	78.3	67.5	−16	Unchanged
Methyl Ethyl Ketone	+19.9	61.6	61.2	−14	Unchanged
Perchloroethylene	+262.4	18.7	21.9	−33	Unchanged
Potassium Permanganate (25%)	+2.59	97.0	72.9	+1	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Skydrol 500	+19.4	74.8	74.6	−15	Unchanged
Sodium Chloride (25%)	+0.96	104.5	76.0	+1	Unchanged
Sodium Hydroxide (10%)	+1.92	102.0	84.7	+1	Sl. Tacky
Toluene	+238.2	17.7	29.9	−41	Unchanged
Tide (1%)	+5.94	99.5	76.0	−2	Sl. Tacky
UDMH	+18.6	84.9	45.7	−14	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+4.89	91.9	87.1	+1	Tacky
A.S.T.M. No 1 Oil	+11.1	84.3	75.3	−4	Sl. Tacky
A.S.T.M. No. 3 Oil	+39.5	53.5	49.4	−13	Unchanged
Benzaldehyde	+21.9	71.7	62.8	−9	Tacky
Dioctyl Phthalate	+2.71	95.5	85.4	+2	Sl. Tacky
Distilled Water	−0.11	102.0	91.8	+2	Unchanged
Ethyl Alcohol	+1.78	99.0	91.1	+3	Tacky
Ethyl Ether	+64.4	34.9	35.3	−20	Sl. Tacky
Gasoline (RON 99)	+158.2	25.8	23.5	−23	Unchanged
Hexane	+138.4	28.3	25.2	−21	Sl. Tacky
Hydrochloric Acid (10%)	+0.68	103.5	93.4	+3	Unchanged
Lard	+3.75	90.9	84.7	−4	Sl. Tacky
Methyl Ethyl Ketone	+16.7	77.3	66.6	−10	Sl. Tacky
Perchloroethylene	+170.0	24.2	21.2	−23	Sl. Tacky
Potassium Permanganate (25%)	+0.69	102.5	84.7	+4	Unchanged
Skydrol 500	+2.45	101.5	91.1	+2	Sl. Tacky
Sodium Chloride (25%)	−0.12	104.5	91.8	+2	Unchanged
Sodium Hydroxide (10%)	0.00	102.5	92.5	+4	Unchanged
Toluene	+179.9	29.3	28.2	−22	Sl. Tacky
Tide (1%)	+1.01	101.5	92.5	+4	Unchanged
UDMH	+17.8	83.3	77.6	−11	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+6.64	94.4	90.1	0	Sl. Tacky
A.S.T.M. No. 1 Oil	+21.8	77.8	65.9	−9	Unchanged
A.S.T.M. No. 3 Oil	+114.8	46.0	37.5	−21	Unchanged
Benzaldehyde	+31.7	63.1	54.1	−10	Tacky
Dioctyl Phthalate	+6.32	97.0	85.4	−1	Sl. Tacky
Distilled Water	+0.58	104.0	91.8	+4	Unchanged
Ethyl Alcohol	+1.46	93.9	80.0	−3	Sl. Tacky
Ethyl Ether	+62.8	33.8	36.9	−20	Unchanged
Gasoline (RON 99)	+193.2	30.3	27.5	−22	Unchanged
Hexane	+156.3	30.8	25.9	−21	Sl. Tacky
Hydrochloric Acid (10%)	+0.63	98.0	87.8	+3	Unchanged
Lard	+8.20	96.0	87.1	−5	Unchanged
Methyl Ethyl Ketone	+15.6	74.2	64.2	−9	Unchanged
Perchloroethylene	+220.0	22.2	19.5	−23	Sl. Tacky
Potassium Permanganate (25%)	+2.41	100.5	86.4	+4	Unchanged
Skydrol 500	+2.80	99.5	85.4	+1	Sl. Tacky
Sodium Chloride (25%)	0.00	103.0	88.7	+4	Unchanged
Sodium Hydroxide (10%)	+0.46	99.0	84.0	+2	Unchanged
Toluene	+182.5	29.3	27.5	−21	Unchanged
Tide (1%)	+1.13	100.0	87.8	+1	Unchanged
UDMH	+17.0	72.7	68.9	−11	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+4.05	96.5	91.8	0	Tacky
A.S.T.M. No. 1 Oil	+43.7	66.2	55.8	−15	Sl. Tacky
A.S.T.M. No. 3 Oil	+157.0	43.4	33.6	−25	Unchanged
Benzaldehyde	+36.5	54.0	48.7	−11	Tacky
Dioctyl Phthalate	+9.38	93.4	82.4	−4	Sl. Tacky
Distilled Water	+1.97	100.5	81.7	+2	Unchanged
Ethyl Alcohol	+1.43	100.0	88.2	+1	Sl. Tacky
Ethyl Ether	+59.8	37.4	36.9	−21	Unchanged
Gasoline (RON 99)	+189.0	24.8	26.6	−25	Sl. Tacky
Hexane	+131.6	31.8	26.6	−21	Sl. Tacky
Hydrochloric Acid (10%)	+0.89	100.0	87.1	+4	Unchanged
Lard	+14.7	90.9	76.0	−9	Sl. Tacky
Methyl Ethyl Ketone	+14.7	77.8	64.2	−9	Unchanged
Perchloroethylene	+213.4	24.2	20.5	−23	Unchanged
Potassium Permanganate (25%)	+4.59	106.1	86.4	+4	Sl. Brittle
Skydrol 500	+4.79	98.5	87.1	0	Sl. Tacky
Sodium Chloride (25%)	+0.12	97.0	84.0	+4	Unchanged
Sodium Hydroxide (10%)	+0.23	112.5	87.8	+4	Unchanged
Toluene	+191.3	31.3	26.6	−23	Sl. Tacky
Tide (1%)	+2.27	100.0	83.1	+1	Unchanged
UDMH	+14.5	73.7	71.3	−9	Sl. Tacky

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+7.58	89.9	92.5	−3	Tacky
A.S.T.M. No. 1 Oil	+52.8	63.6	54.1	−20	Sl. Tacky
A.S.T.M. No. 3 Oil	+135.0	39.9	33.7	−21	Unchanged
Benzaldehyde	+44.5	49.5	46.4	−13	Tacky
Dioctyl Phthalate	+12.8	96.0	82.4	−6	Sl. Tacky
Distilled Water	+2.56	101.5	88.7	+4	Unchanged
Ethyl Alcohol	+2.82	99.0	82.4	+2	Sl. Tacky
Ethyl Ether	+70.0	34.3	37.6	−22	Unchanged
Gasoline (RON 99)	+155.0	25.8	25.2	−26	Sl. Tacky
Hexane	+110.4	25.8	29.9	−28	Sl. Tacky
Hydrochloric Acid (10%)	+1.90	101.5	80.7	+5	Unchanged
Lard	+19.9	87.4	81.2	−11	Sl. Tacky
Methyl Ethyl Ketone	+14.1	75.3	66.6	−8	Unchanged
Perchloroethylene	+220.0	21.7	22.3	−25	Sl. Tacky
Potassium Permanganate (25%)	+6.64	98.0	77.6	+4	Sl. Brittle
Skydrol 500	+5.27	97.0	88.7	−1	Sl. Tacky
Sodium Chloride (25%)	+0.25	98.0	86.4	+4	Unchanged
Sodium Hydroxide (10%)	+0.80	100.5	84.0	+2	Unchanged
Toluene	+127.5	25.8	27.5	−22	Sl. Tacky
Tide (1%)	+4.03	102.0	87.4	+4	Sl. Tacky
UDMH	+13.5	72.2	72.2	−10	Unchanged

CHEMICAL RESISTANCE OF VISTALON 404 COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+5.60	105.0	114.0	−3	Sl. Tacky
A.S.T.M. No. 1 Oil	+129.2	53.3	46.2	−34	Swollen
A.S.T.M. No. 3 Oil	+216.4	38.9	33.3	−35	Swollen
Benzaldehyde	+26.4	85.0	80.3	−13	Sl. Tacky
Dioctyl Phthalate	+39.6	88.5	82.8	−18	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Distilled Water	+0.65	106.1	102.2	+2	Unchanged
Ethyl Alcohol	−1.31	107.7	105.0	−4	Unchanged
Ethyl Ether	+97.0	41.5	38.5	−28	Unchanged
Gasoline (RON 99)	+187.8	38.4	35.2	−37	Swollen
Hexane	+177.6	36.9	30.2	−30	Sl. Brittle
Hydrochloric Acid (10%)	+5.80	100.0	88.0	+1	Unchanged
Hydrochloric Acid (Conc.)	+37.7	80.5	72.6	−10	Unchanged
Lard	+64.0	69.2	66.7	−26	Swollen
Methyl Ethyl Ketone	+16.3	83.0	78.3	−12	Unchanged
Perchloroethylene	+207.1	23.6	40.4	−40	Unchanged
Potassium Permanganate (25%)	+0.84	103.7	94.3	+5	Unchanged
Skydrol 500	+9.54	99.8	101.0	−4	Unchanged
Sodium Chloride (25%)	+0.93	111.5	101.8	0	Unchanged
Sodium Hydroxide (10%)	+0.40	107.0	91.0	+3	Unchanged
Sulfuric Acid (Conc.)	+57.9	Brittle	Brittle	+36	Cracked
Tide (1%)	+0.91	102.7	100.0	+1	Swollen
Toluene	+218.1	22.6	30.2	−35	Unchanged
UDMH	+16.5	86.4	97.5	−11	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+2.14	103.8	109.5	+2	Sl. Tacky
A.S.T.M. No. 1 Oil	+70.1	57.2	47.2	−23	Swollen
A.S.T.M. No. 3 Oil	+214.4	46.8	34.0	−29	Swollen
Benzaldehyde	+15.9	79.8	76.8	−8	Unchanged
Dioctyl Phthalate	+9.08	103.6	94.0	−4	Unchanged
Distilled Water	−0.10	109.3	105.1	+5	Unchanged
Ethyl Alcohol	+0.12	101.9	102.5	+1	Sl. Tacky
Ethyl Ether	+99.9	36.9	38.5	−27	Sl. Tacky
Gasoline (RON 99)	+166.8	40.8	33.3	−30	Swollen
Hexane	+190.9	36.4	28.9	−32	Sl. Brittle
Hydrochloric Acid (10%)	+0.94	114.4	110.1	+5	Sl. Tacky
Hydrochloric Acid (Conc.)	+7.53	101.6	116.7	+3	Sl. Tacky
Lard	+23.9	93.2	83.6	−13	Unchanged
Methyl Ethyl Ketone	+8.59	92.7	83.6	−8	Unchanged
Perchloroethylene	+93.3	45.8	44.3	−29	Unchanged
Potassium Permanganate (25%)	+1.04	94.5	83.8	+8	Unchanged
Skydrol 500	+1.08	104.3	103.8	+3	Unchanged
Sodium Chloride (25%)	+0.02	107.8	103.8	+6	Unchanged
Sodium Hydroxide (10%)	+0.14	103.6	99.5	+3	Unchanged
Sulfuric Acid (Conc.)	+10.1	61.1	74.4	+4	Unchanged
Tide (1%)	+0.43	112.3	107.1	+6	Sl. Tacky
Toluene	+182.9	34.0	28.9	−31	Unchanged
UDMH	+7.68	93.7	99.3	−4	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+2.26	103.8	110.8	+2	Unchanged
A.S.T.M. No. 1 Oil	+108.4	51.7	44.8	−27	Swollen
A.S.T.M. No. 3 Oil	+218.4	39.4	32.7	−31	Swollen
Benzaldehyde	+27.3	77.8	74.4	−8	Unchanged
Dioctyl Phthalate	+9.92	103.7	101.0	−3	Unchanged
Distilled Water	+0.44	106.9	106.5	+5	Unchanged
Ethyl Alcohol	+0.25	97.2	104.5	+4	Unchanged
Ethyl Ether	+94.4	40.8	42.8	−28	Unchanged
Gasoline (RON 99)	+183.5	43.4	35.8	−33	Swollen
Hexane	+175.8	32.5	32.7	−30	Swollen
Hydrochloric Acid (10%)	+1.02	105.0	106.5	+6	Sl. Tacky
Hydrochloric Acid (Conc.)	+11.0	95.5	113.0	−2	Unchanged
Lard	+20.9	85.2	92.8	−14	Unchanged
Methyl Ethyl Ketone	+8.54	98.5	93.7	−5	Sl. Tacky
Perchloroethylene	+88.1	41.8	46.8	−27	Swollen

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Potassium Permanganate (25%)	+2.67	87.8	88.5	+6	–
Skydrol 500	+1.15	104.3	105.1	0	Unchanged
Sodium Chloride (25%)	+0.15	107.8	106.5	−3	Unchanged
Sodium Hydroxide (10%)	+0.28	103.7	101.8	−7	Unchanged
Sulfuric Acid (Conc.)	+32.2	39.9	48.2	+1	Unchanged
Tide (1%)	+0.56	102.7	100.0	−7	Unchanged
Toluene	+169.9	31.1	32.7	−31	Swollen
UDMH	+8.98	93.7	100.0	−3	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+1.99	98.5	103.2	−1	Unchanged
A.S.T.M. No. 1 Oil	+130.0	51.2	44.8	−25	Swollen
A.S.T.M. No. 3 Oil	+213.5	41.4	37.6	−27	Swollen
Benzaldehyde	+38.2	77.4	74.4	−10	Unchanged
Dioctyl Phthalate	+10.1	105.5	107.2	−6	Unchanged
Distilled Water	+0.66	103.8	104.4	−6	Unchanged
Ethyl Alcohol	−0.28	99.8	101.8	−3	Unchanged
Ethyl Ether	+87.5	39.4	41.0	−25	Unchanged
Gasoline (RON 99)	+181.6	42.8	37.8	−30	Swollen
Hexane	+167.3	32.3	32.5	−27	Swollen
Hydrochloric Acid (10%)	+1.63	97.2	108.2	−4	Sl. Tacky
Hydrochloric Acid (Conc.)	+14.8	86.8	98.2	−3	Unchanged
Lard	+34.8	83.0	85.5	−18	Unchanged
Methyl Ethyl Ketone	+8.09	94.0	90.4	−6	Sl. Tacky
Perchloroethylene	+86.8	40.3	45.7	−26	Swollen
Potassium Permanganate (25%)	+2.65	93.7	94.3	−3	–
Skydrol 500	+1.05	106.5	105.2	−2	Unchanged
Sodium Chloride (25%)	+0.07	99.8	103.2	−4	Unchanged
Sodium Hydroxide (10%)	+0.33	103.7	101.8	−4	Unchanged
Sulfuric Acid (Conc.)	+42.6	23.4	28.3	−2	Unchanged
Tide (1%)	+0.53	103.7	103.8	−4	Sl. Tacky
Toluene	+156.4	30.4	32.5	−27	Swollen
UDMH	+9.74	91.7	96.8	−3	Unchanged

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+1.90	105.4	108.3	−1	Unchanged
A.S.T.M. No. 1 Oil	+144.2	53.2	44.2	−29	Swollen
A.S.T.M. No. 3 Oil	+211.8	42.8	34.1	−29	Swollen
Benzaldehyde	+31.3	81.3	75.0	−12	Sl. Tacky
Dioctyl Phthalate	+10.5	108.9	104.5	−6	Unchanged
Distilled Water	+0.55	107.9	108.9	+3	Unchanged
Ethyl Alcohol	−0.06	107.4	108.2	+2	Unchanged
Ethyl Ether	+107.5	38.5	40.3	−25	Unchanged
Gasoline (RON 99)	+179.4	42.8	34.6	−30	Swollen
Hexane	+193.5	32.5	30.8	−28	Swollen
Hydrochloric Acid (10%)	+1.54	110.2	108.2	+2	Sl. Tacky
Hydrochloric Acid (Conc.)	+23.3	75.8	82.7	−4	Unchanged
Lard	+32.1	83.8	79.4	−16	Unchanged
Methyl Ethyl Ketone	+10.3	98.6	96.9	−6	Sl. Tacky
Perchloroethylene	+103.8	42.4	49.4	−30	Swollen
Potassium Permanganate (25%)	+2.50	98.8	99.3	0	–
Skydrol 500	+1.01	110.4	103.3	−1	Unchanged
Sodium Chloride (25%)	+0.01	103.2	100.0	+3	Unchanged
Sodium Hydroxide (10%)	+0.19	101.9	102.5	+1	Unchanged
Sulfuric Acid (Conc.)	+76.7	10.3	5.2	−3	Unchanged
Tide (1%)	+0.69	109.8	106.2	−2	Sl. Tacky
Toluene	+178.6	37.9	32.8	−30	Swollen
UDMH	+12.4	102.4	98.2	−8	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF COMPOUND BASED ON HIGH MOONEY EPDM

	72 Hours Immersion at 212°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+1.72	98.5	87.6	−1	Sl. Tacky
A.S.T.M. No. 1 Oil	+83.1	51.7	49.5	−25	Swollen
A.S.T.M. No. 3 Oil	+119.9	35.9	37.2	−28	Swollen
Benzaldehyde	+12.8	77.0	72.4	−10	Unchanged
Dioctyl Phthalate	+24.7	83.0	73.0	−11	Unchanged
Distilled Water	+1.10	104.7	85.0	0	Unchanged
Ethyl Alcohol	−3.47	95.6	83.6	+1	Unchanged
Ethyl Ether	+62.6	36.0	36.3	−16	Unchanged
Gasoline (RON 99)	+121.8	35.5	38.0	−25	Swollen
Hexane	+93.4	28.1	25.8	−18	Unchanged
Hydrochloric Acid (10%)	+14.6	74.8	60.0	0	Unchanged
Hydrochloric Acid (Conc.)	+32.3	70.7	60.9	−8	Unchanged
Lard	+38.9	65.0	63.7	−19	Unchanged
Methyl Ethyl Ketone	+5.15	72.1	73.5	−7	Unchanged
Perchloroethylene	+109.7	20.7	31.4	−27	Unchanged
Potassium Permanganate (25%)	+1.65	99.5	78.0	+1	Unchanged
Skydrol 500	+2.08	104.4	89.5	−1	Unchanged
Sodium Chloride (25%)	+2.69	94.7	73.5	0	Unchanged
Sodium Hydroxide (10%)	+0.43	98.8	74.3	0	Unchanged
Sulfuric (Acid (Conc.)	+66.9	44.7	0	+29	Cracked
Tide (1%)	+1.63	88.6	77.2	+1	Unchanged
Toluene	+150.2	23.0	30.6	−25	Unchanged
UDMH	+5.22	70.1	66.5	−1	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+5.05	93.4	90.7	−1	Sl. Tacky
A.S.T.M. No. 1 Oil	+53.1	56.7	48.5	−13	Swollen
A.S.T.M. No. 3 Oil	+128.6	44.7	35.9	−16	Swollen
Benzaldehyde	+3.00	75.4	71.4	−4	Sl. Tacky
Dioctyl Phthalate	+3.35	91.2	87.7	−2	Unchanged
Distilled Water	+0.37	104.5	94.4	+2	Unchanged
Ethyl Alcohol	−0.65	97.5	89.5	+1	Sl. Tacky
Ethyl Ether	+61.6	33.3	36.3	−12	Sl. Tacky
Gasoline (RON 99)	+106.9	42.8	36.3	−17	Swollen
Hexane	+119.2	32.7	25.8	−13	Unchanged
Hydrochloric Acid (10%)	+1.22	104.2	94.4	+1	Unchanged
Hydrochloric Acid (Conc.)	+4.37	102.4	92.3	+2	Unchanged
Lard	+20.8	77.7	76.3	−8	Unchanged
Methyl Ethyl Ketone	+0.28	76.5	77.2	−1	Unchanged
Perchloroethylene	+73.5	37.4	36.3	−17	Unchanged
Potassium Permanganate (25%)	+0.59	105.4	96.3	+2	Unchanged
Skydrol 500	−5.99	102.4	97.2	+2	Unchanged
Sodium Chloride (25%)	+0.04	102.2	93.5	+2	Unchanged
Sodium Hydroxide (10%)	+0.45	104.5	95.2	+2	Unchanged
Sulfuric (Acid (Conc.)	+7.81	52.3	37.8	+6	Unchanged
Tide (1%)	+1.61	100.8	94.4	+3	Sl. Tacky
Toluene	+121.1	28.5	26.6	−16	Unchanged
UDMH	+1.65	75.2	60.8	+2	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+4.97	90.8	89.5	−1	Unchanged
A.S.T.M. No. 1 Oil	+75.0	51.7	46.7	−17	Swollen
A.S.T.M. No. 3 Oil	+128.4	36.5	30.6	−17	Swollen
Benzaldehyde	+7.30	83.8	80.8	−4	Unchanged
Dioctyl Phthalate	+3.52	99.5	97.2	−2	Unchanged
Distilled Water	+0.69	106.0	97.2	+2	Unchanged
Ethyl Alcohol	−0.67	95.8	91.5	+1	Unchanged
Ethyl Ether	+63.7	39.6	40.8	−13	Sl. Tacky
Gasoline (RON 99)	+111.1	43.8	40.0	−18	Swollen
Hexane	+111.4	30.4	31.5	−15	Swollen

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Hydrochloric Acid (10%)	+1.30	90.8	83.6	+1	Sl. Tacky
Hydrochloric Acid (Conc.)	+9.43	97.5	91.5	−1	Unchanged
Lard	+25.5	61.7	62.0	−9	Unchanged
Methyl Ethyl Ketone	+0.62	85.7	85.7	−1	Sl. Tacky
Perchloroethylene	+72.8	37.8	41.4	−17	Swollen
Potassium Permanganate (25%)	−0.91	91.7	89.5	+2	–
Skydrol 500	−5.95	101.8	96.3	−1	Unchanged
Sodium Chloride (25%)	+0.23	103.8	97.8	+1	Unchanged
Sodium Hydroxide (10%)	+0.26	99.5	93.5	+3	Unchanged
Sulfuric (Acid (Conc.)	+32.1	35.5	22.8	+9	Unchanged
Tide (1%)	+1.90	102.2	97.2	+2	Unchanged
Toluene	+117.3	26.1	29.4	−16	Swollen
UDMH	+3.13	71.8	58.7	0	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+4.55	93.9	95.3	−1	Unchanged
A.S.T.M. No. 1 Oil	+85.0	50.7	48.5	−15	Swollen
A.S.T.M. No. 3 Oil	+129.7	41.8	37.8	−15	Swollen
Benzaldehyde	+9.90	87.8	80.0	−3	Unchanged
Dioctyl Phthalate	+3.72	96.4	94.4	−2	Unchanged
Distilled Water	+0.93	104.2	100.0	+1	Unchanged
Ethyl Alcohol	−0.51	93.2	87.7	+1	Unchanged
Ethyl Ether	+59.4	38.9	40.0	−11	Sl. Tacky
Gasoline (RON 99)	+110.5	35.5	37.8	−17	Swollen
Hexane	+103.0	30.4	31.5	−14	Swollen
Hydrochloric Acid (10%)	+2.00	97.5	89.5	+2	Sl. Tacky
Hydrochloric Acid (Conc.)	+12.5	92.6	80.8	−2	Unchanged
Lard	+27.0	72.8	74.3	−10	Unchanged
Methyl Ethyl Ketone	+0.36	76.0	77.2	0	Sl. Tacky
Perchloroethylene	+73.2	37.3	39.2	−15	Swollen
Potassium Permanganate (25%)	+1.88	95.0	89.5	+3	–
Skydrol 500	−5.73	91.7	91.5	+2	Unchanged
Sodium Chloride (25%)	+0.20	98.8	95.2	−2	Unchanged
Sodium Hydroxide (10%)	+0.26	100.9	93.5	−1	Unchanged
Sulfuric (Acid (Conc.)	+45.2	23.8	11.4	+8	Unchanged
Tide (1%)	+1.82	104.9	98.0	+1	Sl. Tacky
Toluene	+115.3	26.3	28.6	−14	Swollen
UDMH	+4.30	70.0	56.3	+2	Unchanged

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+6.53	95.0	95.2	−3	Unchanged
A.S.T.M. No. 1 Oil	+90.9	47.8	43.7	−18	Swollen
A.S.T.M. No. 3 Oil	+144.4	42.8	36.3	−22	Swollen
Benzaldehyde	+7.63	87.9	80.0	−4	Unchanged
Dioctyl Phthalate	+4.02	110.3	96.4	−3	Unchanged
Distilled Water	+1.92	103.6	94.3	0	Unchanged
Ethyl Alcohol	+0.33	100.3	93.5	0	Unchanged
Ethyl Ether	+69.4	35.3	23.6	−10	Sl. Tacky
Gasoline (RON 99)	+110.4	38.7	36.3	−18	Swollen
Hexane	+128.3	30.4	29.5	−13	Swollen
Hydrochloric Acid (10%)	+3.86	88.0	80.0	+1	Sl. Tacky
Hydrochloric Acid (Conc.)	+18.3	79.7	66.5	0	Unchanged
Lard	+27.2	69.2	69.5	−9	Unchanged
Methyl Ethyl Ketone	+2.04	74.6	73.5	−1	Sl. Tacky
Perchloroethylene	+75.9	32.7	31.5	−14	Swollen
Potassium Permanganate (25%)	+2.46	101.8	93.4	+2	–
Skydrol 500	−5.47	100.8	92.3	+1	Unchanged
Sodium Chloride (25%)	−0.14	96.7	87.7	+2	Unchanged
Sodium Hydroxide (10%)	+0.29	100.8	90.6	0	Unchanged
Sulfuric (Acid (Conc.)	+55.8	Broken	Broken	+19	Sl. Brittle
Tide (1%)	+2.83	105.0	93.5	−1	Sl. Tacky
Toluene	+114.6	39.9	30.5	−16	Swollen
UDMH	+21.9	61.3	43.6	−3	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF HIGHLY LOADED COMPOUND BASED ON HIGH MOONEY EPDM

	72 Hours Immersion at 212°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	−10.7	116.0	81.9	+10	Unchanged
A.S.T.M. No. 1 Oil	+57.1	108.0	89.3	−31	Swollen
A.S.T.M. No. 3 Oil	+103.3	65.2	68.0	−39	Swollen
Benzaldehyde	−5.26	102.3	68.0	+4	Unchanged
Dioctyl Phthalate	+3.11	112.3	84.0	−2	Unchanged
Distilled Water	+0.66	117.3	87.1	0	Unchanged
Ethyl Alcohol	−16.4	110.2	85.6	+12	Unchanged
Ethyl Ether	+21.9	83.8	68.0	−20	Unchanged
Gasoline (RON 99)	+85.6	69.5	68.0	−35	Swollen
Hexane	+59.8	58.7	48.2	−28	Unchanged
Hydrochloric Acid (10%)	+9.35	121.0	87.1	−4	Unchanged
Hydrochloric Acid (Conc.)	+25.2	109.5	90.9	−13	Unchanged
Lard	+19.4	116.0	85.6	−15	Unchanged
Methyl Ethyl Ketone	−8.71	76.5	64.1	+4	Unchanged
Perchloroethylene	+68.5	60.8	60.5	−38	Brittle
Potassium Permanganate (25%)	+3.13	134.0	92.5	+2	Unchanged
Skydrol 500	−9.89	114.5	69.5	+9	Unchanged
Sodium Chloride (25%)	−0.18	123.0	89.3	−3	Unchanged
Sodium Hydroxide (10%)	+0.76	126.0	89.3	+2	Unchanged
Sulfuric Acid (Conc.)	+74.2	65.0	—	+16	Broken
Tide (1%)	+1.55	119.5	85.6	+1	Unchanged
Toluene	+96.9	42.2	48.2	−38	Sl. Brittle
UDMH	−10.6	99.5	69.5	+7	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	−5.40	105.7	94.7	+5	Unchanged
A.S.T.M. No. 1 Oil	+29.3	116.2	90.8	−19	Swollen
A.S.T.M. No. 3 Oil	+81.1	80.8	64.2	−26	Swollen
Benzaldehyde	−5.76	98.6	85.5	+4	Unchanged
Dioctyl Phthalate	−5.18	97.7	89.5	+2	Unchanged
Distilled Water	+0.16	115.8	94.4	+2	Unchanged
Ethyl Alcohol	−6.77	102.8	92.6	+6	Unchanged
Ethyl Ether	+27.5	86.4	73.2	−16	Unchanged
Gasoline (RON 99)	+69.8	77.8	64.2	−28	Swollen
Hexane	+70.8	61.4	44.3	−25	Unchanged
Hydrochloric Acid (10%)	+0.49	121.4	97.8	+2	Sl. Tacky
Hydrochloric Acid (Conc.)	+4.31	126.3	94.7	+2	Unchanged
Lard	+7.99	104.2	92.6	−8	Unchanged
Methyl Ethyl Ketone	−7.73	95.8	85.5	+6	Unchanged
Perchloroethylene	+39.3	100.0	85.5	−24	Unchanged
Potassium Permanganate (25%)	+0.64	117.2	97.8	+2	Unchanged
Skydrol 500	−11.8	94.3	87.2	+8	Unchanged
Sodium Chloride (25%)	+0.05	117.8	97.8	0	Unchanged
Sodium Hydroxide (10%)	+0.08	119.8	100.0	+2	Unchanged
Sulfuric Acid (Conc.)	+15.5	64.4	26.7	−3	Unchanged
Tide (1%)	+0.21	117.2	97.8	+1	Sl. Tacky
Toluene	+72.9	60.7	54.5	−25	Sl. Brittle
UDMH	−8.76	110.7	58.5	+7	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	−5.43	103.5	105.3	+6	Unchanged
A.S.T.M. No. 1 Oil	+48.7	97.7	83.9	−24	Swollen
A.S.T.M. No. 3 Oil	+85.1	72.8	60.5	−29	Swollen
Benzaldehyde	−6.19	103.5	89.5	+4	Unchanged
Dioctyl Phthalate	−5.21	100.0	97.8	+4	Unchanged
Distilled Water	+0.35	123.0	105.3	+2	Unchanged
Ethyl Alcohol	−6.98	110.7	101.5	+3	Unchanged
Ethyl Ether	+28.1	86.4	81.9	−18	Unchanged
Gasoline (RON 99)	+71.6	80.0	69.5	−28	Swollen
Hexane	+62.2	63.5	53.8	−23	Swollen

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

Three Months Immersion at 75° ± 5°F	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hydrochloric Acid (10%)	+0.39	117.2	100.0	+1	Sl. Tacky
Hydrochloric Acid (Conc.)	+6.24	122.2	96.3	−1	Unchanged
Lard	+10.0	87.2	85.5	−11	Unchanged
Methyl Ethyl Ketone	−7.55	97.2	89.5	+6	Unchanged
Perchloroethylene	+34.5	97.7	81.9	−24	Swollen
Potassium Permanganate (25%)	+1.08	84.5	81.9	0	—
Skydrol 500	−11.5	92.2	85.5	+4	Unchanged
Sodium Chloride (25%)	+0.10	122.2	105.3	+2	Unchanged
Sodium Hydroxide (10%)	+1.12	121.4	105.3	+2	Unchanged
Sulfuric Acid (Conc.)	+33.9	42.2	9.4	0	Unchanged
Tide (1%)	+0.31	117.2	100.0	+2	Unchanged
Toluene	+64.6	62.2	55.0	−26	Swollen
UDMH	−7.84	113.5	62.6	+7	Unchanged

Six Months Immersion at 75° ± 5°F	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	−5.43	101.3	96.3	−4	Unchanged
A.S.T.M. No. 1 Oil	+55.6	93.7	89.5	−24	Swollen
A.S.T.M. No. 3 Oil	+85.9	74.4	65.8	−28	Swollen
Benzaldehyde	−7.03	103.7	85.6	−5	Unchanged
Dioctyl Phthalate	−5.15	102.3	92.5	+2	Unchanged
Distilled Water	+0.32	108.0	96.3	−2	Unchanged
Ethyl Alcohol	−6.56	103.5	94.7	+4	Unchanged
Ethyl Ether	+44.1	81.5	74.8	−13	Unchanged
Gasoline (RON 99)	+73.0	75.0	74.8	−29	Swollen
Hexane	+61.6	63.5	57.3	−28	Swollen
Hydrochloric Acid (10%)	+0.26	118.5	101.5	+2	Sl. Tacky
Hydrochloric Acid (Conc.)	+8.58	124.2	100.0	−3	Unchanged
Lard	+12.0	108.5	97.8	−13	Unchanged
Methyl Ethyl Ketone	−7.77	96.5	83.9	+5	Unchanged
Perchloroethylene	+32.1	91.8	80.2	−21	Swollen
Potassium Permanganate (25%)	+2.79	102.8	87.1	0	—
Skydrol 500	−11.5	99.4	90.9	+8	Unchanged
Sodium Chloride (25%)	−0.01	106.3	92.3	−2	Unchanged
Sodium Hydroxide (10%)	−0.08	113.5	97.3	0	Unchanged
Sulfuric Acid (Conc.)	+41.0	Broken	Broken	+3	Unchanged
Tide (1%)	+0.90	111.5	97.8	+1	Sl.Tacky
Toluene	+68.1	58.5	55.0	−27	Swollen
UDMH	−7.22	119.2	65.8	+6	Unchanged

12 Months Immersion at 75° ± 5°F	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	−4.31	109.2	97.8	+3	Unchanged
A.S.T.M. No. 1 Oil	+59.3	91.5	80.2	−28	Swollen
A.S.T.M. No. 3 Oil	+88.0	77.9	67.8	−29	Swollen
Benzaldehyde	−7.94	106.2	73.2	+5	Sl. Tacky
Dioctyl Phthalate	−5.18	108.5	89.3	+4	Unchanged
Distilled Water	+0.68	107.0	92.3	−1	Unchanged
Ethyl Alcohol	−5.64	116.3	96.3	+5	Unchanged
Ethyl Ether	+31.1	82.2	69.5	−20	Unchanged
Gasoline (RON 99)	+75.2	75.7	71.2	−29	Swollen
Hexane	+70.9	64.3	53.5	−22	Swollen
Hydrochloric Acid (10%)	+0.39	116.5	92.5	+1	Sl. Tacky
Hydrochloric Acid (Conc.)	+12.2	122.0	90.8	−4	Unchanged
Lard	+10.6	100.0	89.3	−9	Unchanged
Methyl Ethyl Ketone	−7.48	93.5	74.8	+3	Unchanged
Perchloroethylene	+36.8	100.0	71.2	−19	Swollen
Potassium Permanganate (25%)	+4.56	104.5	87.1	−2	—
Skydrol 500	−11.2	99.3	87.1	+10	Unchanged
Sodium Chloride (25%)	−0.34	111.5	96.3	+1	Unchanged
Sodium Hydroxide (10%)	+0.05	110.7	92.5	0	Unchanged
Sulfuric Acid (Conc.)	+44.1	Broken	Broken	+8	Sl. Brittle
Tide (1%)	+0.51	112.9	100.0	−1	Sl. Tacky
Toluene	+77.0	59.4	53.5	−28	Swollen
UDMH	+9.78	124.3	58.8	−5	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF NATURAL RUBBER COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+32.1	30.2	45.5	−19	Unchanged
A.S.T.M. No. 1 Oil	+77.6	38.7	70.0	−34	Unchanged
A.S.T.M. No. 3 Oil	+143.9	11.2	50.8	−35	Unchanged
Benzaldehyde	+244.8	4.3	16.2	−25	Unchanged
Dioctyl Phthalate	+147.7	10.2	27.7	−30	Unchanged
Distilled Water	+6.14	89.2	78.5	−3	Unchanged
Ethyl Alcohol	+2.35	78.4	58.4	0	Unchanged
Ethyl Ether	+84.6	34.8	34.6	−15	Unchanged
Hexane	+108.8	26.2	28.4	−20	Unchanged
Hydrochloric Acid (10%)	+11.2	61.0	49.2	−4	Sl. Tacky
Lard	+80.9	36.7	42.3	−20	Unchanged
Methyl Ethyl Ketone	+47.2	44.6	51.5	−21	Unchanged
Perchloroethylene	+465.4	3.6	17.8	−43	Unchanged
Potassium Permanganate (25%)	+3.15	54.4	49.2	−1	Sl. Brittle
Skydrol 500	+48.6	22.6	65.4	−41	Unchanged
Sodium Chloride (25%)	−0.36	89.5	83.1	−3	Unchanged
Sodium Hydroxide (10%)	+2.96	94.8	83.1	−5	Sl. Tacky
Toluene	Disintegrated				
Tide (1%)	+5.89	86.9	75.5	−3	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+8.90	94.4	90.1	−5	Sl. Tacky
A.S.T.M. No. 1 Oil	+24.6	88.2	82.5	−10	Unchanged
A.S.T.M. No. 3 Oil	+107.3	42.0	38.6	−18	Unchanged
Benzaldehyde	+78.3	34.4	38.1	−20	Unchanged
Dioctyl Phthalate	+64.3	54.4	53.1	−15	Unchanged
Distilled Water	+1.32	102.6	100.9	0	Unchanged
Ethyl Alcohol	+1.85	88.9	73.2	−4	Unchanged
Ethyl Ether	+95.5	28.2	32.3	−17	Unchanged
Hexane	+107.4	31.5	31.6	−16	Unchanged
Hydrochloric Acid (10%)	+2.17	96.1	91.7	−1	Unchanged
Lard	+51.3	63.6	60.1	−15	Unchanged
Methyl Ethyl Ketone	+46.8	53.4	56.1	−15	Unchanged
Perchloroethylene	+219.7	23.0	22.4	−20	Unchanged
Potassium Permanganate (25%)	+4.19	84.3	81.5	−3	Brittle
Skydrol 500	+25.8	89.2	88.5	−11	Unchanged
Sodium Chloride (25%)	−0.83	105.3	97.7	−1	Unchanged
Sodium Hydroxide (10%)	+0.72	102.3	97.7	−1	Unchanged
Toluene	+206.1	20.7	20.8	−20	Unchanged
Tide (1%)	+1.92	97.1	94.7	0	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+11.8	89.8	88.5	−7	Sl. Tacky
A.S.T.M. No. 1 Oil	+41.8	79.3	74.6	−10	Unchanged
A.S.T.M. No. 3 Oil	+102.2	41.0	38.6	−15	Unchanged
Benzaldehyde	+87.0	20.7	30.7	−24	Sl. Tacky
Dioctyl Phthalate	+78.4	57.4	55.4	−19	Unchanged
Distilled Water	+2.98	103.0	98.6	0	Unchanged
Ethyl Alcohol	+2.15	79.7	78.5	−3	Unchanged
Ethyl Ether	+119.3	24.3	31.6	−21	Unchanged
Hexane	+107.3	28.9	30.7	−18	Unchanged
Hydrochloric Acid (10%)	+3.61	84.0	79.2	−2	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Lard	+65.4	56.4	53.1	−17	Unchanged
Methyl Ethyl Ketone	+48.0	31.8	44.6	−20	Sl. Tacky
Perchloroethylene	+229.4	22.6	21.5	−23	Unchanged
Potassium Permanganate (25%)	−1.29	71.2	68.6	0	Brittle
Skydrol 500	+27.4	76.4	77.8	−10	Unchanged
Sodium Chloride (25%)	+0.71	98.0	91.7	+2	Unchanged
Sodium Hydroxide (10%)	+2.41	84.3	77.2	0	Unchanged
Toluene	+212.2	21.0	23.1	−23	Sl. Tacky
Tide (1%)	+3.28	97.1	91.7	−1	Sl. Tacky
	Six Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+10.8	89.5	87.1	−8	Sl. Tacky
A.S.T.M. No. 1 Oil	+47.9	71.8	67.7	−15	Unchanged
A.S.T.M. No. 3 Oil	+125.8	35.4	34.0	−20	Unchanged
Benzaldehyde	+91.6	11.5	23.1	−29	Sl. Tacky
Dioctyl Phthalate	+82.9	44.9	45.5	−20	Unchanged
Distilled Water	+3.34	97.7	91.7	0	Unchanged
Ethyl Alcohol	+1.81	76.7	73.9	−5	Unchanged
Ethyl Ether	+106.8	21.6	27.0	−23	Unchanged
Hexane	+104.5	30.2	30.0	−18	Unchanged
Hydrochloric Acid (10%)	+4.22	79.3	69.3	0	Unchanged
Lard	+68.8	51.5	50.1	−16	Unchanged
Methyl Ethyl Ketone	+50.8	24.6	38.6	−23	Sl. Tacky
Perchloroethylene	+255.0	19.0	20.8	−25	Unchanged
Potassium Permanganate (25%)	+0.65	61.0	53.1	−3	Brittle
Skydrol 500	+29.5	57.1	67.0	−18	Unchanged
Sodium Chloride (25%)	+1.31	87.5	81.5	0	Unchanged
Sodium Hydroxide (10%)	+3.49	74.1	67.0	−1	Unchanged
Toluene	+246.8	16.4	20.8	−26	Tacky
Tide (1%)	+4.75	98.0	92.4	0	Sl. Tacky
	12 Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+14.1	83.6	84.8	−7	Sl. Tacky
A.S.T.M. No. 1 Oil	+48.1	68.9	67.7	−20	Unchanged
A.S.T.M. No. 3 Oil	+128.8	33.4	34.6	−23	Unchanged
Benzaldehyde	+106.8	4.3	19.2	−36	Sl. Tacky
Dioctyl Phthalate	+90.0	32.8	39.9	−24	Unchanged
Distilled Water	+4.54	92.1	84.8	+4	Unchanged
Ethyl Alcohol	+3.59	74.8	68.6	−2	Unchanged
Ethyl Ether	+111.5	16.7	27.7	−29	Unchanged
Hexane	+81.7	25.3	30.0	−20	Sl. Tacky
Hydrochloric Acid (10%)	+5.06	67.2	60.1	+2	Sl. Tacky
Lard	+74.8	40.0	44.6	−24	Unchanged
Methyl Ethyl Ketone	+57.0	13.4	32.3	−30	Sl. Tacky
Perchloroethylene	+211.4	13.1	19.2	−30	Unchanged
Potassium Permanganate (25%)	+1.29	71.2	67.0	−3	Brittle
Skydrol 500	+32.4	37.4	53.8	−25	Unchanged
Sodium Chloride (25%)	−0.24	84.3	76.2	+3	Unchanged
Sodium Hydroxide (10%)	+7.34	57.1	50.8	0	Unchanged
Toluene	+187.6	12.5	20.8	−22	Sl. Tacky
Tide (1%)	+6.44	90.2	76.2	+2	Sl. Tacky

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF SBR COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+71.1	25.8	34.0	−26	Unchanged
A.S.T.M. No. 1 Oil	+24.9	84.4	66.0	−13	Unchanged
A.S.T.M. No. 3 Oil	+103.9	37.7	55.8	−26	Unchanged
Benzaldehyde	+150.6	22.5	25.5	−27	Unchanged
Dioctyl Phthalate	+86.2	41.8	40.5	−22	Unchanged
Distilled Water	+5.17	98.8	62.3	+2	Unchanged
Ethyl Alcohol	−0.12	70.9	47.3	+3	Unchanged
Ethyl Ether	+68.7	29.5	28.3	−17	Unchanged
Hexane	+61.6	31.2	32.0	−17	Unchanged
Hydrochloric Acid (10%)	+12.5	95.1	59.5	−2	Sl. Tacky
Lard	+45.8	64.3	51.8	−17	Unchanged
Methyl Ethyl Ketone	+52.4	29.9	33.1	−17	Unchanged
Perchloroethylene	+208.3	13.9	16.2	−28	Unchanged
Potassium Permanganate (25%)	+3.74	78.7	51.0	0	V. Brittle
Skydrol 500	+97.2	20.1	38.8	−37	Unchanged
Sodium Chloride (25%)	−0.11	102.5	65.2	+3	Unchanged
Sodium Hydroxide (10%)	+1.86	99.6	70.8	0	Unchanged
Toluene	+255.7	11.1	18.4	−38	Unchanged
Tide (1%)	+4.03	107.8	70.0	+2	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+20.3	67.2	58.1	−11	Sl. Tacky
A.S.T.M. No. 1 Oil	+5.21	104.9	92.6	−3	Unchanged
A.S.T.M. No. 3 Oil	+58.0	53.3	45.3	−18	Unchanged
Benzaldehyde	+105.8	28.3	26.4	−19	Unchanged
Dioctyl Phthalate	+53.3	53.3	47.3	−16	Unchanged
Distilled Water	+1.35	111.9	96.3	0	Unchanged
Ethyl Alcohol	+0.79	99.2	85.8	−1	Unchanged
Ethyl Ether	+74.8	29.5	29.2	−17	Sl. Tacky
Hexane	+92.5	32.0	30.3	−16	Sl. Tacky
Hydrochloric Acid (10%)	+2.04	109.8	92.6	+1	Unchanged
Lard	+16.2	70.5	61.5	−14	Unchanged
Methyl Ethyl Ketone	+47.5	34.4	34.8	−16	Sl. Tacky
Perchloroethylene	+190.5	24.6	19.8	−20	Sl. Tacky
Potassium Permanganate (25%)	+7.42	109.0	88.7	−2	V. Brittle
Skydrol 500	+46.6	56.5	53.0	−17	Unchanged
Sodium Chloride (25%)	+0.21	109.0	90.7	+1	Unchanged
Sodium Hydroxide (10%)	+0.71	108.2	90.7	+3	Unchanged
Toluene	+196.4	25.0	19.8	−19	Sl. Tacky
Tide (1%)	+2.16	107.8	96.3	+1	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	**Tensile Strength Retained %**	**Elongation Retained %**	**Hardness Change Pts.**	**Surface Condition**
Aniline	+22.1	54.8	50.1	−9	Sl. Tacky
A.S.T.M. No. 1 Oil	+9.70	98.4	84.1	+6	Unchanged
A.S.T.M. No. 3 Oil	+91.8	56.2	45.3	−17	Unchanged
Benzaldehyde	+104.8	21.7	22.7	−21	Sl. Tacky
Dioctyl Phthalate	+75.9	50.4	43.3	−16	Unchanged
Distilled Water	+2.93	117.6	93.5	+3	Unchanged
Ethyl Alcohol	+0.45	94.3	77.3	0	Unchanged
Ethyl Ether	+110.0	29.9	28.3	−17	Unchanged
Hexane	+93.0	31.9	32.0	−15	Sl. Tacky
Hydrochloric Acid (10%)	+3.95	109.4	87.8	+3	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

Three Months Immersion at 75° ± 5°F	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Lard	+54.7	68.0	60.3	−16	Unchanged
Methyl Ethyl Ketone	+53.1	32.4	31.1	−15	Unchanged
Perchloroethylene	+189.6	22.9	17.9	−20	Sl. Tacky
Potassium Permanganate (25%)	+9.10	101.2	79.3	−1	Brittle
Skydrol 500	+45.3	53.7	50.1	−12	Unchanged
Sodium Chloride (25%)	+0.52	113.9	94.3	+3	Unchanged
Sodium Hydroxide (10%)	+1.74	107.0	85.0	+1	Unchanged
Toluene	+189.1	23.8	17.1	−19	Sl. Tacky
Tide (1%)	+3.67	109.8	89.8	+2	Unchanged

Six Months Immersion at 75° ± 5°F	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+19.6	57.4	47.3	−5	Sl. Tacky
A.S.T.M. No. 1 Oil	+13.5	101.6	85.0	−6	Unchanged
A.S.T.M. No. 3 Oil	+88.2	52.5	41.6	−19	Unchanged
Benzaldehyde	+100.8	24.6	23.6	−22	Sl. Tacky
Dioctyl Phthalate	+83.4	54.9	44.5	−17	Unchanged
Distilled Water	+4.28	109.4	83.0	+3	Unchanged
Ethyl Alcohol	+1.26	89.8	71.7	0	Unchanged
Ethyl Ether	+73.7	28.7	27.5	−18	Unchanged
Hexane	+58.4	32.8	31.2	−15	Sl. Tacky
Hydrochloric Acid (10%)	+3.49	107.8	77.3	0	Unchanged
Lard	+46.3	75.5	66.0	−16	Unchanged
Methyl Ethyl Ketone	+52.9	37.3	34.0	−16	Unchanged
Perchloroethylene	+195.9	21.7	17.0	−17	Sl. Tacky
Potassium Permanganate (25%)	+9.31	91.4	70.0	−2	Brittle
Skydrol 500	+45.8	54.5	50.1	−18	Unchanged
Sodium Chloride (25%)	+1.25	108.6	85.0	+3	Unchanged
Sodium Hydroxide (10%)	+2.84	92.6	70.0	+3	Unchanged
Toluene	+201.8	18.4	16.2	−20	Sl. Tacky
Tide (1%)	+4.75	107.8	82.2	+3	Sl. Tacky

12 Months Immersion at 75° ± 5°F	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+26.5	57.4	56.7	−6	Sl. Tacky
A.S.T.M. No. 1 Oil	+14.9	96.7	82.2	−7	Unchanged
A.S.T.M. No. 3 Oil	+87.8	53.3	45.3	−19	Unchanged
Benzaldehyde	+110.0	16.0	21.8	−21	Sl. Tacky
Dioctyl Phthalate	+78.3	49.2	41.7	−17	Unchanged
Distilled Water	+6.08	111.9	76.5	+4	Unchanged
Ethyl Alcohol	+0.42	94.7	72.8	+2	Unchanged
Ethyl Ether	+82.8	26.2	27.5	−17	Unchanged
Hexane	+52.7	29.5	33.1	−16	Sl. Tacky
Hydrochloric Acid (10%)	+6.09	106.6	72.8	+3	Unchanged
Lard	+36.2	62.7	54.7	−17	Unchanged
Methyl Ethyl Ketone	+57.3	25.4	27.5	−16	Unchanged
Perchloroethylene	+204.2	21.7	19.8	−22	Unchanged
Potassium Permanganate (25%)	+11.2	77.9	55.8	−4	Brittle
Skydrol 500	+46.4	47.5	47.3	−17	Unchanged
Sodium Chloride (25%)	+0.11	109.0	83.0	+4	Unchanged
Sodium Hydroxide (10%)	+4.06	85.7	61.5	+1	Unchanged
Toluene	+156.6	13.9	17.9	−21	Sl. Tacky
Tide (1%)	+6.48	110.7	78.5	+4	Sl. Tacky

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF NITRILE RUBBER COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+250.9	17.8	21.7	−34	Unchanged
A.S.T.M. No. 1 Oil	−1.17	118.6	79.4	−1	Unchanged
A.S.T.M. No. 3 Oil	+11.3	104.4	83.0	−7	Unchanged
Benzaldehyde	+229.5	20.6	19.9	−28	Unchanged
Dioctyl Phthalate	+54.1	60.1	55.2	−19	Unchanged
Distilled Water	+7.16	117.4	97.5	−5	Unchanged
Ethyl Alcohol	+22.3	52.6	49.8	−10	Unchanged
Ethyl Ether	+33.5	53.0	51.6	−14	Sl. Tacky
Gasoline (RON 99)	+29.1	62.9	62.9	−16	Unchanged
Hexane	+9.71	66.4	57.8	−9	Unchanged
Hydrochloric Acid (10%)	+11.8	92.1	75.8	−4	Unchanged
Lard	+0.41	108.3	85.6	−2	Unchanged
Methyl Ethyl Ketone	+108.8	25.7	24.2	−24	Unchanged
Perchloroethylene	+51.4	43.5	48.0	−22	Unchanged
Potassium Permanganate (25%)	−5.87	83.0	57.8	+1	V. Brittle
Skydrol 500	+154.2	24.5	33.6	−34	Unchanged
Sodium Chloride (25%)	+1.09	109.9	84.8	−3	Unchanged
Sodium Hydroxide (10%)	+1.22	101.2	86.6	−5	Unchanged
Toluene	+124.8	10.7	17.0	−31	Unchanged
Tide (1%)	+7.54	106.3	86.6	−5	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+204.2	24.5	20.6	−23	Unchanged
A.S.T.M. No. 1 Oil	+2.69	104.0	93.9	−4	Unchanged
A.S.T.M. No. 3 Oil	+4.30	105.1	97.5	−7	Unchanged
Benzaldehyde	+198.2	26.1	22.7	−23	Unchanged
Dioctyl Phthalate	+15.7	79.8	74.7	−10	Unchanged
Distilled Water	+2.51	109.5	103.6	−4	Unchanged
Ethyl Alcohol	+11.0	86.2	82.0	−11	Unchanged
Ethyl Ether	+21.8	53.8	55.2	−15	Sl. Tacky
Gasoline (RON 99)	+35.9	80.2	78.3	−13	Unchanged
Hexane	+11.0	85.4	83.0	−9	Sl. Tacky
Hydrochloric Acid (10%)	+1.44	102.8	97.5	−3	Unchanged
Lard	+5.52	105.5	100.0	−3	Unchanged
Methyl Ethyl Ketone	+128.2	26.1	24.2	−23	Unchanged
Perchloroethylene	+43.2	60.5	60.3	−18	Sl. Tacky
Potassium Permanganate (25%)	+1.68	110.3	109.4	−7	V. Brittle
Skydrol 500	+134.2	37.9	35.0	−24	Unchanged
Sodium Chloride (25%)	+0.71	111.5	101.1	−2	Unchanged
Sodium Hydroxide (10%)	+1.11	111.1	100.0	−2	Unchanged
Toluene	+112.4	29.3	28.9	−23	Sl. Tacky
Tide (1%)	+2.54	101.2	93.9	−3	Sl. Tacky

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+211.8	29.6	21.7	−22	Unchanged
A.S.T.M. No. 1 Oil	−1.24	110.7	97.5	−3	Unchanged
A.S.T.M. No. 3 Oil	+4.54	109.1	97.5	−3	Unchanged
Benzaldehyde	+202.8	20.6	19.1	−23	Sl. Tacky
Dioctyl Phthalate	+37.4	71.2	63.9	−18	Sl. Tacky
Distilled Water	+3.88	110.7	101.1	−3	Unchanged
Ethyl Alcohol	+10.6	80.8	78.3	−10	Unchanged
Ethyl Ether	+19.4	52.6	54.2	−16	Unchanged
Gasoline (RON 99)	+18.6	75.5	75.8	−13	Sl. Tacky
Hexane	+9.36	80.6	78.3	−8	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hydrochloric Acid (10%)	+1.92	99.6	91.3	−4	Unchanged
Lard	+1.02	111.1	102.2	+1	Unchanged
Methyl Ethyl Ketone	+126.0	24.9	28.7	−22	Unchanged
Perchloroethylene	+55.8	53.8	54.2	−17	Unchanged
Potassium Permanganate (25%)	+1.56	98.8	98.6	−4	Brittle
Skydrol 500	+150.9	36.4	32.5	−23	Unchanged
Sodium Chloride (25%)	+0.48	114.2	108.3	0	Unchanged
Sodium Hydroxide (10%)	+1.73	96.8	86.6	−4	Unchanged
Toluene	+119.5	28.9	30.7	−23	Unchanged
Tide (1%)	+3.55	102.8	96.4	−4	Sl. Tacky

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+220.0	21.0	19.1	−25	Unchanged
A.S.T.M. No. 1 Oil	−0.21	111.9	95.0	−1	Unchanged
A.S.T.M. No. 3 Oil	+6.87	116.6	74.7	−4	Unchanged
Benzaldehyde	+191.0	19.8	20.6	−24	Sl. Tacky
Dioctyl Phthalate	+56.3	64.0	55.2	−18	Unchanged
Distilled Water	+5.44	105.9	93.9	−4	Unchanged
Ethyl Alcohol	+10.0	84.2	77.6	−10	Unchanged
Ethyl Ether	+34.5	49.8	49.5	−15	Unchanged
Gasoline (RON 99)	+22.3	77.1	75.8	−13	Sl. Tacky
Hexane	+9.20	79.1	72.2	−6	Unchanged
Hydrochloric Acid (10%)	+2.88	104.0	93.9	−3	Unchanged
Lard	−0.71	115.9	101.1	+1	Unchanged
Methyl Ethyl Ketone	+154.6	24.9	25.3	−24	Unchanged
Perchloroethylene	+43.6	46.3	49.5	−18	Unchanged
Potassium Permanganate (25%)	+2.63	98.0	98.6	−6	Brittle
Skydrol 500	+142.6	35.6	35.0	−24	Unchanged
Sodium Chloride (25%)	+1.90	107.9	90.3	−3	Unchanged
Sodium Hydroxide (10%)	+1.60	94.9	79.4	−4	Unchanged
Toluene	+127.4	27.7	27.8	−23	Sl. Tacky
Tide (1%)	+5.79	104.7	93.9	−4	Sl. Tacky

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+230.1	17.4	22.7	−28	Unchanged
A.S.T.M. No. 1 Oil	−0.70	105.9	87.7	0	Unchanged
A.S.T.M. No. 3 Oil	+9.00	94.1	79.4	−5	Unchanged
Benzaldehyde	+216.3	20.6	24.2	−23	Sl. Tacky
Dioctyl Phthalate	+53.0	64.8	57.8	−18	Unchanged
Distilled Water	+6.92	108.3	92.8	−3	Unchanged
Ethyl Alcohol	+14.2	81.8	75.8	−9	Unchanged
Ethyl Ether	+38.0	55.3	55.2	−16	Unchanged
Gasoline (RON 99)	+27.6	72.7	72.2	−14	Sl. Tacky
Hexane	+26.9	85.8	76.9	−7	Unchanged
Hydrochloric Acid (10%)	+3.25	106.3	86.6	−3	Unchanged
Lard	+12.3	107.1	92.8	−2	Unchanged
Methyl Ethyl Ketone	+151.6	24.9	25.3	−24	Unchanged
Perchloroethylene	+59.6	57.7	55.2	−18	Unchanged
Potassium Permanganate (25%)	+1.92	97.2	89.2	−6	Brittle
Skydrol 500	+147.7	33.6	35.0	−24	Unchanged
Sodium Chloride (25%)	+0.71	111.1	97.5	−1	Unchanged
Sodium Hydroxide (10%)	+7.04	89.7	73.3	−4	Unchanged
Toluene	+110.2	24.5	28.9	−24	Unchanged
Tide (1%)	+8.02	102.0	89.2	−5	Sl. Tacky

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF POLYCHLOROPRENE COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+143.3	22.9	58.3	−45	Unchanged
A.S.T.M. No. 1 Oil	+5.74	100.0	88.3	−4	Unchanged
A.S.T.M. No. 3 Oil	+61.7	46.1	67.3	−24	Unchanged
Benzaldehyde	+61.3	25.0	40.4	−35	Unchanged
Dioctyl Phthalate	+116.6	39.1	61.4	−34	Unchanged
Distilled Water	+9.34	97.2	85.2	−4	Unchanged
Ethyl Alcohol	+2.92	85.6	79.4	−4	Unchanged
Ethyl Ether	+49.5	44.7	53.8	−20	Unchanged
Gasoline (RON 99)	+69.6	41.2	58.3	−28	Unchanged
Hexane	+24.5	78.5	80.7	−15	Unchanged
Hydrochloric Acid (10%)	+15.1	93.3	76.2	−8	Unchanged
Lard	+20.0	95.4	89.7	−15	Unchanged
Methyl Ethyl Ketone	+72.3	32.4	52.5	−28	Unchanged
Perchloroethylene	+242.9	22.9	42.6	−38	Unchanged
Potassium Permanganate (25%)	+3.07	89.1	71.8	+2	V. Brittle
Skydrol 500	+151.0	17.3	57.0	−45	Unchanged
Sodium Chloride (25%)	+1.20	95.8	76.2	+5	Unchanged
Sodium Hydroxide (10%)	+0.24	101.4	89.7	+1	Unchanged
Toluene	+209.1	15.9	37.2	−44	Unchanged
Tide (1%)	+11.6	91.6	74.9	−9	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+67.3	63.0	76.2	−28	Unchanged
A.S.T.M. No. 1 Oil	+0.57	110.9	100.0	0	Unchanged
A.S.T.M. No. 3 Oil	+19.5	91.9	85.2	−13	Unchanged
Benzaldehyde	+132.0	30.6	40.4	−25	Sl. Tacky
Dioctyl Phthalate	+77.1	56.7	58.3	−24	Unchanged
Distilled Water	+3.67	112.7	106.3	0	Unchanged
Ethyl Alcohol	+3.26	97.5	91.0	−4	Unchanged
Ethyl Ether	+49.8	41.2	52.5	−20	Unchanged
Gasoline (RON 99)	+45.8	57.8	62.8	−17	Unchanged
Hexane	+19.4	86.3	80.7	−13	Unchanged
Hydrochloric Acid (10%)	+2.65	107.8	95.5	+1	Unchanged
Lard	+7.08	104.2	98.7	−8	Unchanged
Methyl Ethyl Ketone	+70.6	32.4	52.5	−30	Unchanged
Perchloroethylene	+132.6	31.0	37.2	−23	Unchanged
Potassium Permanganate (25%)	+4.16	108.8	97.3	−1	V. Brittle
Skydrol 500	+115.6	38.7	53.8	−31	Unchanged
Sodium Chloride (25%)	+2.30	112.7	97.3	0	Unchanged
Sodium Hydroxide (10%)	+1.41	104.6	94.2	0	Unchanged
Toluene	+141.5	29.9	35.9	−24	Sl. Tacky
Tide (1%)	+3.78	109.2	100.0	+1	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+67.8	50.0	70.4	−27	Sl. Tacky
A.S.T.M. No. 1 Oil	+0.34	108.1	98.7	+1	Unchanged
A.S.T.M. No. 3 Oil	+37.5	87.0	80.7	−15	Unchanged
Benzaldehyde	+146.2	24.7	35.9	−29	Sl. Tacky
Dioctyl Phthalate	+108.7	46.1	49.3	−25	Unchanged
Distilled Water	+6.35	114.4	94.2	0	Unchanged
Ethyl Alcohol	+2.44	94.0	86.6	−4	Unchanged
Ethyl Ether	+54.8	46.8	60.5	−23	Unchanged
Gasoline (RON 99)	+48.9	60.9	68.6	−19	Unchanged
Hexane	+21.1	70.1	77.6	−12	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hydrochloric Acid (10%)	+4.09	108.8	95.5	+1	Unchanged
Lard	+14.4	110.9	103.1	−10	Unchanged
Methyl Ethyl Ketone	+85.5	29.5	51.6	−30	Unchanged
Perchloroethylene	+132.5	32.8	37.2	−24	Unchanged
Potassium Permanganate (25%)	+7.22	112.0	95.5	0	Sl. Brittle
Skydrol 500	+130.6	32.0	53.8	−35	Unchanged
Sodium Chloride (25%)	+2.53	116.2	97.3	+1	Unchanged
Sodium Hydroxide (10%)	+3.17	103.5	92.8	−5	Unchanged
Toluene	+166.5	28.9	35.9	−25	Unchanged
Tide (1%)	+5.99	107.0	94.2	0	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+62.7	51.4	77.6	−29	Sl. Tacky
A.S.T.M. No. 1 Oil	+1.20	112.3	101.8	+1	Unchanged
A.S.T.M. No. 3 Oil	+44.2	91.9	83.0	−20	Unchanged
Benzaldehyde	+156.4	20.1	39.0	−35	Unchanged
Dioctyl Phthalate	+114.4	48.6	50.7	−26	Unchanged
Distilled Water	+10.5	94.7	80.7	−4	Unchanged
Ethyl Alcohol	+2.48	90.1	89.7	−5	Unchanged
Ethyl Ether	+51.9	38.4	57.0	−25	Unchanged
Gasoline (RON 99)	+50.7	50.7	64.1	−20	Unchanged
Hexane	+20.3	75.7	73.1	−12	Unchanged
Hydrochloric Acid (10%)	+5.77	102.1	85.2	−1	Unchanged
Lard	+15.5	107.4	94.2	−14	Unchanged
Methyl Ethyl Ketone	+92.8	23.2	49.3	−34	Unchanged
Perchloroethylene	+142.9	26.8	31.4	−29	Unchanged
Potassium Permanganate (25%)	+9.72	106.7	83.9	−2	Sl. Brittle
Skydrol 500	+142.3	25.0	53.8	−40	Unchanged
Sodium Chloride (25%)	+3.02	112.3	94.2	+2	Unchanged
Sodium Hydroxide (10%)	+3.87	95.8	86.6	0	Unchanged
Toluene	+204.2	23.2	31.4	−28	Unchanged
Tide (1%)	+9.42	91.2	77.6	−3	Unchanged

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+65.9	28.2	67.3	−38	Sl. Tacky
A.S.T.M. No. 1 Oil	+1.10	98.9	94.2	0	Unchanged
A.S.T.M. No. 3 Oil	+43.8	78.5	79.4	−19	Unchanged
Benzaldehyde	+190.0	7.4	35.9	−51	Sl. Tacky
Dioctyl Phthalate	+125.5	38.7	49.3	−29	Unchanged
Distilled Water	+18.7	79.6	70.4	−8	Unchanged
Ethyl Alcohol	+6.05	89.8	86.6	−4	Unchanged
Ethyl Ether	+56.8	34.5	59.6	−29	Unchanged
Gasoline (RON 99)	+54.6	47.9	67.3	−23	Unchanged
Hexane	+20.8	65.1	70.4	−13	Unchanged
Hydrochloric Acid (10%)	+9.13	95.8	73.1	0	Unchanged
Lard	+17.5	94.0	95.5	−14	Unchanged
Methyl Ethyl Ketone	+94.4	21.5	55.2	−38	Unchanged
Perchloroethylene	+147.5	25.0	37.2	−31	Unchanged
Potassium Permanganate (25%)	+13.0	90.5	70.4	−4	Sl. Brittle
Skydrol 500	+156.7	18.7	57.0	−43	Unchanged
Sodium Chloride (25%)	+1.81	104.6	83.9	−7	Unchanged
Sodium Hydroxide (10%)	+3.99	85.6	73.1	+1	Unchanged
Toluene	+171.5	20.4	35.9	−34	Sl. Tacky
Tide (1%)	+12.3	84.2	64.1	0	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF CHLOROSULFONATED POLYETHYLENE COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+147.4	86.4	73.9	−54	Unchanged
A.S.T.M. No. 1 Oil	+6.59	73.3	35.3	+4	Unchanged
A.S.T.M. No. 3 Oil	+66.9	49.6	114.5	−21	Unchanged
Benzaldehyde	+40.4	20.1	29.0	−30	Unchanged
Dioctyl Phthalate	+125.3	28.4	49.8	−29	Unchanged
Distilled Water	+9.43	97.2	80.7	−4	Sl. Brittle
Ethyl Alcohol	+4.80	81.1	82.1	−6	Unchanged
Ethyl Ether	+44.9	34.5	48.3	−17	Unchanged
Gasoline (RON 99)	+104.7	25.4	53.1	−30	Unchanged
Hexane	+24.7	49.3	62.8	−14	Unchanged
Hydrochloric Acid (10%)	+4.25	103.9	88.4	−1	Unchanged
Lard	+20.3	76.3	77.3	−11	Unchanged
Methyl Ethyl Ketone	+61.2	27.3	40.1	−24	Unchanged
Perchloroethylene	+150.2	22.3	37.2	−30	Unchanged
Potassium Permanganate (25%)	+7.74	100.8	80.7	−5	Sl. Brittle
Skydrol 500	+108.7	23.1	44.9	−32	Unchanged
Sodium Chloride (25%)	+1.14	99.7	83.6	−1	Unchanged
Sodium Hydroxide (10%)	+1.07	96.1	78.7	0	Unchanged
Toluene	+171.1	17.8	36.2	−37	Unchanged
Tide (1%)	+8.65	85.0	73.9	−5	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+63.1	47.6	67.6	−18	Unchanged
A.S.T.M. No. 1 Oil	+0.59	104.7	101.5	0	Unchanged
A.S.T.M. No. 3 Oil	+8.02	82.5	82.1	−3	Unchanged
Benzaldehyde	+117.4	28.4	33.8	−16	Unchanged
Dioctyl Phthalate	+40.3	56.6	61.4	−21	Unchanged
Distilled Water	+1.17	104.5	100.0	+1	Unchanged
Ethyl Alcohol	+2.51	97.5	98.1	−4	Sl. Tacky
Ethyl Ether	+43.8	28.7	46.9	−18	Sl. Tacky
Gasoline (RON 99)	+48.4	37.8	51.7	−20	Tacky
Hexane	+22.1	57.7	67.6	−11	Unchanged
Hydrochloric Acid (10%)	+1.80	109.8	102.9	+3	Unchanged
Lard	+5.04	81.9	85.5	−2	Unchanged
Methyl Ethyl Ketone	+70.0	32.3	43.5	−16	Unchanged
Perchloroethylene	+112.7	27.6	37.2	−6	Unchanged
Potassium Permanganate (25%)	+2.50	109.8	101.5	0	Unchanged
Skydrol 500	+88.0	40.4	44.9	−19	Unchanged
Sodium Chloride (25%)	−0.23	109.2	98.1	+1	Unchanged
Sodium Hydroxide (10%)	+0.58	109.5	114.5	+2	Unchanged
Toluene	+128.8	25.6	33.8	−18	Unchanged
Tide (1%)	+1.98	108.1	100.0	+2	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+64.1	38.7	61.4	−20	Sl. Tacky
A.S.T.M. No. 1 Oil	+0.34	108.6	96.7	+2	Unchanged
A.S.T.M. No. 3 Oil	+18.2	74.9	75.7	−9	Unchanged
Benzaldehyde	+115.2	25.4	33.8	−19	Unchanged
Dioctyl Phthalate	+115.5	43.7	42.0	−16	Unchanged
Distilled Water	+2.45	109.6	88.4	+2	Unchanged
Ethyl Alcohol	+5.50	94.4	90.3	−2	Unchanged
Ethyl Ether	+45.6	35.1	51.7	−16	V. Tacky
Gasoline (RON 99)	+51.7	37.9	53.1	−19	Tacky
Hexane	+23.6	47.6	59.4	−11	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hydrochloric Acid (10%)	+2.36	108.6	98.1	+2	Unchanged
Lard	+7.56	96.1	90.3	−4	Unchanged
Methyl Ethyl Ketone	+68.4	28.1	40.1	−16	Unchanged
Perchloroethylene	+125.5	28.1	33.8	−18	Unchanged
Potassium Permanganate (25%)	+4.17	115.9	98.1	+4	Unchanged
Skydrol 500	+87.8	42.1	44.9	−17	Unchanged
Sodium Chloride (25%)	+0.23	116.4	99.0	+5	Unchanged
Sodium Hydroxide (10%)	+0.93	99.7	90.3	0	Unchanged
Toluene	+135.4	23.7	32.4	−18	Unchanged
Tide (1%)	+3.95	107.8	96.7	+1	Sl. Tacky

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+62.0	35.1	62.8	−22	Unchanged
A.S.T.M. No. 1 Oil	+0.44	109.8	93.2	+2	Unchanged
A.S.T.M. No. 3 Oil	+30.3	77.7	82.1	−10	Unchanged
Benzaldehyde	+103.8	28.4	37.2	−20	Unchanged
Dioctyl Phthalate	+122.8	41.0	42.0	−17	Unchanged
Distilled Water	+5.13	113.9	91.8	0	Unchanged
Ethyl Alcohol	+6.54	98.6	91.8	−3	Sl. Tacky
Ethyl Ether	+46.0	33.7	51.7	−18	Tacky
Gasoline (RON 99)	+51.1	35.1	58.0	−20	Tacky
Hexane	+23.6	60.2	62.8	−11	Unchanged
Hydrochloric Acid (10%)	+3.27	108.1	95.2	+2	Unchanged
Lard	+16.4	86.6	84.5	−7	Unchanged
Methyl Ethyl Ketone	+68.4	29.5	42.0	−17	Unchanged
Perchloroethylene	+109.0	25.1	30.4	−19	Unchanged
Potassium Permanganate (25%)	+6.80	111.4	90.3	+1	Sl. Brittle
Skydrol 500	+102.2	40.1	48.3	−19	Unchanged
Sodium Chloride (25%)	+0.46	113.9	95.2	+3	Unchanged
Sodium Hydroxide (10%)	+1.28	107.0	90.3	+2	Unchanged
Toluene	+143.6	26.7	33.8	−18	Unchanged
Tide (1%)	+5.16	104.2	88.4	+2	Sl. Tacky

	12 Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Aniline	+71.8	26.2	64.3	−29	Unchanged
A.S.T.M. No. 1 Oil	+0.59	108.6	95.2	+2	Unchanged
A.S.T.M. No. 3 Oil	+40.3	72.4	75.9	−12	Unchanged
Benzaldehyde	+119.8	24.5	37.2	−21	Unchanged
Dioctyl Phthalate	+110.5	39.8	43.5	−20	Unchanged
Distilled Water	+6.86	116.2	87.0	0	Unchanged
Ethyl Alcohol	+5.53	101.7	91.8	−11	Sl. Tacky
Ethyl Ether	+47.8	33.9	58.0	−19	Tacky
Gasoline (RON 99)	+51.8	32.3	51.7	−19	Tacky
Hexane	+25.0	54.6	66.2	−11	Unchanged
Hydrochloric Acid (10%)	+16.1	114.2	90.3	+4	Unchanged
Lard	+24.9	75.2	78.7	−10	Unchanged
Methyl Ethyl Ketone	+86.0	28.1	42.0	−20	Unchanged
Perchloroethylene	+105.7	24.5	37.2	−20	Unchanged
Potassium Permanganate (25%)	+8.83	114.2	87.0	+1	Sl. Brittle
Skydrol 500	+88.6	32.9	48.3	−19	Unchanged
Sodium Chloride (25%)	+1.03	115.9	93.2	+4	Unchanged
Sodium Hydroxide (10%)	+1.52	110.3	90.3	+4	Unchanged
Toluene	+188.0	24.5	35.3	−20	Sl. Tacky
Tide (1%)	+9.11	112.3	82.1	0	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF VISTALON 6505 COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+129.3	30.8	45.9	−37	Sl. Tacky
A.S.T.M. No. 3 Oil	+222.4	20.9	29.5	−44	Sl. Tacky
A.S.T.M. Fuel B	+171.9	14.1	21.3	−11	Unchanged
Distilled Water	+0.5	93.2	77.0	+1	Unchanged
Ethyl Alcohol	−4.6	87.5	82.0	+3	Unchanged
Hexane	+69.0	18.6	24.6	+2	Unchanged
Hydrochloric Acid (10%)	+10.4	66.9	57.4	−2	Unchanged
Methyl Ethyl Ketone	+10.7	62.7	70.5	−9	Unchanged
Olive Oil	+41.6	55.1	65.6	−27	Sl. Tacky
Skydrol 500	+5.5	98.1	88.5	−9	Sl. Tacky
Sodium Chloride (25%)	+2.8	88.6	75.4	+1	Unchanged
Sodium Hydroxide (10%)	−0.4	93.9	75.7	0	Unchanged
Tide (1%)	+0.6	89.7	75.4	−1	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+42.8	40.3	49.2	−18	Unchanged
A.S.T.M. No. 3 Oil	+162.3	25.5	24.6	−29	Unchanged
A.S.T.M. Fuel B	+168.7	19.0	23.0	−27	Unchanged
Distilled Water	+1.25	111.0	96.7	−2	Unchanged
Ethyl Alcohol	+1.9	98.9	95.1	−5	Unchanged
Hexane	+159.9	20.2	23.0	−26	Unchanged
Hydrochloric Acid (10%)	+1.2	107.2	101.6	−2	Unchanged
Methyl Ethyl Ketone	+3.1	82.9	90.2	−10	White Res.
Olive Oil	+ 14.6	81.0	85.3	−9	Unchanged
Skydrol 500	−1.8	103.0	101.6	−4	V. Tacky
Sodium Chloride (25%)	+0.6	97.3	100.0	−2	White Res.
Sodium Hydroxide (10%)	+0.1	95.8	95.1	−3	Unchanged
Tide (1%)	+0.7	92.0	95.1	0	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+83.7	36.1	42.6	−26	Unchanged
A.S.T.M. No. 3 Oil	+175.0	24.3	26.2	−27	Unchanged
A.S.T.M. Fuel B	+183.3	17.9	16.4	−30	Unchanged
Distilled Water	−0.9	98.1	96.7	0	Unchanged
Ethyl Alcohol	+1.2	88.9	93.4	−4	Unchanged
Hexane	+152.6	20.5	22.9	−29	Unchanged
Hydrochloric Acid (10%)	+1.7	108.4	95.1	+1	Unchanged
Methyl Ethyl Ketone	+2.7	77.6	83.6	− 7	Unchanged
Olive Oil	+25.4	76.8	85.2	−16	Unchanged
Skydrol 500	−2.2	104.2	96.8	−2	Unchanged
Sodium Chloride (25%)	0	91.2	88.5	−0	Unchanged
Sodium Hydroxide (10%)	−0.2	98.5	96.7	+1	Unchanged
Tide (1%)	+0.2	85.2	90.2	0	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+115.3	36.1	42.0	−27	Unchanged
A.S.T.M. No. 3 Oil	+198.9	27.8	27.9	−31	Unchanged
A.S.T.M. Fuel B	+211.0	18.6	18.0	−31	Unchanged
Distilled Water	−0.5	98.5	98.4	+1	Unchanged
Ethyl Alcohol	+1.25	82.1	88.5	−2	Unchanged
Hexane	+192.1	19.4	23.0	−28	Unchanged
Hydrochloric Acid (10%)	+0.6	98.9	95.1	+1	Unchanged
Methyl Ethyl Ketone	+2.8	82.5	86.9	−5	Unchanged
Olive Oil	+29.0	73.8	83.6	−15	Unchanged
Skydrol 500	−2.6	100.0	95.1	−2	Unchanged
Sodium Chloride (25%)	−0.2	94.3	91.8	+2	Unchanged
Sodium Hydroxide (10%)	0	98.5	93.4	+1	Unchanged
Tide (1%)	+0.4	92.8	93.4	0	Unchanged

CHEMICAL RESISTANCE OF 30 VISTALON 6505/70 BUTYL RUBBER BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+ 68.2	57.6	57.1	−25	Sl. Tacky
A.S.T.M. No. 3 Oil	+136.9	36.6	35.7	−28	Sl. Tacky
A.S.T.M. Fuel B	+133.7	30.2	35.7	−27	Unchanged
Distilled Water	+2.2	98.8	92.9	0	Unchanged
Ethyl Alcohol	−2.0	91.9	78.6	+1	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hexane	+51.9	35.5	35.7	-5	Unchanged
Hydrochloric Acid (10%)	+7.1	88.4	75.0	0	Unchanged
Methyl Ethyl Ketone	+12.8	68.0	71.4	-12	Unchanged
Olive Oil	+28.1	71.5	78.6	-20	Sl. Tacky
Skydrol 500	+8.5	84.3	85.7	-12	Sl. Tacky
Sodium Chloride (25%)	+0.8	100.6	85.7	+1	Unchanged
Sodium Hydroxide (10%)	-0.1	95.9	85.7	-1	Unchanged
Tide (1%)	+0.9	92.4	82.1	-2	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+15.1	73.8	71.4	-8	Unchanged
A.S.T.M. No. 3 Oil	+67.9	49.4	50.0	-16	Unchanged
A.S.T.M. Fuel B	+117.2	34.9	32.1	-19	Unchanged
Distilled Water	+2.5	98.3	92.9	-1	Unchanged
Ethyl Alcohol	+2.5	94.2	92.9	-2	Unchanged
Hexane	+104.6	33.1	32.1	-18	Unchanged
Hydrochloric Acid (10%)	+0.2	101.7	96.4	0	Unchanged
Methyl Ethyl Ketone	+5.7	74.4	78.6	-8	White Res.
Olive Oil	+5.3	93.6	92.9	-5	Unchanged
Skydrol 500	+0.4	94.8	107.1	-2	V. Tacky
Sodium Chloride (25%)	+0.1	95.3	96.4	-1	White Res.
Sodium Hydroxide (10%)	+0.2	102.3	100.0	-2	Unchanged
Tide (1%)	+0.2	100.5	100.0	0	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+29.0	66.9	64.3	-12	Unchanged
A.S.T.M. No. 3 Oil	+108.6	45.4	42.9	-17	Unchanged
A.S.T.M. Fuel B	+132.3	34.3	32.1	-21	Unchanged
Distilled Water	-0.4	100.0	96.4	+1	Unchanged
Ethyl Alcohol	-1.8	91.9	89.3	-2	Unchanged
Hexane	+117.3	37.8	35.7	-18	Unchanged
Hydrochloric Acid (10%)	+0.5	95.9	96.4	+1	Unchanged
Methyl Ethyl Ketone	+6.5	75.0	82.1	-7	Unchanged
Olive Oil	+10.6	85.5	89.3	-8	Unchanged
Skydrol 500	+0.4	97.7	96.4	-3	Unchanged
Sodium Chloride (25%)	-0.11	97.1	78.6	0	Unchanged
Sodium Hydroxide (10%)	0	92.4	89.3	+1	Unchanged
Tide (1%)	+0.3	94.8	85.7	0	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+45.2	59.9	60.7	-17	Unchanged
A.S.T.M. No. 3 Oil	+118.0	45.3	39.3	-20	Unchanged
A.S.T.M. Fuel B	+151.1	33.7	28.6	-19	Unchanged
Distilled Water	-0.1	97.7	100.0	+1	White Res.
Ethyl Alcohol	+1.7	89.0	85.7	0	Unchanged
Hexane	+159.0	37.8	32.1	-18	Unchanged
Hydrochloric Acid (10%)	+0.5	98.9	92.9	-8	Unchanged
Methyl Ethyl Ketone	+5.9	79.7	82.1	-7	Unchanged
Olive Oil	+15.8	87.2	92.9	-9	Unchanged
Skydrol 500	+0.1	94.2	92.9	-3	Unchanged
Sodium Chloride (25%)	-0.3	98.8	92.9	+3	Unchanged
Sodium Hydroxide (10%)	0	93.0	89.3	+2	Unchanged
Tide (1%)	+0.3	97.7	96.4	+1	Unchanged

CHEMICAL RESISTANCE OF 30 VISTALON 6505/70 VISTALON 2504 BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+94.7	59.6	63.0	-27	Sl. Tacky
A.S.T.M. No. 3 Oil	+141.0	37.3	40.7	-32	Sl. Tacky
A.S.T.M. Fuel B	+138.0	32.4	33.3	-12	Unchanged
Distilled Water	-13.0	105.9	92.6	-1	Unchanged
Ethyl Alcohol	-2.7	94.5	85.2	0	Unchanged
Hexane	+49.8	40.5	37.0	-2	Unchanged
Hydrochloric Acid (10%)	+12.2	89.3	74.1	-4	Unchanged
Methyl Ethyl Ketone	+11.9	73.0	77.8	-10	Unchanged
Olive Oil	+34.9	68.6	74.1	-22	Sl. Tacky
Skydrol 500	+8.4	91.9	96.3	-10	Sl. Tacky
Sodium Chloride (25%)	+1.7	106.5	88.9	0	Unchanged
Sodium Hydroxide (10%)	+0.3	105.4	107.4	+1	Unchanged
Tide (1%)	+0.2	98.8	88.9	-2	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+42.3	68.1	66.7	-15	Unchanged
A.S.T.M. No. 3 Oil	+114.0	47.0	40.7	-21	Unchanged
A.S.T.M. Fuel B	+126.5	30.8	29.6	-21	Unchanged
Distilled Water	+1.1	105.9	107.4	-1	Unchanged
Ethyl Alcohol	+1.9	101.6	96.3	-4	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hexane	+115.7	37.8	29.6	−18	Unchanged
Hydrochloric Acid (10%)	+0.5	107.0	111.1	−3	Unchanged
Methyl Ethyl Ketone	+5.6	89.1	100.0	−8	White Res.
Olive Oil	+14.9	85.4	96.3	−9	Unchanged
Skydrol 500	+0.6	101.6	103.7	−4	V. Tacky
Sodium Chloride (25%)	+0.3	104.3	107.4	−2	White Res.
Sodium Hydroxide (10%)	+0.2	104.3	100.0	−2	Unchanged
Tide (1%)	+0.4	101.1	100.0	−1	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+69.5	64.2	62.9	−19	Unchanged
A.S.T.M. No. 3 Oil	+123.9	47.0	40.7	−19	Unchanged
A.S.T.M. Fuel B	+135.6	33.5	25.9	−22	White Res.
Distilled Water	+0.1	106.5	103.7	0	Unchanged
Ethyl Alcohol	+1.2	97.3	92.6	−2	Unchanged
Hexane	+121.9	42.2	33.3	−20	White Res.
Hydrochloric Acid (10%)	0	102.7	96.3	0	Unchanged
Methyl Ethyl Ketone	+7.0	88.7	85.2	−7	Unchanged
Olive Oil	+23.9	82.7	92.6	−13	Unchanged
Skydrol 500	−0.6	101.6	100.0	−3	Unchanged
Sodium Chloride (25%)	+0.1	98.4	81.5	0	Unchanged
Sodium Hydroxide (10%)	+0.7	98.9	92.6	0	Unchanged
Tide (1%)	+0.08	103.8	100.0	−1	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+100.6	58.9	55.6	−20	Unchanged
A.S.T.M. No. 3 Oil	+122.1	46.5	37.0	−23	Unchanged
A.S.T.M. Fuel B	+156.8	34.6	29.6	−22	White Res.
Distilled Water	+0.4	103.8	103.7	0	White Res.
Ethyl Alcohol	+2.4	101.6	100.0	0	Unchanged
Hexane	+157.3	42.2	37.0	−20	White Res.
Hydrochloric Acid (10%)	+0.5	99.5	85.2	0	Unchanged
Methyl Ethyl Ketone	+5.6	88.1	85.2	−8	Unchanged
Olive Oil	+26.2	86.5	81.5	−13	Unchanged
Skydrol 500	−0.2	102.2	100.0	−3	Unchanged
Sodium Chloride (25%)	−0.3	104.3	100.0	+1	White Res.
Sodium Hydroxide (10%)	+0.3	105.4	100.0	0	Unchanged
Tide (1%)	+0.9	103.2	96.3	0	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF 30 VISTALON 6505/70 NATURAL RUBBER BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+121.5	42.3	54.8	-37	Sl. Tacky
A.S.T.M. No. 3 Oil	+232.4	12.6	25.8	-45	Sl. Tacky
A.S.T.M. Fuel B	+155.9	18.1	22.6	-38	Unchanged
Distilled Water	+3.5	101.5	93.5	0	Unchanged
Ethyl Alcohol	-1.2	104.8	96.8	+1	Unchanged
Hexane	+39.5	31.8	38.7	-4	Unchanged
Hydrochloric Acid (10%)	+16.4	74.1	67.7	-4	Unchanged
Methyl Ethyl Ketone	+37.8	59.4	67.7	+3	Unchanged
Olive Oil	+76.6	48.8	61.3	-31	Sl. Tacky
Skydrol 500	+35.7	55.4	90.3	-28	Sl. Tacky
Sodium Chloride (25%)	+0.2	107.6	93.5	+1	Unchanged
Sodium Hydroxide (10%)	+0.9	98.8	90.3	-1	Unchanged
Tide (1%)	+3.1	109.2	97.8	-2	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+37.2	61.5	64.5	-7	Unchanged
A.S.T.M. No. 3 Oil	+141.8	41.2	41.9	-25	Unchanged
A.S.T.M. Fuel B	+178.9	18.1	16.1	-2	Unchanged
Distilled Water	+1.7	111.4	100.0	-1	Unchanged
Ethyl Alcohol	+3.1	105.9	103.2	-6	Unchanged
Hexane	+131.4	32.4	38.7	-24	Unchanged
Hydrochloric Acid (10%)	+1.1	110.3	106.5	-1	Unchanged
Methyl Ethyl Ketone	+34.0	47.2	58.1	-17	White Res.
Olive Oil	+45.4	65.9	64.5	-14	Unchanged
Skydrol 500	+13.9	77.9	83.9	-4	V. Tacky
Sodium Chloride (25%)	+0.1	105.9	106.5	+2	White Res.
Sodium Hydroxide (10%)	0	116.9	112.9	-2	Unchanged
Tide (1%)	+0.9	107.0	103.2	0	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+64.3	60.4	61.3	-20	Unchanged
A.S.T.M. No. 3 Oil	+157.1	39.0	38.7	-25	Unchanged
A.S.T.M. Fuel B	+193.5	23.1	29.0	-32	Unchanged
Distilled Water	+1.5	114.7	106.5	0	Unchanged
Ethyl Alcohol	+2.4	84.5	96.8	-4	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hexane	+141.3	31.3	35.5	-28	Unchanged
Hydrochloric Acid (10%)	+1.4	100.4	96.8	+1	Unchanged
Methyl Ethyl Ketone	+35.1	52.7	74.2	-21	Unchanged
Olive Oil	+63.4	53.2	54.8	-23	Unchanged
Skydrol 500	+16.5	65.9	77.4	-13	Unchanged
Sodium Chloride (25%)	-0.1	104.3	80.7	+1	Unchanged
Sodium Hydroxide (10%)	+0.5	104.8	93.6	0	Unchanged
Tide (1%)	+1.7	104.8	100.0	0	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+79.0	57.6	58.1	-25	Unchanged
A.S.T.M. No. 3 Oil	+161.8	41.2	41.9	-29	Unchanged
A.S.T.M. Fuel B	+258.2	19.2	29.0	-33	Unchanged
Distilled Water	+1.9	107.0	100.0	+1	Unchanged
Ethyl Alcohol	+2.4	58.7	74.2	-3	Unchanged
Hexane	+189.9	24.1	29.0	-29	Unchanged
Hydrochloric Acid (10%)	+1.8	103.2	96.8	+1	Unchanged
Methyl Ethyl Ketone	+41.1	24.7	54.8	-25	Unchanged
Olive Oil	+72.7	65.9	61.3	-23	Unchanged
Skydrol 500	+21.8	39.5	64.5	-17	Unchanged
Sodium Chloride (25%)	-0.3	101.0	90.3	+2	Unchanged
Sodium Hydroxide (10%)	+0.7	98.2	87.1	+2	Unchanged
Tide (1%)	+2.2	110.3	100.0	+1	Unchanged

CHEMICAL RESISTANCE OF 30 VISTALON 6505/70 SBR BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+ 41.8	74.9	66.7	-17	Sl. Tacky
A.S.T.M. No. 3 Oil	+107.0	50.7	42.9	-22	Sl. Tacky
A.S.T.M. Fuel B	+115.1	16.8	28.6	-23	Unchanged
Distilled Water	+5.3	97.7	95.2	-1	Unchanged
Ethyl Alcohol	-2.1	87.5	81.0	-1	Unchanged
Hexane	+28.8	39.6	42.9	-2	Unchanged
Hydrochloric Acid (10%)	+12.8	94.9	76.2	-2	Unchanged
Methyl Ethyl Ketone	+30.6	55.4	57.1	+4	Unchanged
Olive Oil	+39.4	67.0	61.9	-18	Sl. Tacky
Skydrol 500	+37.7	64.7	66.7	-19	Sl. Tacky
Sodium Chloride (25%)	+2.7	102.4	85.7	0	Unchanged
Sodium Hydroxide (10%)	+0.6	104.2	85.7	0	Unchanged
Tide (1%)	+5.3	101.9	85.7	-1	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+13.1	91.2	90.5	-7	Unchanged
A.S.T.M. No. 3 Oil	+84.9	53.1	47.6	-17	Unchanged
A.S.T.M. Fuel B	+105.8	34.4	38.1	-17	Unchanged
Distilled Water	+2.86	105.6	95.2	-2	Unchanged
Ethyl Alcohol	+2.8	94.9	90.1	-3	Unchanged
Hexane	+75.7	40.9	33.3	-16	Unchanged
Hydrochloric Acid (10%)	+1.8	106.6	109.5	-2	Unchanged
Methyl Ethyl Ketone	+31.9	53.5	57.1	-12	White Res.
Olive Oil	+22.5	81.9	76.2	-8	Unchanged
Skydrol 500	+21.9	77.7	76.2	-8	V. Tacky
Sodium Chloride (25%)	+0.5	103.7	100.0	-2	White Res.
Sodium Hydroxide (10%)	+1.2	106.9	109.5	-2	Unchanged
Tide (1%)	+1.3	93.0	95.2	0	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+23.4	77.7	71.4	-11	Unchanged
A.S.T.M. No. 3 Oil	+98.2	54.9	47.6	-16	Unchanged
A.S.T.M. Fuel B	+108.7	36.8	33.3	-18	Yellow Res.
Distilled Water	+2.6	100.1	95.2	0	Unchanged
Ethyl Alcohol	+3.1	94.5	100.0	-3	Unchanged
Hexane	+82.9	42.8	38.1	-16	Unchanged
Hydrochloric Acid (10%)	+2.8	102.4	95.2	+1	Unchanged
Methyl Ethyl Ketone	+32.7	61.4	61.9	-13	Unchanged
Olive Oil	+24.3	74.5	76.2	-13	Unchanged
Skydrol 500	+19.9	76.8	71.4	-10	Unchanged
Sodium Chloride (25%)	+0.6	99.1	76.2	0	Unchanged
Sodium Hydroxide (10%)	+2.0	98.7	95.2	0	Unchanged
Tide (1%)	+2.5	99.6	104.8	0	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+31.0	82.8	76.2	-13	Unchanged
A.S.T.M. No. 3 Oil	+99.0	54.4	47.6	-18	Unchanged
A.S.T.M. Fuel B	+126.1	39.1	38.1	-16	Yellow Res.
Distilled Water	+3.7	102.8	90.5	+1	Unchanged
Ethyl Alcohol	+1.3	90.7	85.7	-1	Residue

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hexane	+116.3	44.7	42.8	-16	Yellow Res.
Hydrochloric Acid (10%)	+3.7	85.6	61.9	+1	Unchanged
Methyl Ethyl Ketone	+31.7	57.7	52.4	-11	Yellow Res.
Olive Oil	+39.3	72.1	61.9	-12	Unchanged
Skydrol 500	+19.6	79.1	71.4	-10	Unchanged
Sodium Chloride (25%)	+0.5	104.7	90.5	+1	Unchanged
Sodium Hydroxide (10%)	+2.8	96.3	85.7	+1	Unchanged
Tide (1%)	+3.3	105.6	90.5	+1	Unchanged

CHEMICAL RESISTANCE OF 30 VISTALON 6505/70 NITRILE RUBBER BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+19.4	77.5	56.3	-7	Sl. Tacky
A.S.T.M. No. 3 Oil	+63.5	62.0	50.0	-22	Sl. Tacky
A.S.T.M. Fuel B	+84.4	37.1	40.6	-24	Unchanged
Distilled Water	+7.8	106.6	81.3	-1	Unchanged
Ethyl Alcohol	+9.3	83.6	71.9	-6	Unchanged
Hexane	+27.8	53.5	50.0	-3	Unchanged
Hydrochloric Acid (10%)	+10.7	98.6	65.6	0	Unchanged
Methyl Ethyl Ketone	+60.5	31.9	37.5	-29	Unchanged
Olive Oil	+10.6	80.3	65.6	-7	Sl. Tacky
Skydrol 500	+73.5	23.9	34.4	-37	Sl. Tacky
Sodium Chloride (25%)	+0.9	93.9	71.9	+1	Unchanged
Sodium Hydroxide (10%)	-0.5	98.1	75.0	-1	Unchanged
Tide (1%)	+7.6	100.0	75.0	-2	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+6.0	95.3	87.5	-4	Unchanged
A.S.T.M. No. 3 Oil	+28.2	65.7	62.5	-17	Unchanged
A.S.T.M. Fuel B	+79.9	42.7	40.6	-24	Unchanged
Distilled Water	+2.1	97.6	87.5	-4	Unchanged
Ethyl Alcohol	+6.9	83.5	81.3	-10	Unchanged
Hexane	+45.4	49.3	46.9	-20	Unchanged
Hydrochloric Acid (10%)	+1.83	98.6	87.5	-2	Unchanged
Methyl Ethyl Ketone	+99.9	40.9	37.5	-22	White Res.
Olive Oil	+1.6	103.3	93.8	-1	Unchanged
Skydrol 500	+96.9	46.9	43.8	-17	V. Tacky
Sodium Chloride (25%)	+0.7	99.5	93.5	-3	White Res.
Sodium Hydroxide (10%)	+0.8	101.9	96.9	-4	Unchanged
Tide (1%)	+1.0	93.9	87.5	0	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+8.9	86.9	78.1	-4	Unchanged
A.S.T.M. No. 3 Oil	+50.2	63.4	59.4	-18	Unchanged
A.S.T.M. Fuel B	+87.3	41.3	40.6	-23	Unchanged
Distilled Water	+3.2	92.0	84.4	0	Unchanged
Ethyl Alcohol	+5.5	82.6	78.2	-8	Unchanged
Hexane	+48.9	54.9	50.0	-18	Unchanged
Hydrochloric Acid (10%)	+2.3	96.7	87.5	+1	Unchanged
Methyl Ethyl Ketone	+110.8	42.2	43.8	-25	Unchanged
Olive Oil	+3.5	93.0	84.4	-2	Unchanged
Skydrol 500	+100.7	41.3	40.6	-23	Unchanged
Sodium Chloride (25%)	+0.5	95.8	78.1	+1	Unchanged
Sodium Hydroxide (10%)	+0.9	94.4	81.3	0	Unchanged
Tide (1%)	+2.2	98.6	87.5	0	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+16.6	81.7	75.0	-5	Unchanged
A.S.T.M. No. 3 Oil	+54.3	68.5	65.6	-19	Unchanged
A.S.T.M. Fuel B	+103.5	43.2	34.4	-22	Unchanged
Distilled Water	+4.2	101.9	87.5	+2	Unchanged
Ethyl Alcohol	+4.6	89.7	78.1	-6	Unchanged
Hexane	+90.4	53.1	46.9	-18	Unchanged
Hydrochloric Acid (10%)	+2.0	99.1	84.4	+2	Unchanged
Methyl Ethyl Ketone	+124.3	35.2	34.4	-23	Unchanged
Olive Oil	+5.1	100.0	84.4	-2	Unchanged
Skydrol 500	+103.5	36.6	37.5	-24	Unchanged
Sodium Chloride (25%)	+0.4	96.2	84.4	+3	Unchanged
Sodium Hydroxide (10%)	+0.8	91.6	75.0	+2	Unchanged
Tide (1%)	+3.1	96.2	81.3	+1	Unchanged

CHEMICAL RESISTANCE OF 50 VISTALON 6505/50 NITRILE RUBBER BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+43.9	64.0	53.6	-15	Sl. Tacky
A.S.T.M. No. 3 Oil	+100.3	45.7	39.3	-29	Sl. Tacky
A.S.T.M. Fuel B	+263.3	34.9	28.6	-33	Unchanged
Distilled Water	+13.2	100.5	71.4	+1	Unchanged
Ethyl Alcohol	+5.0	96.8	78.6	-4	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hexane	+33.3	48.9	42.9	−3	Unchanged
Hydrochloric Acid (10%)	+11.1	91.9	60.7	−3	Unchanged
Methyl Ethyl Ketone	+35.7	52.7	50.0	−23	Unchanged
Olive Oil	+18.7	83.3	64.3	−12	Sl. Tacky
Skydrol 500	+76.5	42.5	50.0	−31	Sl. Tacky
Sodium Chloride (25%)	+1.3	101.6	71.4	+2	Unchanged
Sodium Hydroxide (10%)	−0.3	101.1	75.0	−1	Unchanged
Tide (1%)	+4.4	98.5	75.0	−3	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+16.3	87.6	71.4	−10	Unchanged
A.S.T.M. No. 3 Oil	+69.8	58.1	50.0	−23	Unchanged
A.S.T.M. Fuel B	+95.4	42.5	39.3	−26	Unchanged
Distilled Water	+ 4.8	103.2	92.7	− 4	Unchanged
Ethyl Alcohol	+ 4.3	96.2	89.3	−10	Unchanged
Hexane	+64.9	47.9	46.4	−22	Unchanged
Hydrochloric Acid (10%)	+1.7	104.8	100.0	−2	Unchanged
Methyl Ethyl Ketone	+61.7	53.7	50.0	−20	White Res.
Olive Oil	+5.3	98.4	89.3	−5	Unchanged
Skydrol 500	+37.9	65.6	60.7	−15	V. Tacky
Sodium Chloride (25%)	+0.2	104.8	92.6	−3	White Res.
Sodium Hydroxide (10%)	+0.2	106.5	92.6	−4	Unchanged
Tide (1%)	+1.2	101.1	89.3	−1	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+29.0	79.0	71.4	−15	Unchanged
A.S.T.M. No. 3 Oil	+81.1	61.3	50.0	−23	Unchanged
A.S.T.M. Fuel B	+99.7	42.5	32.1	−27	Unchanged
Distilled Water	+0.3	104.8	85.7	−1	Unchanged
Ethyl Alcohol	+3.3	82.3	82.1	−8	Unchanged
Hexane	+74.5	48.4	42.9	−23	Unchanged
Hydrochloric Acid (10%)	+1.4	101.1	82.1	0	Unchanged
Methyl Ethyl Ketone	+62.9	61.8	53.6	−21	Unchanged
Olive Oil	+9.5	94.6	78.6	−6	Unchanged
Skydrol 500	+54.6	61.8	53.6	−20	Unchanged
Sodium Chloride (25%)	+0.3	96.8	75.0	−1	Unchanged
Sodium Hydroxide (10%)	+0.4	99.5	89.3	0	Unchanged
Tide (1%)	+4.3	102.2	89.3	−1	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+41.2	67.7	60.7	-15	Unchanged
A.S.T.M. No. 3 Oil	+83.9	61.3	46.4	-24	Unchanged
A.S.T.M. Fuel B	+114.4	33.9	32.1	-24	Unchanged
Distilled Water	+0.9	99.5	82.1	+1	Unchanged
Ethyl Alcohol	+2.5	85.5	78.6	-6	Unchanged
Hexane	+104.6	50.0	42.9	-21	Unchanged
Hydrochloric Acid (10%)	+1.9	98.4	85.7	+2	Unchanged
Methyl Ethyl Ketone	+63.0	53.8	46.4	-19	White Res.
Olive Oil	+12.6	89.8	71.4	-6	Unchanged
Skydrol 500	+56.6	56.5	53.6	-21	Unchanged
Sodium Chloride (25%)	+0.4	96.2	85.7	+2	Unchanged
Sodium Hydroxide (10%)	0	93.0	75.0	+2	Unchanged
Tide (1%)	+2.8	99.5	82.1	+1	Unchanged

CHEMICAL RESISTANCE OF 70 VISTALON 6505/30 NITRILE RUBBER BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+70.0	53.9	51.7	-25	Sl. Tacky
A.S.T.M. No. 3 Oil	+130.9	43.9	37.9	-32	Sl. Tacky
A.S.T.M. Fuel B	+224.0	33.9	27.6	-34	Unchanged
Distilled Water	+2.2	100.6	75.8	+1	Unchanged
Ethyl Alcohol	-12.7	97.8	86.2	-8	Unchanged
Hexane	+27.4	45.0	34.5	-2	Unchanged
Hydrochloric Acid (10%)	+12.6	94.4	65.5	-1	Unchanged
Methyl Ethyl Ketone	+32.6	67.2	62.1	-1	Unchanged
Olive Oil	+26.3	71.1	65.5	-16	Sl. Tacky
Skydrol 500	+38.3	65.6	72.4	-25	Sl. Tacky
Sodium Chloride (25%)	+0.7	97.2	72.4	+2	Unchanged
Sodium Hydroxide (10%)	-0.3	98.9	79.3	-1	Unchanged
Tide (1%)	+2.4	97.2	72.4	-1	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+26.6	80.6	68.9	-13	Unchanged
A.S.T.M. No. 3 Oil	+98.1	62.7	44.8	-23	Unchanged
A.S.T.M. Fuel B	+114.9	42.8	34.5	-25	Unchanged
Distilled Water	+1.9	98.9	93.1	-3	Unchanged
Ethyl Alcohol	+3.1	95.0	93.1	-7	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS–EXXON CHEMICALS (continued)

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hexane	+66.6	45.0	37.9	−22	Unchanged
Hydrochloric Acid (10%)	+1.2	104.4	100.0	−2	Unchanged
Methyl Ethyl Ketone	+29.9	73.3	75.9	−17	White Res.
Olive Oil	+7.6	93.3	86.2	−7	Unchanged
Skydrol 500	+21.1	71.1	89.7	−12	V. Tacky
Sodium Chloride (25%)	0	103.3	100.0	−3	White Res.
Sodium Hydroxide (10%)	+0.3	98.9	96.6	−3	Unchanged
Tide (1%)	+0.6	96.7	93.0	−1	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+49.1	67.8	55.2	18	Unchanged
A.S.T.M. No. 3 Oil	+106.3	51.1	41.4	−23	Unchanged
A.S.T.M. Fuel B	+115.6	44.4	34.5	−26	Unchanged
Distilled Water	+0.3	98.9	89.7	−1	Unchanged
Ethyl Alcohol	+1.8	93.9	86.2	−6	Unchanged
Hexane	+98.6	47.8	34.5	−23	Unchanged
Hydrochloric Acid (10%)	+0.73	98.3	86.2	+1	Unchanged
Methyl Ethyl Ketone	+31.1	77.2	72.4	−19	Gray Res.
Olive Oil	+16.1	86.1	79.3	−10	Unchanged
Skydrol 500	+22.2	86.1	75.9	−14	Unchanged
Sodium Chloride (25%)	+0.2	105.0	86.2	+1	Unchanged
Sodium Hydroxide (10%)	+0.3	94.4	82.8	0	Unchanged
Tide (1%)	+1.1	97.2	93.1	0	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+ 61.8	65.6	55.2	−19	Unchanged
A.S.T.M. No. 3 Oil	+109.8	51.7	44.8	−25	Unchanged
A.S.T.M. Fuel B	+138.1	35.4	31.0	−24	Unchanged
Distilled Water	+0.8	98.9	93.1	+1	Unchanged
Ethyl Alcohol	+1.6	93.3	86.2	−4	Unchanged
Hexane	+137.6	52.2	44.8	−22	Unchanged
Hydrochloric Acid (10%)	+1.1	100.0	86.2	+1	Unchanged
Methyl Ethyl Ketone	+30.3	71.7	69.0	−16	White Res.
Olive Oil	+18.9	88.9	79.3	−10	Unchanged
Skydrol 500	+23.2	77.2	75.9	−14	Unchanged
Sodium Chloride (25%)	+0.2	100.0	93.1	+2	Unchanged
Sodium Hydroxide (10%)	+0.2	96.1	82.8	+1	Unchanged
Tide (1%)	+1.1	97.2	86.2	0	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

CHEMICAL RESISTANCE OF 30 VISTALON 6505/70 POLYCHLOROPRENE BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+25.1	86.8	73.9	-10	Sl. Tacky
A.S.T.M. No. 3 Oil	+99.8	46.2	65.3	-27	Sl. Tacky
A.S.T.M. Fuel B	+92.3	33.8	47.8	-25	Unchanged
Distilled Water	+10.9	96.6	78.3	-1	Unchanged
Ethyl Alcohol	-0.1	91.9	87.0	+2	Unchanged
Hexane	+27.9	53.8	60.9	+3	Unchanged
Hydrochloric Acid (10%)	+7.1	88.4	75.0	0	Unchanged
Methyl Ethyl Ketone	+28.5	50.9	65.2	-18	Unchanged
Olive Oil	+32.0	71.4	73.9	-17	Sl. Tacky
Skydrol 500	+73.3	40.6	65.2	-33	Sl. Tacky
Sodium Chloride (25%)	+0.2	100.4	73.9	+6	Unchanged
Sodium Hydroxide (10%)	+2.0	89.3	78.3	-3	Unchanged
Tide (1%)	—	96.6	82.6	-1	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+7.6	95.7	91.3	-4	Unchanged
A.S.T.M. No. 3 Oil	+55.8	59.0	60.8	-16	Unchanged
A.S.T.M. Fuel B	+84.4	38.9	47.8	-19	Unchanged
Distilled Water	+3.5	103.0	95.7	-1	Unchanged
Ethyl Alcohol	+8.1	88.5	86.9	-6	Unchanged
Hexane	+51.9	51.3	60.9	-15	Unchanged
Hydrochloric Acid (10%)	+2.3	105.9	108.7	-1	Unchanged
Methyl Ethyl Ketone	+40.0	52.6	73.9	-16	White Res.
Olive Oil	+9.4	92.3	83.3	-5	Unchanged
Skydrol 500	+50.3	56.8	69.6	-14	V. Tacky
Sodium Chloride (25%)	+1.2	101.3	100.0	0	White Res.
Sodium Hydroxide (10%)	+3.1	101.3	91.3	-2	Unchanged
Tide (1%)	+0.3	105.6	100.0	0	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+13.8	85.9	78.3	-6	Unchanged
A.S.T.M. No. 3 Oil	+72.8	55.9	56.5	-17	Unchanged
A.S.T.M. Fuel B	+89.4	40.2	43.5	-22	Unchanged
Distilled Water	+6.2	104.7	95.7	-1	Unchanged
Ethyl Alcohol	+10.6	79.1	82.6	-6	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hexane	+54.8	49.6	52.2	-15	Unchanged
Hydrochloric Acid (10%)	+4.3	100.4	87.0	+1	Unchanged
Methyl Ethyl Ketone	+41.0	57.7	69.6	-17	Unchanged
Olive Oil	+19.5	84.6	82.6	-11	Unchanged
Skydrol 500	+53.9	49.2	69.6	-21	Unchanged
Sodium Chloride (25%)	+1.5	100.0	75.9	+1	Unchanged
Sodium Hydroxide (10%)	+5.0	95.7	87.0	0	Unchanged
Tide (1%)	+5.8	97.9	87.0	-1	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+20.7	80.3	78.3	-8	Unchanged
A.S.T.M. No. 3 Oil	+76.9	57.7	56.5	-21	Unchanged
A.S.T.M. Fuel B	+87.4	39.3	47.8	-20	Unchanged
Distilled Water	+8.5	99.6	87.0	-1	Unchanged
Ethyl Alcohol	+11.2	79.9	87.0	-4	Residue
Hexane	+54.2	46.6	52.2	-15	Unchanged
Hydrochloric Acid (10%)	+5.7	93.6	82.6	+1	Unchanged
Methyl Ethyl Ketone	+41.6	48.7	65.2	-17	Unchanged
Olive Oil	+23.3	83.8	78.3	-12	Unchanged
Skydrol 500	+57.8	44.4	52.2	-23	Unchanged
Sodium Chloride (25%)	+1.9	102.1	87.0	+2	Unchanged
Sodium Hydroxide (10%)	+6.3	86.8	78.3	+1	Unchanged
Tide (1%)	+8.4	102.6	87.0	+1	Unchanged

CHEMICAL RESISTANCE OF 50 VISTALON 6505/50 POLYCHLOROPRENE BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+46.4	70.8	68.0	-21	Sl. Tacky
A.S.T.M. No. 3 Oil	+114.0	42.7	48.0	-30	Sl. Tacky
A.S.T.M. Fuel B	+118.4	37.1	48.0	-27	Unchanged
Distilled Water	+6.7	98.1	80.0	-1	Unchanged
Ethyl Alcohol	-2.3	88.3	80.0	+2	Unchanged
Hexane	+33.3	46.5	48.0	+2	Unchanged
Hydrochloric Acid (10%)	+15.0	84.0	64.0	-2	Unchanged
Methyl Ethyl Ketone	+21.2	59.3	72.0	-16	Unchanged
Olive Oil	+33.4	72.5	72.0	-22	Sl. Tacky
Skydrol 500	+43.4	53.5	80.0	-28	Sl. Tacky
Sodium Chloride (25%)	+0.01	95.1	76.0	+3	Unchanged
Sodium Hydroxide (10%)	+14.6	87.5	72.0	0	Unchanged
Tide (1%)	+6.2	97.3	84.0	-2	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+17.5	82.3	76.0	-9	Unchanged
A.S.T.M. No. 3 Oil	+81.3	47.4	48.0	-21	Unchanged
A.S.T.M. Fuel B	+99.0	39.7	44.0	-23	Unchanged
Distilled Water	+2.7	104.5	96.0	-2	Unchanged
Ethyl Alcohol	+5.2	88.7	84.0	-7	Unchanged
Hexane	+73.6	40.5	48.0	-18	Unchanged
Hydrochloric Acid (10%)	+2.5	102.8	100.0	-2	Unchanged
Methyl Ethyl Ketone	+27.8	62.3	76.0	-16	White Res.
Olive Oil	+11.0	88.7	84.0	-8	Unchanged
Skydrol 500	+29.6	77.2	84.0	-13	V. Tacky
Sodium Chloride (25%)	+2.0	98.1	96.0	-3	White Res.
Sodium Hydroxide (10%)	+2.2	101.1	96.0	-3	Unchanged
Tide (1%)	+2.1	98.1	.96.0	-1	Unchanged

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+32.1	72.5	76.0	-14	Unchanged
A.S.T.M. No. 3 Oil	93.3	50.3	52.0	-21	Unchanged
A.S.T.M. Fuel B	+110.5	38.4	40.0	-25	Unchanged
Distilled Water	+4.0	101.5	96.0	-1	Unchanged
Ethyl Alcohol	+10.6	86.2	88.0	-6	Unchanged
Hexane	+81.6	44.8	48.0	-21	Unchanged
Hydrochloric Acid (10%)	+3.1	97.3	92.0	0	Unchanged
Methyl Ethyl Ketone	+28.8	68.3	76.0	-17	Unchanged
Olive Oil	+20.8	84.5	84.0	-14	Unchanged
Skydrol 500	+30.2	72.5	80.0	-18	Unchanged
Sodium Chloride (25%)	+0.6	97.7	72.0	0	Unchanged
Sodium Hydroxide (10%)	+2.7	97.7	92.0	-1	Unchanged
Tide (1%)	+3.8	98.1	92.0	-1	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+41.6	67.8	72.0	-16	Unchanged
A.S.T.M. No. 3 Oil	+95.8	46.9	52.0	-25	Unchanged
A.S.T.M. Fuel B	+130.3	36.7	44.0	-24	Unchanged
Distilled Water	+6.3	101.5	92.0	-1	Unchanged
Ethyl Alcohol	+6.1	85.8	88.0	-5	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
Hexane	+114.7	42.7	44.0	-20	Residue
Hydrochloric Acid (10%)	+4.6	90.0	76.0	-1	Unchanged
Methyl Ethyl Ketone	+28.5	60.6	72.0	-16	Unchanged
Olive Oil	+23.6	80.2	76.0	-14	Unchanged
Skydrol 500	+31.5	68.3	84.0	-19	Unchanged
Sodium Chloride (25%)	+1.2	99.8	88.0	+1	Unchanged
Sodium Hydroxide (10%)	+4.3	93.0	84.0	0	Unchanged
Tide (1%)	+5.8	99.8	88.0	-1	Unchanged

CHEMICAL RESISTANCE OF 70 VISTALON 6505/30 POLYCHLOROPRENE BLEND COMPOUND

	72 Hours Immersion at 212°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+66.4	61.0	62.5	-24	Sl. Tacky
A.S.T.M. No. 3 Oil	+130.9	39.5	45.8	-32	Sl. Tacky
A.S.T.M. Fuel B	+137.4	29.5	37.5	-27	Unchanged
Distilled Water	+4.0	101.5	87.5	0	Unchanged
Ethyl Alcohol	-1.5	91.5	83.3	+3	Unchanged
Hexane	+47.4	41.5	45.8	-1	Unchanged
Hydrochloric Acid (10%)	+12.3	91.0	75.0	-1	Unchanged
Methyl Ethyl Ketone	+15.5	64.0	79.2	-14	Unchanged
Olive Oil	+37.0	72.5	75.0	-21	Sl. Tacky
Skydrol 500	+25.6	72.0	87.5	-21	Sl. Tacky
Sodium Chloride (25%)	+0.8	108.0	83.3	+2	Unchanged
Sodium Hydroxide (10%)	+0.6	95.0	79.3	-1	Unchanged
Tide (1%)	+3.6	91.5	83.3	-1	Unchanged

	One Month Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+ 27.0	79.0	75.0	-11	Unchanged
A.S.T.M. No. 3 Oil	+102.2	50.0	45.8	-21	Unchanged
A.S.T.M. Fuel B	+115.3	29.5	33.3	-23	Unchanged
Distilled Water	+ 2.5	108.0	100.0	- 2	Unchanged
Ethyl Alcohol	+3.8	98.0	95.8	- 5	Unchanged
Hexane	+81.5	35.5	37.5	-21	Unchanged
Hydrochloric Acid (10%)	+2.3	109.5	108.3	-2	Unchanged
Methyl Ethyl Ketone	+15.5	61.5	75.0	-12	White Res.
Olive Oil	+14.4	90.5	91.7	-9	Unchanged
Skydrol 500	+15.3	89.5	91.8	-10	V. Tacky
Sodium Chloride (25%)	+0.7	101.5	100.0	-2	White Res.
Sodium Hydroxide (10%)	+1.2	95.5	87.5	-2	Unchanged
Tide (1%)	+1.4	100.0	100.0	-1	Unchanged

(continued)

TABLE 2.12: VARIOUS ELASTOMERS AND RUBBERS—EXXON CHEMICALS (continued)

	Three Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Cnange Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+47.6	67.5	70.8	−15	Unchanged
A.S.T.M. No 3 Oil	+112.4	45.5	45.8	−21	Unchanged
A.S.T.M. Fuel B	+128.5	37.0	37.5	−23	Unchanged
Distilled Water	+3.1	103.5	100.0	0	Unchanged
Ethyl Alcohol	+4.5	93.5	91.7	−4	Unchanged
Hexane	+105.4	43.0	41.7	−21	Unchanged
Hydrochloric Acid (10%)	+2.3	100.0	91.7	0	Unchanged
Methyl Ethyl Ketone	+17.1	79.0	87.5	−13	Unchanged
Olive Oil	+25.3	80.5	79.2	−14	Unchanged
Skydrol 500	+14.3	83.5	95.8	−12	Unchanged
Sodium Chloride (25%)	+0.6	104.0	83.3	−1	Unchanged
Sodium Hydroxide (10%)	+1.8	100.0	95.8	0	Unchanged
Tide (1%)	+2.4	107.5	95.8	−2	Unchanged

	Six Months Immersion at 75° ± 5°F				
	Volume Change %	Tensile Strength Retained %	Elongation Retained %	Hardness Change Pts.	Surface Condition
A.S.T.M. No. 1 Oil	+60.9	66.0	70.8	−19	Unchanged
A.S.T.M. No. 3 Oil	+116.1	51.5	50.0	−23	Unchanged
A.S.T.M. Fuel B	+155.6	36.0	37.5	−23	Unchanged
Distilled Water	+4.5	104.5	95.8	0	Unchanged
Ethyl Alcohol	+3.2	95.0	87.5	−2	Residue
Hexane	+147.3	39.5	41.7	−20	Unchanged
Hydrochloric Acid (10%)	+3.4	102.0	95.8	0	Unchanged
Methyl Ethyl Ketone	+17.7	67.5	75.0	−12	Unchanged
Olive Oil	+28.0	86.0	83.3	−14	Unchanged
Skydrol 500	+14.9	85.0	95.8	−13	Unchanged
Sodium Chloride (25%)	+0.7	104.0	95.8	+1	Unchanged
Sodium Hydroxide (10%)	+2.2	99.0	87.5	+1	Unchanged
Tide (1%)	+4.0	102.5	91.7	0	Unchanged

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS—MINOR RUBBER CO.

CHEMICAL COMPATIBILITY CHARTS

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco · No. 7033 Qualatex · AX 22011 Duro · AX 16750 Amtex · No. 15030	SBR, GRS Ironsides · AX 20065	Butyl Butene · AX 90560	EPR, EPT, EPDM Resist-O (Nordel®) No. AX 60560	Buna N, Nitrile, NBR Oil Ace · AX 41060 Mincar · No. 4045	Hydrin Epi Chloro Hydrin Compound No. GF 0960	Neoprene® Matchless · AX 1060 Mirprene · No. 1050	Hypalon® Chlorosol · No. 19040	Urethane, Polyurethane Polycast · No. UR 2970	Polysulfide Thiokol® No. 23945	Silicone Thermollex · No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK 8870	Fluoro Elastomers Viton® Fluorel® Vi-Chem · No. EV 9970
Acetaldehyde	C	U	A	A	U		C	C	U	C	A	U	U
Acetamide	U	U	B	A	A		B	B	U	U	B	A	B
Acetic Acid 5%	B	B	A	A	B		A	A	U	B	A	B	A
Acetic Acid 30%	B	B	B	A	B	B	A	A	U	B	A	B	B
Acetic Acid, Hot High Press	U	U	U	C	U		U	C	U	U	C	U	U
Acetic Acid, Glacia	B	C	B	B	C	U	U	C	U	B	B	U	U
Acetic Anhydride	B	U	B	B	U	U	A	A	U	B	C	U	U
Acetone	B	B	A	A	U	U	B	B	U	C	B	U	U
Acetophenone	U	U	A	A	U	U	U	U	U	U	U	U	U
Acetyl Acetone	U	U	A	A	U	U	U	U	U	B	U	U	U
Acetyl Chloride	U	U	U	U	U	U	U	U	U	U	C	A	A
Acetylene	B	B	A	A	B	B	B	B		C	B		A
Acetylene Tetrabomide		U	A	A	U		B		U				A
Acrylonitrile	U	C	U	U	U		C	C		U	U	U	U
Adipic Acid					A							A	
Aero Lubriplate	U	B	U	U	A		A	A	A	A	B	A	A
Aero Safe 2300	U	U	B	A	U		U	U	U	U	C	C	U
Aero Safe 2300W	U	U	B	A	U		U	U	U	U	C	C	U
Aero Shell IAC	U	U	U	U	A		B	A	A	A	B	A	A
Aero Shell 7A Grease	U	U	U	U	A		B	A	A	A	B	A	A
Aero Shell 17 Grease	U	U	U	U	A		B	A	A	A	B	A	A
Aero Shell 750	U	U	U	U	B		U	U	U	B	U	B	A
Aerozene 50 (50% Hydrazine 50% UDMH)	U	U	A	A	C		U	U	U	U	U	U	U
Air · Below 300°F	U	U	B	B	B		B	B	C	U	A	A	A
Air · Above 300°F	U	U	U	U	U		U	U	U	U	A	B	A
Alkazene	U	U	U	U	U		U	U	B	A	U	B	B
Alum-NH_3Cr-K	A	A	A	A	A		A	A		U	A		U
Aluminum Acetate	A	B	A	A	B	B	B	B	U	U	U	U	U
Aluminum Bromide	A	A	A	A	A		A	A	C	A	A	A	A
Aluminum Chloride	A	A	A	A	A		A	B	B	U	B	A	A
Aluminum Fluoride	B	A	A	A	A	A	A	A	C	U	B	A	A
Aluminum Nitrate	A	A	A	A	A	A	A	A	C	B	B		A
Aluminum Phosphate	A	A	A	A	A	A	A	A			A		A
Aluminum Salts	A	A	A	A	A		A	A	C	A	A	A	A
Aluminum Sulfate	A	B	A	A	A		A	A	U	U	A	A	A
Ambrex 33 Mobil	U	U	U	U	A		B	C	B	C	U	C	A
Amines, Mixed	B	B	B	B	U		B	U	U	U	B	U	U
Ammonia Anhydrous (Liquid)	U	U	A	A	B		A	U	U	U	C	U	U
Ammonia Gas, Cold	A	A	A	A	A		A	A		A	A	A	U
Ammonia Gas, Hot	U	U	B	B	U		B	B		U	A	U	U
Ammonia and Lithium Metalin Solution	U	U	B	B	B			U	U	U	U	U	U
Ammonium Carbonate	A	A	A	A	U	B	A						
Ammonium Chloride	A	A	A	A	A	A	A	A	A	A			A
Ammonium Hydroxide (Concentrated)	U	U	A	A	U	B	A	A	U	U	A	B	B
Ammonium Nitrate	C	A	A	A	A	A	B	A	U				
Ammonium Nitrite	A	A	A	A	A		A	A			B		
Ammonium Persulfate Solution	A	U	A	A	U		A	A	U				
Ammonium Persulfate 10%	A	U	A	A	U		A		U				
Ammonium Phosphate	B	A	A	A	A	A	A	A		A	A		
Ammonium Phosphate, Mono-Basic	A	A	A	A	A		A	A		A	A		
Ammonium Phosphate, Dibasic	A	A	A	A	A		A	A		A	A		
Ammonium Phosphate, Tribasic	A	A	A	A	A		A	A		A	A		
Ammonium Salts	A	A	A	A	A		A	A			A	C	C
Ammonium Sulfate	A	B	A	A	A		A	A	A	U	A	A	A
Ammonium Sulfide	A	B	A	A	A		A	A		U			U
Amyl Acetate	U	U	A	A	U	U	U	U	U	U	U	U	U
Amyl Alcohol	B	B	A	A	B	A	A	A	U	B	U	A	B
Amyl Borate	U	U	U	U	A		A	A		A			A
Amyl Chloride	U	U	U	U			U	U			U	B	A
Amyl Chloranaphthalene	U	U	U	U	U		U	U	U	C	U	B	A
Amyl Naphthalene	U	U	U	U	U		U	U	U	C	U	A	A
Anderol L-774 (di-ester)	U	U	U	U	B		U	U	U	B	U	B	A
Anderol L-826 (di-ester	U	U	U	U	B		U	U	U	B	U	B	A
Anderol L-829 (di-ester)	U	U	U	U	B		U	U	U	B	U	B	A
Ang-25 (Glyceral Ester)	B	B	B	A	B		B	B	U	U	B	B	A
Ang-25 (Di-ester Base) (TG749)	U	U	U	U	B		U	U	U	B	B	B	A
Anhydrous Ammonia	U	U	A	A	B		A	U	U	U	B	U	U
Anhydrous Hydrazine	U	A	B	B	U		B	B	U	U		U	U
Anhydrous Hydrogen Fluoride	U	U	A	A	U							U	U
Aniline	U	U	B	B	U	U	U	U	U	U	U	C	C
Aniline Dyes	B	B	B	B	U		B	B	U		C	B	B
Aniline Hydrochloride	B	C	B	B	B		U	U	U	U	U	B	B
Aniline Oils	U	U	B	B	U		U	U	U	B	U	C	C
Animal Fats	U	U	B	B	A	A	B	B	B	U	B	A	A
Animal Oils (Lard Oil)	U	U	B	B	A		B	B	B	U	B	A	A
AN-O-3 Grade M	U	U	U	U	A		B	B	A	A	B	A	A
AN-O-6	U	U	U	U	A		B	B	A	A	U	A	A
AN-O-366	U	U	U	U	A		B	B	A	A	U	A	A
AN-VV-O-366b Hydr. Fluid	U	U	U	U	A		B	B	B	A	U	A	A
Ansul Ether	U	U	C	C	C		U	U	B	A	U	C	U
Aqua Regia	U	U	U	C	U		U	C	U	U	U	C	B
Argon	U	U	B	A	C		U	U	A	U	B	B	A
Aroclor 1248	U	U	B	B	C		U	U		U	B	B	A
Aroclor 1254	U	U	U	B	U		U	U		U	C	B	A
Aroclor 1260	A	A	A		A		A	A		A	A	A	A
Aromatic Fuel 50%	U	U	U	U	B		U	U	U	B	U	B	A
Arsenic Acid	B	A	A	A	A	A	A	A	C	A	A	A	A
Arsenic Trichloride					A		A						
Askarel	U	U	U	U	B		U	U	U	U	U	B	A
Asphalt	U	U	U	U	B	A	C	U	B	A	U	B	A

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS—MINOR RUBBER CO. (continued)

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco · No. 7033 Qualatex · AX-22011 Duro · AX-16750 Amtex · No. 15030	SBR, GRS Ironsides · AX-20065	Butyl Butene · AX-90560	EPR, EPT, EPDM Resist-O (Nordel®) No. AX-60660	Buna N, Nitrile, NBR Oil Ace · AX-41060 Mincar · No. 4045	Hydrin Epi Chloro Hydrin Compound No. GF-0960	Neoprene® Matchless · AX-1060 Mirprene · No. 1050	Hypalon® Chlorosol · No. 19040	Urethane, Polyurethane Polycast · No. UR-2970	Polysulfide Thiokol® No. 23945	Silicone Thermoflex · No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK 8870	Fluoro Elastomers Viton® Fluorel® Vi-Chem · No. EV 9970
ASTM Oil #1	U	U	U	U	A		A	B	A	A	A	A	A
ASTM Oil #2	U	U	U	U	A		B	U	B	C	U	A	A
ASTM Oil #3	U	U	U	U	A		U	U	B	C	C	A	A
ASTM Oil #4	U	U	U	U	B		U	U	U	C	U	B	A
ASTM Reference Fuel A	U	U	U	U	A		B	B	A	A	U	A	A
ASTM Reference Fuel B	U	U	U	U	A		U	U	B	A	U	A	A
ASTM Reference Fuel C	U	U	U	U	B		U	U	U	B	U	B	A
ATL-857	U	U	U	U	B		U	U	U	B	U	B	A
Atlantic Dominion F	U	U	U	U	A		B	U	B	C	U	A	A
Aurex 903R Mobil	B	U	U	U	A		B	U	A	A	U	U	A
Automatic Transmission Fluid	U	U	U	U	A		B	C	B		U		A
Automotive Brake Fluid		A	B	A	C		B	B		U	C	U	U
B													
Bardol B	U	U	U	U	U		U	U	U	B	U	B	A
Barium Chloride	A	A	A	A	A	A	A	A	A	A	A	A	A
Barium Hydroxide	A	A	A	A	A	A	A	A	A	A	A	A	A
Barium Salts	A	A	A	A	A		A	A	A	A	A	A	A
Barium Sulfate	A	A	A	A	A	A	A	A	A	A	A	A	A
Barium Sulfide	A	B	A	A	A	A	A	A	A	B	A	A	A
Bayol D	U	U	U	U	A		B	U	U	B	U	A	A
Beer	A	A	A	A	A	A	A	A	U	U	A	A	A
Beet Sugar Liquors	A	A	A	A	A		A	A	U	U	A	A	A
Benzaldehyde	U	U	A	A	U	U	U	U	U	U	U	U	U
Benzene	U	U	U	U	U	U	U	U	U	C	U	A	A
Benzenesulfonic Acid	U	U	U	U	U		A	B	U	U	U	B	A
Benzine	U	U	U	U	A		B	C	B	A	U	A	A
Benzochloride	U	U	B	A	U		U	U		U		A	A
Benzoic Acid	U	U	U	U	U		U	U	U		B	B	A
Benzophenone		U	B	B					U	B		A	A
Benzyl Alcohol	U	U	B	B	U	U	B	B	U	U		B	A
Benzyl Benzoate	U	U	B	B	U		U	U		U		A	A
Benzyl Chloride	U	U	U	U	U		U	U	U	U	U	A	A
Black Point 77	C	C	A	A	A		C	C	C	C	C	C	A
Black Sulphate Liquors	B	B	B	B	B		B	B	U	U	B	B	A
Blast Furnace Gas	U	U	U	U	U		U	U	U	U	A	B	A
Bleach Solutions	U	U	A	A	U		C	A	U	U	B	B	A
Borax	B	B	A	A	B		A	A	A	U	B	B	A
Bordeaux Mixture	B	B	A	A	B		B	A	U	U	B	B	A
Boric Acid	A	A	A	A	A	A	A	A	A	U	A	A	A
Boron Fluids (HEF)	U	U	U	U	B		U	U	U	B	U	B	A
Brake Fluid (Non-Petroleum)		A	B	A	C		B	B		U	C	U	U
Bray GG-130	U	U	U	U	B		U	U	U	B	U	B	A
Brayco 719-R (VV-H-910)	B		B	A	C		B	B	U	U	B	B	U
Brayco 885 (MIL-L-6085A)	U	U	U	U	B		U	U	A	B	U	B	A
Brayco 910	A	B	A	A	B		B	A	C	U	U	U	U
Bret 710	A	B	A	A	B		B	A	C	U	U	U	U
Brine			A	A	A		A	A					
Brom - 113		U	U	U	C		U	U		B	U		
Brom - 114	U	U	U	U	B		B	B		A	U		B
Bromine	U	U	U	U	U		U	U	U	B	U	B	A
Bromine Anhydrous							U	U		B	C	B	A
Bromine Pentafluoride	U	U	U	U	U		U	U	U	U	U	U	U
Bromine Trifluoride	U	U	U	U	U	U	U	U	U	U	U	U	U
Bromine Water	U	U	U	U	U		B	B	U	C	U	B	A
Bromobenzene	U	U	U	U	U	U	U	U	U	C	U	A	A
Bromochloro Trifluoroethane	U	U	U	U	U		U	U	U	U	U	B	A
Bunker Oil	U	U	U	U	A		U	U	B	A	B	A	A
Butadiene	U	U	U	C	U	U	B	B	U	C	U	B	B
Butane	U	U	U	U	A	A	A	B	A	A	U	A	A
Butane 2,2-Dimethyl	U	C	U	U	A		B	B	U	A	U	A	A
Butane 2, 3-Dimethyl	U	C	U	U	A		B	B	U	A	U	A	A
Butanol (Butyl Alcohol)	A	A	B	B	A		A	A	U	B	B	A	A
1-Butene, 2-Ethyl	U	U	U	U	A		U	U	U	A	U	C	A
Butter	U	U	B	A	A	A	B	B	A	U	B	A	A
Butyl Acetate	U	U	B	B	U	U	U	U	U	U	U	U	U
Butyl Acetyl Ricinoleate	U	U	A	A	B		B	B	U			B	A
Butyl Acrylate	U	U	U	U	U		U	U		B		U	U
Butyl Alcohol	A	A	B	B	A		A	A	U	B	B	A	A
Butyl Amine	U	U	U	U	C		U	U	U	U	B	U	U
Butyl Benzoate	U	U	B	A	U		U	U		U		A	A
Butyl Butyrate	U	U	A	A	U		U	U		U		A	A
Butyl Carbitol	U	U	A	A	B		B	B		U	U	U	C
Butyl Cellosolve	U	U	A	A	C		C	B	U			U	U
Butyl Cellosolve Adipate	U	U	B	B	U		U	U	U	B	B	B	B
Butyl Ether	U	U	C	C	C		U	U	B	A	U	C	U
Butyl Oleate	U	U	B	B	U		U	U				B	A
Butyl Stearate	U	U	B	B	B		U	U		A		B	A
Butylene	U	U	U	U	B		C	U	U	B	U	B	A
Butyraldehyde	U	U	B	B	U		U	U	U	C	U	U	U
Butyric Acid		U	B	B	U		U	U					B
C													
Calcine Liquors			A	A	A				U			A	A
Calcium Acetate	A	U	A	A	B		B	U	U	U	U	U	U
Calcium Bisulfite	U	U	U	U	A		A	A	A	U	A	A	A
Calcium Carbonate	A	A	A	A	A		A	A	C	U	A	A	A
Calcium Chloride	A	A	A	A	A	A	A	A	A	A	A	A	A
Calcium Cyanide	A	A	A	A	A		A	A		A	A		
Calcium Hydroxide	A	A	A	A	A	A	A	A	A	U	A	A	A
Calcium Hypochloride	U	U	A	A	U	B	U	A	U	U		A	A
Calcium Hypochlorite	U	U	A	A	C	B	C	A	U	U	B	B	A
Calcium Nitrate	A	A	A	A	A	A	A	A	A	A	B	A	A
Calcium Phosphate	A	A	A	A	A		B	A	A		A		A
Calcium Salts	A	A	A	A	A		A	A	A	A	B	A	A
Calcium Silicate	A	A	A	A	A		A	A					A

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS—MINOR RUBBER CO. (continued)

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco No. 7033 Qualatex AX 22011 Duro AX 16750 Amtex No. 15030	SBR, GRS Ironsides AX-20065	Butyl Butene AX-90560	EPR, EPT, EPDM Resist-O (Nordel®) No. AX-60660	Buna N, Nitrile, NBR Oil Ace AX-41060 Mincar No. 4045	Hydrin Epi-Chloro Hydrin Compound No. GF 0960	Neoprene® Matchless AX-1080 Mirprene No. 1050	Hypalon® Chlorosol No. 19040	Urethane, Polyurethane Polycast No. UR-2970	Polysulfide Thiokol® No. 23945	Silicone Thermoflex No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK 8870	Fluoro Elastomers Viton® Fluorel® Vi-Chem. No. EV 9970
Calcium Sulfide	B	B	A	A	B	B	A	A	A	U	B	A	A
Calcium Sulfite	B	B	A	A	A		A	A	A	B	A	A	A
Calcium Thiosulfate	B	B	A	A	B		A	A	A	B	A	A	A
Caliche Liquors	A	A	A	A	A		A	A	A	A	B	A	A
Cane Sugar Liquors	A	A	A	A	A	A	A	A	U	U	A	A	A
Caproic Aldehyde	B		B	B					U	B	B	U	U
Carbamate	U	U	B	B	C		B	B	U	B		A	A
Carbitol	B	B	B	B	B		B	B	U	B	B	B	B
Carbolic Acid	U	U	B	B	U		C	C		U	U	A	A
Carbon Bisulfide			U	U	C	U	U	U		C		A	A
Carbon Dioxide, Dry	B	B	B	B	A	A	B	B	A	B	B	B	B
Carbon Dioxide, Wet	B	B	B	B	A		B	B		B	B	B	B
Carbon Disulfide	U	U	U	U	U		U	U				A	A
Carbon Monoxide	B	B	A	A	A	A	A	A	A	U	A	B	A
Carbon Tetrachloride	U	U	U	U	C	B	U	U	U	C	U	A	A
Carbonic Acid	A	B	A	A	B		A	A	A	A	A	A	A
Castor Oil	A	A	B	B	A	A	A	A	A	C	A	A	A
Cellosolve	U	U	B	B	U		U	U	U	B	U	U	U
Cellosolve Acetate	U	U	B	B	U		U	U	U	B	U	U	U
Cellosolve Butyl	U	U	B	B	U		U	U	U	B	U	U	U
Celluguard	A	A	A	A	A		A	A	U	A	A	A	A
Cellulube A60 Now Fyrquel)	U	U	B	A	U		U	U	U	B		C	B
Cellulube 90, 100, 150, 220, 300, 500	U	U	A	A	U		U	U	U	U	A	B	A
Cellutherm 2505A	U	U	U	U	B		U	U	U	A	U	B	A
Cetane (Hexadecane)	U	U	U	U	A		B	B	U	A	U	C	A
China Wood Oil (Tung Oil)	U	U	C	U	A		B	C	C	C	U	B	A
Chloracetic Acid	U	U	B	B	U		U	U	U	U		U	U
Chlorodane	U	U	U	U	B		C	C			U	B	A
Chlorextol	U	U	U	U	B		B	U	U	U	U	B	A
Chlorinated Salt Brine	B	U	U	U	U		U	B	U	U	U	A	A
Chlorinated Solvents, Dry	U	U	U	U	U		U	U	U	U	U	A	A
Chlorinated Solvents, Wet	U	U	U	U	U		U	U	U	U	U	A	A
Chlorine, Dry	U	U	U	A	U	B	C	B	U	U	U	A	A
Chlorine, Wet	U	U	C	C	U	B	U	C	U	U		B	A
Chlorine Dioxide	U	U	C	C	U		U	C	U	U		B	A
Chlorine Dioxide (8% Cl as $NAClO_2$ in solution)	U	U	U	U	U		U	U	U	U		B	A
Chlorine Trifluoride	U	U	U	U	U	U	U	U	U	U	U	B	U
Chloroacetone	U	U	B	A	U		B	U	U	U	U	U	U
Chloroacetic Acid			B	B			A	A					
Chlorobenzene	U	U	U	U	U	U	U	U	U	U	U	B	A
Chlorobenzene, (Mono)	U	U	U	U	U		U	U	U	U	U	B	A
Chlorobromo Methane	U	U	B	B	U		U	U	U	U	U	B	B
Chlorobutadiene	U	U	U	U	U		U	U	U	U	U	B	A
Chlorododecane	U	U	U	U	U		U	U	U	U	U	A	A
Chloroform	U	U	U	U	U		U	U	U	U	U	B	A
O-Chloronapthalene	U	U	U	U	U		U	U	U	U	U	B	A
1-Chloro 1-Nitro Ethane	U	U	U	U	U		U	U	U	U	U	U	C
Chlorosulfonic Acid	U	U	U	U	U		U	U	U	U	U	U	C
Chlorotoluene	U	U	U	U	U		U	U	U	U	U	B	A
Chlorox	U	U	B	B	B		B	B	U	U		A	A
O-Chlorphenol	U	U	U	U	U		U	U	U	U	U	B	A
Chrome Alum	A	A	A	A	A		A	A		U	A		A
Chrome Plating Solutions	U	U	U	U	U		U	U	U	U	B	B	A
Chromic Acid	U	U	C	C	U		U	B	U	U	C	C	A
Chromic Oxide .88 Wt. % Aqueous Solution	U	U	B	B	U		U	A	U	U	B	B	A
Circo Light Process Oil	U	U	U	U	A		B	B	A	A	U	A	A
Citric Acid	A	A	A	A	A	A	A	A	A	U	A	A	A
City Service Koolmotor-AP Gear Oil 140-E.P. lube	U	U	U	U	A		B	B	A	A	U	A	A
City Service Pacemaker #2	U	U	U	U	A		B	U	B		U	A	A
City Service #65, #120, #250	U	U	U	U	A		B	U	B		U	A	A
Cobalt Chloride	A	A	A	A	A		A	A	U	U	B	A	A
Cobalt Chloride, 2N	A	A	A	A	A		A	A	U	U	A	A	A
Cocoanut Oil	U	U	B	C	A		C	C	C	U	A	A	A
Cod Liver Oil	U	U	A	A	A		B	B	A	U	B	A	A
Coffee	A	A	A	A	A		A	A	U	U	A	A	A
Coke Oven Gas	U	U	U	U	U		U	U	U	U	B	B	A
Coliche Liquors	A	B	B	B	B		A			U			
Convelex 10	U	U	U		U		U	U	B	A	U		
Coolanol (Monsanto)	U	U	U	U	A		A	B	U	U	U	B	A
Coolanol 45 (Monsanto)	U	U	U	U	A		A	B	U	U	U	B	A
Copper Acetate	A	U	A	A	B		B	U	U	U	U	U	U
Copper Chloride	A	A	A	A	A		A	A	A	U	A	A	A
Copper Cyanide	A	A	A	A	A		A	A	A		A	A	A
Copper Salts	A	A	A	A	A		A	A	A		A	A	A
Copper Sulfate	B	B	B	A	A		A	A	A	U	A	A	A
Copper Sulfate 10%	B	B	B	A	A		A	A	B	U	A	A	A
Copper Sulfate 50%	A	B	B	A	A		A	A	C	A	A	A	A
Corn Oil	U	U	C	C	A	A	C	B	A	U	A	A	A
Cottonseed Oil	U	U	C	C	A	A	C	B	A	U	A	A	A
Creosols	U	U	U	U	U	U	U	U	U	U	U	B	A
Creosote	U	U	U	U	B	U	C	C	B	C	U	A	A
Creosote, Coal Tar	U	U	U	U	A		B	U	C	C	U	A	A
Creosote, Wood	U	U	U	U	A		B	U	C	C	U	A	A
Creosylic Acid	U	U	U	U	U		U	U	U	U	U	B	A
Crude Oil	U	U	U	U	B		U	U			U	B	A
Cumene	U	U	U	U	U		U	U	U	B	U	B	A
Cutting Oil	U	U	U	U	A		B	B	A	A	U	A	A
Cyclohexane	U	U	U	U	A		U	U	B	A	U	A	A
Cyclohexanol	U	U	U	U	B		B	B		B	U	A	A
Cyclohexanone	U	U	B	B	U	U	U	U	U	B	U	U	U
P-Cymene	U	U	U	U	U		U	U	U	U	U	B	A
D													
Decalin	U	U	U	U	U		U	U		B	U	A	A
Decane	U	U	U	U	B		U	U	B	A	B	A	A
Delco Brake Fluid		A	B	A	C		B	B		U	C	U	U

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS—MINOR RUBBER CO. (continued)

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco No. 7033 Qualitex AX 22011 Duro AX 16750 Amtex No. 15030	SBR, GRS Ironsides AX 20065	Butyl Butene AX 90560	EPR, EPT, EPDM Resist-O (Nordel®) No. AX 60560	Buna N, Nitrile, NBR Oil Ace AX 41060 Mincer No. 4045	Hydrin Epi Chloro Hydrin Compound No. GF 0960	Neoprene® Matchless AX 1060 Mirprene No. 1050	Hypalon® Chlorosol No. 19040	Urethane, Polyurethane Polycast No. UR 2970	Polysulfide Thiokol® No. 23945	Silicone Thermoflex No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK 8870	Fluoro Elastomers Viton® Fluorel® Vi-Chem No. EV 9970
Denatured Alcohol	A	A	A	A	A	A	A	A	U	C	A	A	A
Detergent Solutions	B	B	A	A	A	A	B	B	U		A	A	A
Developing Fluids (Photo)	A	B	B	B	A		A	A		A	A	A	A
Dextron	U	U	U	U	A		B	U	B		U	B	A
Diacetone	U	U	A	A	U		U	U	U	B	U	U	U
Diacetone Alcohol	U	U	A	A	U	U	U	U	U	B	U	U	U
Diazinon	U	U	U	U	C		C	C			U	B	B
Dibenzyl Ether	U	U	B	B	U	U	U	U	B	B			U
Dibenzyl Sebacate	U	U	B	B	U		U	U	B	B	C	C	B
Dibromoethyl Benzene	U	U	U	U	U		U	U	U	U	U	B	A
Dibutylamine	U	U	U	U	U		U	U	U	U	C	U	U
Dibutyl Ether	U	U	C	C	U		U	U	B	A	U	C	C
Dibutyl Phthalate	U	U	C	A	U	B	U	U	U	A	B	C	B
Dibutyl Sebacate	U	U	B	B	U		U	U	U	B	B	B	B
O-Dichlorobenzene	U	U	U	U	U		U	U	U	A	U	B	A
P-Dichlorobenzene	U	U	U	U	U		U	U	U	A	U	B	A
Dichloro-Butane	U	U	U	U	B		U	U	U	C	U	B	A
Dichloro-Isopropyl Ether	U	U	U	C	U		U	U	B	A	U	C	C
Dicyclohexylamine	U	U	U	U	C		U	U	U	U		U	U
Diesel Oil	U	U	U	U	A	A	B	B	C	A	U	A	A
Di-ester Lubricant MIL-L-7808	U	U	U	U	B		U	U	U	B	U	B	A
Di-ester Synthetic Lubricants	U	U	U	U	B		U	U	U	B	U	B	A
Diethylamine	B	B	B	B	C		C	C	C	B	B	U	U
Diethyl Benezene	U	U	U	U	U		U	U	U	B	U	C	A
Diethyl Ether	U	U	U	U	U		C	U	A	A	U	C	U
Diethyl Sebacate	U	U	B	B	U		U	U	U	B	B	B	B
Diethylene Glycol	A	A	A	A	A	A	A	A	U	U	B	A	A
Difluorodibromomethane	U	U	B	B	U		U	U	U	U	U		
Diisobutylene	U	U	U	U	B		U	U	U	A	U	C	A
Diisooctyl Sebacate	U	U	U	C	C		U	U	U	C	C	C	B
Diisopropyl Benzene	U	U	U	U	U		U	U		B		B	A
Diisopropyl Ketone	U	U	A	A	U		U	U	U	B	U	U	U
Dimethyl Aniline	U	U	U	B			U					U	U
Dimethyl Formamide	U	U	U	B	B		U	U		B	B	U	U
Dimethyl Phthalate	U	U	B	B	U		U	U		B		B	B
Dinitro Toluene	U	U	U	U	U		U	U	U	U	U	U	U
Dioctyl Phthalate	U	U	B	B	U	B	U	U	U	B	C	B	B
Dioctyl Sebacate	U	U	B	B	U	C	U	U	B	C	C	C	B
Dioxane	U	U	B	B	U		U	U	U	U	U	U	U
Dioxolane	U	U	C	B	U		U	U	U	U	U	U	U
Dipentene	U	U	U	U	B		U	U	U	A	U	C	A
Diphenyl	U	U	U	U	U		U	U	U	B	U	B	A
Diphenyl Oxides	U	U	U	U	A		U	U	U	U	C	B	A
Dow Chemical 50-4		A	B	A			B	B		U		U	U
Dow Chemical ET378	U	U	U		U		U	U	B	A	U		
Dow Chemical ET588		A	B	A	C		B	B		U		U	U
Dow Corning - 3	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 4	A	A	A	A	A		A	A	A		C	A	A
Dow Corning - 5	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 11	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 33	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 44	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 55	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 200	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 220	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 510	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 550	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 704			A	A	B								A
Dow Corning - 705			A	A	B								A
Dow Corning - 710	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 1208	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 4050	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - 6620	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - F60	A	A	A	A	A		A	A	A	A	C	A	A
Dow Corning - F61	A	A	A	A	A		A	A	A	A	B	A	A
Dow Corning - XF60	A	A	A	A	A		A	A	A	A	C	A	A
Dow Guard	A	A	A	A	A		A	A	C		A	A	A
Dowtherm Oil	U	U	U	U		U	U	U	B		B	A	A
Dowtherm A or E	U	U	U	U	U		U	U	U	U	U	B	A
Dowtherm 209, 50% Solution			B	A	C		B				C		U
Drinking Water	A	A	A	A	A	B	B	A	U	U	A	A	A
Dry Cleaning Fluids	U	U	U	U	C		U	U	U	U	U	B	A
DTE Light Oil	U	U	U	U	A		B	U	B		U	A	A
E													
Elco 28-EP Lubricant	U	U	U	U	A		C	U	A	B	B	A	A
Epichlorohydrin	U	U	B	B	U		U	U	U	U	U	U	U
Epoxy Resins			A	A			A						U
Esam-6 Fluid		A	B	A			B	B		U		U	U
Esso Fuel 208	U	U	U	U	A		B	C	U	A	U	A	A
Esso Golden Gasoline	U	U	U	U	B		U	U	U	B	U	A	A
Esso Motor Oil	U	U	U	U	A		C	U	U	A	U	A	A
Esso Transmission fluid (type A)	U	U	U	U	A		B	U	C	A	U	A	A
Esso WS3812 (MIL-L-7808A)	U	U	U	U	A		U	U	U	B	U	A	A
Esso XP90-EP Lubricant	U	U	U	U	A		B	B	A	A	U	A	A
Esstic 42, 43	U	U	U	U	A		B	U	B		U	A	A
Ethane	U	U	U	U	A		B	B	C	A	U	B	A
Ethanol	A	A	A	A	C		A	A	U	A	B	A	C
Ethanol Amine	B	B	B	B	B	B	B	C	C	B	B	U	U
Ethers	U	U	U	C	U		U	U	B	A	U	C	C
Ethyl Acetate-Organic Ester	U	U	B	B	U	U	U	U	U	B	B	U	U
Ethyl Acetoacetate	C	C	B	B	U		U	U	U	B	B	U	U
Ethyl Acrylate	U	U	B	B	U	U	U	U	U	B	B	U	U
Ethyl Acrylic Acid	U	U	B	B	U		B	U	U		U	U	
Ethyl Alcohol	A	A	A	A	C	A	A	A	U	A	B	A	A
Ethyl Benzene	U	U	U	U	U	U	U	U	U	U	U	A	A

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS–MINOR RUBBER CO. (continued)

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber, Mirco No. 7033, Qualatex AX 22011, Duro AX 16750, Amtex No. 15030	SBR, GRS, Ironsides AX 20065	Butyl, Butene AX 90560	EPR, EPT, EPDM, Resist-O (Nordel®) No. AX 60660	Buna N, Nitrile, NBR, Oil Ace AX 41060, Mincar No. 4045	Hydrin, Epi-Chloro Hydrin Compound No. GF 0960	Neoprene®, Matchless AX 1060, Mirprene No. 1050	Hypalon®, Chlorosol No. 19040	Urethane, Polyurethane, Polycast No. UR 2970	Polysulfide, Thiokol® No. 23945	Silicone, Thermoflex No. 2850R	Fluorosilicone, Fluorosilicone Compound No. WK 8870	Fluoro Elastomers, Viton® Fluorel®, V. Chem. No. EV 9970
Ethyl Benzoate	U	U	U	U	U		U	U	U	B	U	A	A
Ethyl Bromide	U		U	U	B		U	U				A	A
Ethyl Cellosolve	U	U	B	B	U		U	U	U	B	U	U	U
Ethyl Cellulose	B	B	B	B	B		B	B	B	U	C	U	U
Ethyl Chloride	B	B	A	A	A	B	B	U	B	U	U	A	A
Ethyl Chlorocarbonate	U	U	U	U	U		U	U	U	U	U	B	A
Ethyl Chloroformate	U	U	U	U	U		U	U	U	U	U	B	A
Ethyl Cyclopentane	U	U	U	U	A		C	U	A	B	U	A	A
Ethyl Ether	U	U	C	C	C	B	U	U	B	A	U	C	U
Ethyl Formate	U	U	B	B	U	U	B	B		U		A	A
Ethyl Hexanol	A	A	A	A	A		A	A	U	B	B	A	A
Ethyl Mercaptan	U	U	U	U	U	U	C	C		U	C		B
Ethyl Oxalate	U	U	U	U	U	U	U	U	A	A	U	B	A
Ethyl Pentachlorobenzene	U	U	U	U	U	C	U	U	U	U	U	B	A
Ethyl Silicate	B	B	A	A	A	A	A	B		B		A	A
Ethylene					A							A	A
Ethylene Chloride	U	U	U	U	U		U	U	U	B	U	C	B
Ethylene Chlorohydrin	B	B	B	B	U		B	B	U	B	C	B	A
Ethylene Diamine	B	B	A	A	A	A	A	B	U	U	A	U	U
Ethylene Dibromide	U	U	C	C	U		U	U	U	U	U	C	A
Ethylene Dichloride	U	U	C	C	U	U	U	U	U	U	U	C	A
Ethylene Glycol	A	A	A	A	A	A	A	A	B	C	A	A	A
Ethylene Oxide	U	U	C	C	U	U	U	U	U		U	U	U
Ethylene Trichloride	U	U	C	C	U		U	U	U	U	U	C	A
Ethylmorpholene Stannous Octoate (50/50 mixture)		U	B	B	U								U
F													
F-60 Fluid (Dow Corning)	A	A	A	A	A		A	A	A	A	U	A	A
F-61 Fluid (Dow Corning)	A	A	A	A	A		A	A	A	A	U	A	A
Fatty Acids	C	U	U	U	B		B	U		U	C		A
FC-43 Heptacosofluorotri-butylamine		U	A	A	A		A	A		A	A	A	A
FC75 Fluorocarbon		U	A	A	A		A	A		A	A	B	B
Ferric Chloride	A	A	A	A	A	A	B	B	A	A	B	A	A
Ferric Nitrate	A	A	A	A	A	A	A	A	A	A	C	A	A
Ferric Sulfate	A	A	A	A	A	A	A	A		A	B	A	A
Fish Oil					A						A	A	A
Fluoroboric Acid	A	A	A	A	A		A	A					
Fluorine (Liquid)			C	C						U	U		B
Fluorobenzene	U	U	U	U	U		U	U			U	B	A
Fluorocarbon Oils			A	A									
Fluorolube		U	A	A	A		A	A		A	A	B	B
Fluorinated Cyclic Ethers			A	A									
Fluosilicic Acid	A				A		A	A					
Formaldehyde	B	C	A	A	C	B	C	C	U	B	B	U	U
Formic Acid	A	A	A	A	B	B	A	A	U		B	C	C
Freon, 11	U	U	U	U	B		U	A	U	A	U	B	A
Freon, 12	B	A	B	B	A	A	A	A	A	A	U	U	B
Freon, 12 and ASTM-Oil #2 (50/50 mixture)	U	U	U	U	A		B	B			U	B	A
Freon, 12 and Suniso 4G (50/50 mixture)	U	U	U	U	A		B	B			U	B	A
Freon, 13	A	A	A	A	A	A	A	A		A	U	U	A
Freon, 13B1	A	A	A	A	A		A	A	A	A	U	B	A
Freon, 14	A	A	A	A	A		A	A	A	A	U		A
Freon, 21	U	U	U	U	U	B	B	U		U	U		U
Freon, 22	A	A	A	A	U	A	A	A	U	U	U	U	U
Freon, 22 and ASTM Oil #2 (50/50 mixture)	U	U	U	U	U		B			B	U	B	B
Freon, 31	B	B	A	A	U		A	B		C			U
Freon, 32	A	A	A	A	A		A	A		A			U
Freon, 112	U	U	U	U	B		B	B		A	U		A
Freon, 113	U	B	U	U	A	A	A	A	B	A	U	U	B
Freon, 114	A	A	A	A	A	A	A	A	A	A	U	B	B
Freon, 114B2	U	U	U	U	B		A	A		B	U		B
Freon, 115	A	A	A	A	A		A	A		A	U		B
Freon, 142b	A	A	A	A	A		A	A		A			U
Freon, 152a	A	A	A	A	A		A	C		A			U
Freon, 218	A	A	A	A	A		A	A		A			A
Freon, C316	A	A	A	A	A		A	A					
Freon, C318	A	A	A	A	A		A	A		A			A
Freon, 502	A	A	A	A	B		A						B
Freon, BF	U	U	U	U	B		B	B		A	U		A
Freon, MF	U	U	U	U	B		U	U		A	U		B
Freon, TF	U	B	U	U	A	A	A	A	A	A	U		B
Freon, TA	A	A	A	A	A		A	A	A	A	A		C
Freon, TC	U	B	A	B	A		A	A	A	A	U		A
Freon, TMC	B	C	B	B	B		B	B	B	A	C		A
Freon, T-P35	A	A	A	A	A		A	A	A	A	A		A
Freon, T-WD602	C	B	A	B	B		B	B	A	A	U		A
Freon, PCA	U	B	U	U	A		A	A	A	A	U		B
Fuel Oil	U	U	U	U	A	A	B	C	U	A	U	A	A
Fuel Oil, Acidic	U	U	U	U	A		B	U	B	A	A	A	A
Fuel Oil, #6	U	U	U	U	B		U	U	B	A	A	A	A
Fumaric Acid	A	A	U		A		B	B			B	A	A
Fuming Sulphuric Acid (20/25% Oleum)	U	U	U	U	U		U	U	U	U	U		A
Furan (Furfuran)	U	U	U	C	U		U	U		B			
Furfural	U	U	B	B	U	U	U	U		U	U		U
Furfuraldehyde	U	U	B	B	U		U	U		U	U		U
Furfaryl Alcohol	U	U	B	B	U		U	U	U	U	U	U	
Furyl Carbinol	U	U	B	B	U		U	U	U	U	U	U	
Fyrquel A60	U	U	B	B	U		U	U	U	U	C	U	U
Fyrquel 90, 100, 150, 220, 300, 500	U	U	A	A	U		U	U	U	U	A	B	A
G													
Gallic Acid	A	B	B	B	B		B	B	U			A	A
Gasoline	U	U	U	U	A	A	B	B	B	A	U	A	A
Gelatin	A	A	A	A	A	A	A	A	U	U	A	A	A
Girling Brake Fluid		A	B	A	C		B	B		U		U	U
Glacial Acetic Acid	B	B	B	B	B		U	U	U	B	B	U	U

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS—MINOR RUBBER CO. (continued)

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco No. 7033 Qualatex AX-22011 Duro AX-16750 Amtex No. 15030	SBR, GRS Ironsides AX-20065	Butyl Butene AX-90560	EPR, EPT, EPDM Resist-O (Nordel®) No. AX-60660	Buna N, Nitrile, NBR Oil Ace AX-41060 Mincar No. 4045	Hydrin Epi-Chloro Hydrin Compound No. GF-0960	Neoprene® Matchless AX-1060 Mirprene No. 1050	Hypalon® Chlorosol No. 19040	Urethane, Polyurethane Polycast No. UR-2970	Polysulfide Thiokol® No. 23945	Silicone Thermoflex No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK-8870	Fluoro Elastomers Viton®, Fluorel® V-Chem No. EV-9970
Glauber's Salt	B	U	B	B	U		B	B		U		A	B
Glucose	A	A	A	A	A	A	A	A	U	U	A	A	A
Glue (Depending on type)	A	A	A	A	A	A	A	A	A	U	A	A	A
Glycerine-Glycerol	A	A	A	A	A	A	A	A	U	B	A	A	A
Glycols	A	A	A	A	A	A	A	A	U	A	A	A	A
Green Sulphate Liquor	B	B	A	A	B	A	B	B	A	U	A	B	A
Gulfcrown Grease	U	U	U	U	A		B	U	A	C	U	A	A
Gulf Endurance Oils	U	U	U	U	A		B	U	A	C	U	A	A
Gulf FR Fluids (Emulsion)	U	U	U	U	A		B	U	A	A	U	A	A
Gulf FRG-Fluids	A	A	A	A	A		A	A	B	C	A	A	A
Gulf FRP-Fluids	U	U	B	B	U		U	U	U	C	A	B	B
Gulf Harmony Oils	U	U	U	U	A		B	U	A	C	U	A	A
Gulf High Temperature Grease	U	U	U	U	A		B	U	A	C	U	A	A
Gulf Legion Oils	U	U	U	U	A		B	U	A	C	U	A	A
Gulf Paramount Oils	U	U	U	U	A		B	U	B	C	U	A	A
Gulf Security Oils	U	U	U	U	A		B	U	B	C	U	A	A
H													
Halothane	U	U	U	U	U		U	U	U	U	U	B	A
Halowax Oil	U	U	U	U	U		U	U		A	U	A	A
Hannifin Lube A	U	B	U	U	A		A	A	A	A	B	A	A
Heavy Water	A	A	A	A	A		B	A	U	U	A	A	
HEF-2 (High Energy Fuel)	U	U	U	U	B		U	U	U	B	U	B	A
Helium	A	A	A	A	A		A	A	A	A	A	A	A
N-Heptane	U	U	U	U	A		B	B	B	A	U	A	A
N-Hexaldehyde	U	U	B	A	U		A	C	B	B	B	U	U
Hexane	U	U	U	U	A	A	B	B	B	A	U	A	A
N-Hexane-1	U	U	U	U	B		B	B	B	A	U	A	A
Hexyl Alcohol	A	A	C	C	A		B	B	U	A	B	B	A
High Viscosity Lubricant, U4		A	A	A	A		B		U		A	B	A
High Viscosity Lubricant, H2		A	A	A	A		B		U		A	B	A
Hilo MS#1	U	U	B	A	U		U	U	U	U	C	C	U
Houghto-Safe 271 (Water and Glycol base)		A	B	A	A		B		U		B	B	B
Houghto-Safe 620 (Water/Glycol)		A	B	A	A		B		U		B	B	B
Houghto-Safe 1010, Phosphate Ester	U	U	A	A	U		U	U		C	C	B	A
Houghto-Safe 1055, Phosphate Ester	U	U	A	A	U		U	U		C	C	B	A
Houghto-Safe 1120, Phosphate Ester	U	U	A	A	U		U	U	U	C	C	B	A
Houghto-Safe 5040 (Water/Oil emulsion)	U	U	U	U	A		B	U	U		C	B	A
Hydraulic Oil (Petroleum Base)	U	U	U	U	A	A	B	B	A	A	C	A	A
Hydrazine		B	A	A	B		B	B	U	U	C		
Hydrobromic Acid	A	U	A	A	U		U	A	U		U	C	A
Hydrobromic Acid 40%	A	U	A	A	U		B	A	U		U	C	A
Hydrocarbons (Saturdated)	U	U	U	U	A		B	C	B	A	U	A	A
Hydrochloric Acid Hot 37%	U	U	C	C	U	U	U	C	U	U	U	U	A
Hydrochloric Acid Cold 37%	B	B	A	A	B	U	B	A	U	U	B	B	A
Hydrochloric Acid 3 Molar	C	C	A	A	C		C	B		U	U	B	A
Hydrochloric Acid Concentrated	U	U	A	C	U		U	U		U	U	C	A
Hydrocyanic Acid	B	B	A	A	B		B	A		U	C	B	A
Hydro-Drive, MIH-50 (Petroleum Base)	U	U	U	U	A		B	U	B	A	B	A	A
Hydro-Drive, MIH-10 (Petroleum Base)	U	U	U	U	A		B	U	B	A	B	A	A
Hydrofluoric Acid, 65% Max. Cold	B	B	A	A	B		A	A		U	U		A
Hydrofluoric Acid, 65% Min. Cold	U	U	C	C	U		U	A		U	U	U	A
Hydrofluoric Acid, 65% Max. Hot	U	U	U	U	U		C	C	U	U	U	U	C
Hydrofluoric Acid, 65% Min. Hot	U	U	U	U	U		U	U	U	U	U	U	C
Hydrofluosilicic Acid	A	B	A	A	B		B	A		U	U	U	A
Hydrogen Gas, Cold	B	B	A	A	A		A	A	A	C	C	C	A
Hydrogen Gas, Hot	B	B	A	A	A		A	A	A	U	C	C	A
Hydrogen Peroxide (1)	B	B	A	A	B		A	B		C	A	A	A
Hydrogen Peroxide 90% (1)	U	U	C	C	U		U	C		U	B	B	B
Hydrogen Sulfide Dry, Cold	A	A	A	A	A		A	A		B	C	C	U
Hydrogen Sulfide Dry, Hot	U	U	A	A	U		B	C		A	C	C	U
Hydrogen Sulfide Wet, Cold	U	U	A	A	U	B	A	B		A	C	C	U
Hydrogen Sulfide Wet, Hot	U	U	A	A	U	B	B	C		A	C	C	U
Hydrolube-Water/Ethylene Glycol		A	B	A	A		B		U		B	B	A
Hydroquinone	B	U	U	U	C		U	U		C		B	U
Hydyne	B	B	B	A	B		B			U	U	U	U
Hyjet	U	U	B	A	U		U	U	U	U			U
Hyjet III	U	U	B	A	U		U	U	U	U			U
Hyjet S	U	U	B	A	U		U	U	U	U			U
Hyjet W	U	U	B	A	U		U	U	U	U			U
Hypochlorous Acid	B	U	B	B	U	B	U	U		U			A
I													
Industron FF44	U	U	U	U	A		B	U	B		U	A	A
Industron FF48	U	U	U	U	A		B	U	B		U	A	A
Industron FF53	U	U	U	U	A		B	U	B		U	A	A
Industron FF80	U	U	U	U	A		B	U	B		U	A	A
Iodine		B	B	B	B		U	B				A	A
Iodine Pentafluoride	U	U	U	U	U	U	U	U	U	U	U	U	U
Iodoform			A	A									
Isobutyl Alcohol	A	B	A	A	B		A	A	U	B	A	B	A
Iso-Butyl N-Butyrate	U	U	A	A	U		U	U		U		A	A
Isododecane	U	U	U	U	A		B	B		A	U	A	A
Iso-Octane	U	U	U	U	A	A	B	B	B	A	U	A	A
Isophorone (Ketone)	U	U	A	A	U		U	U	U	B	U	U	U
Isopropanol	A	B	A	A	B		B	A	U	A	A	B	A
Isopropyl Acetate	U	U	B	B	U		U	U	U	B	U	U	U
Isopropyl Alcohol	A	B	A	A	B	A	B	A	U	A	A	B	A
Isopropyl Chloride	U	U	U	U	U		U	U	U	U	U	B	A
Isopropyl Ether	U	U	U	U	B		C	C	B	A	U	C	U
J													
JP 3 (MIL-J-5624)	U	U	U	U	A		U	U	B	B	U	A	A
JP 4 (MIL-J-5624)	U	U	U	U	A		U	U	B	B	U	B	A
JP 5 (MIL-J-5624)	U	U	U	U	A		U	U	B	B	U	B	A
JP 6 (MIL-J-25656)	U	U	U	U	A		U	U	B	B	U	B	A

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS—MINOR RUBBER CO. (continued)

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco No. 1033 Qualatex AX-16750 Duro AX-22011 Amtex No. 15030	SBR, GRS Ironsides AX-20065	Butyl Butene AX-90560	EPR, EPT, EPDM Resist-O (Nordel®) No. AX-60560	Buna N, Nitrile, NBR Oil Ace AX-41060 Mincar No. 4045	Hydrin Epi Chloro Hydrin Compound No. GF 0960	Neoprene® Matchless AX-1060 Mirprene No. 1050	Hypalon® Chlorosol No. 19040	Urethane, Polyurethane Polycast No. UR-2970	Polysulfide Thiokol® No. 23945	Silicone Thermoflex No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK 8870	Fluoro Elastomers Viton® Fluorel® Vi-Chem No. EV 9970
JP X (MIL-F-25604)	U	U	U	U	A		B	U		A	U	U	U
K													
Kel F Liquids		A	A	A	A			A		A	A	B	B
Kerosene	U	U	U	U	A	A	C	U	B	B	U	A	A
Keystone #87HX-Grease	U	U	U	U	A		U	U	A	A	U	A	A
L													
Lactams-Amino Acids	U	U	B	B	U		B	B		U		U	U
Lactic Acid, Cold	A	A	A	A	A		A	A		U		A	A
Lactic Acid, Hot	U	U	U	U	U		U	B		U		B	A
Lacquers	U	U	U	U	U	U	U	U	U	A	U	U	U
Lacquer Solvents	U	U	U	U	U	U	U	U	U	A	U	U	U
Lactic Acids	A	A	A	A	A		A	A		U	A	A	A
Lard, Animal Fats	U	U	U	U	A	A	C	U	A	U	B	A	A
Lavender Oil	U	U	U	U	B		U	U	U	B	U	B	A
Lead Acetate	A	U	A	A	B	B	B	U	U	U	U	U	U
Lead Nitrate	A	A	A	A	A		A	U		U	B	A	
Lead Sulphamate	B	B	A	A	B		A	A		U	B	A	A
Lehigh X1169	U	U	U	U	A		B	B	A	A	U	A	A
Lehigh X1170	U	U	U	U	A		B	B	A	A	U	A	A
Light Grease	U	U	U	U	A		U	U	A	A	U	A	A
Ligroin (Petroleum Ether or Benzine)	U	U	U	U	A		B	C	B	A	U	A	A
Lime Bleach	A	A	A	A	A		B	B		U	B	A	A
Lime Sulphur	U	U	A	A	U		A	A		U	A	A	A
Lindol, Hydraulic Fluid (Phosphate ester type)	U	U	A	A	U		U	U	U	U	C	C	B
Linoleic Acid	U	U	U	U	B		U	U		U	B		B
Linseed Oil	U	U	C	C	A		C	C	B	B	A	A	A
Liquid Oxygen	U	U	U	U	U		U	U	U	U	U	U	U
Liquid Petroleum Gas (LPG)	U	U	U	U	A	A	B	U	A	A	C	C	A
Liquimoly	U	U	U	U	A		B	U	B		U	A	A
Lubricating Oils, Di-ester	U	U	U	U	B		C			C	U	B	A
Lubricating Oils, Petroleum Base	U	U	U	U	A	A	B	U	B	C	U	A	A
Lubricating Oils, SAE 10, 20, 30, 40, 50	U	U	U	U	A		B	U	B	C	U	A	A
Lye Solutions	B	B	A	A	B		B	A	U	B	B	B	B
M													
Magnesium Chloride	A	A	A	A	A	A	A	A	A	C	A	A	A
Magnesium Hydroxide	B	B	A	A	B	A	B	A	B	C			A
Magnesium Sulphate	B	B	A	A	A	A	A	A		B	A	A	A
Magnesium Sulphite	B	B	A	A	A		A	A		B	A	A	A
Magnesium Salts	A	A	A	A	A		A	A	A	A	A	A	A
Malathion	U	U	U	U	B						U	B	A
Maleic Acid	U	U	U	U	U		U	U		B			A
Maleic Anhydride	U	U	U	U	U		U	U					A
Malic Acid	A	B	U	U	A		B	B			B	A	A
MCS 312	U	U	U	U	U		U				A	A	A
MCS 352	U	U	B	A	U		U	U	U	U	C	C	U
MCS 463	U	U	B	A	U		U	U	U	U	C	C	U
Mercuric Chloride	A	A	A	A	A	A	A	A					A
Mercury	A	A	A	A	A	A	A	A	A	A			A
Mercury Vapors	A	A	A	A	A		A	A					A
Mesityl Oxide (Ketone)	U	U	B	B	U		U	U	U	B	U	U	U
Methane	U	U	U	U	A	A	B	B	C	A	U	B	A
Methanol	A	A	A	A	A		A	A	U	B	A	A	A
Methyl Acetate	U	U	B	B	U	U	B	U	U	B	U	U	U
Methyl Acetoacetate			B	B	U		U	U	U	B	B	U	U
Methyl Acrylate	U	U	B	B	U		B	U	U	B	U	U	U
Methylacrylic Acid	U	U	B	B	U		B	U	U		U	U	C
Methyl Alcohol	A	A	A	A	A	B	A	A	U	B	A	A	U
Methyl Benzoate	U	U	U	U	U		U	U	U	B	U	A	A
Methyl Bromide	U		U	U	B		U	U				A	A
Methyl Butyl Ketone	U	U	A	A	U		U	U	U	A	U	U	U
Methyl Carbonate	U	U	U	U	U		U	U	U	U	U	B	A
Methyl Cellosolve	U	U	B	B	C		B	U	U		U	U	U
Methyl Cellulose	B	B	B	B	B		B	B	B	U	B	U	U
Methyl Chloride	U	U	C	C	U		U	U	U	C	U	B	A
Methyl Chloroformate	U	U	U	U	U		U	U	U	U	U	B	A
Methyl D-Bromide	U	U			U		U	U	U	U	U	B	A
Methyl Cyclopentane	U	U	U	U	U		U	U	U	B	U	B	A
Methylene Chloride	U	U	U	U	U		U	U	U	U	U	B	B
Methylene Dichloride	U	U	U	U	U		U	U	U	U	U	B	B
Methyl Ether	A	A	A	A	A		C	U		A	A	A	A
Methyl Ethyl Ketone (MEK)	U	U	A	A	U	U	U	U	U	B	U	U	U
Methyl Ethyl Ketone Peroxide	U	U	U	U	U		U	U	U	U	B	U	U
Methyl Formate	U	U	B	B	U	U	B	B		U	B		
Methyl Isobutyl Ketone (MIBK)	U	U	C	C	U	U	U	U	U	B	U	U	U
Methyl Isopropyl Ketone	U	U	B	B	U		U	U	U	B	U	U	U
Methyl Methacrylate	U	U	U	U	U	U	U	U		B	C	U	U
Methyl Oleate	U	U	B	B	U		U	U				B	A
Methyl Salicylate			B	B	U		U	U					
MIL-L-644B	C	C	C	C	A	A	C	C	C		C		
MIL-L-2104B	U	U	U	U	A	A	B	C	A	A	U	A	A
MIL-L-2105B	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-G-2108	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-S-3136B, Type I Fuel	U	U	U	U	A	A	B	C	B	A	U	A	A
MIL-S-3136B, Type II Fuel	U	U	U	U	B	A	U	U	C	A	U	B	A
MIL-S-3136B, Type III Fuel	U	U	U	U	B	A	U	U	C	A	U	B	A
MIL-S-3136B, Type IV	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-S-3136B, Type V	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-S-3136B, Type VI	U	U	U	U	A	A	U	U	B	A	C	A	A
MIL-S-3136B, Type VII	U	U	U	U	A	A	C	C	C	A	U	A	A
MIL-L-3150A	U	U	U	U	A	A	B	B	B	A	U	A	A
MIL-G-3278	U	U	U	U	B		U	U	B	B	U	B	A
MIL-L-3503	U	U	U	U	A	A	B	B	B	A	U	A	A
MIL-L-3545B	U	U	U	U	B	B	B	C	C	C	U	A	A

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS–MINOR RUBBER CO. (continued)

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco No. 7033 Qualatex AX-72011 Duro AX-16750 Amtex No. 15030	SBR, GRS Ironsides AX-20065	Butyl Butene AX-90560	EPR, EPT, EPDM Resist-O (Nordel®) No. AX-60660	Buna N, Nitrile, NBR Oil Ace AX-41060 Mincer No. 4045	Hydrin Epi-Chloro-Hydrin Compound No. GF-0960	Neoprene® Matchless AX-1060 Mirprene No. 1050	Hypalon® Chlorosol No. 19040	Urethane, Polyurethane Polycast No. UR-2970	Polysulfide Thiokol® No. 23945	Silicone Thermoflex No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK-8870	Fluoro Elastomers Viton® Fluorel® Vi-Chem No. EV-9970
MIL-C-4339C	U	U	U	U	A	A	U	U	U	A	C	A	A
MIL-G-4343B	U	U	C	C	B		B	B	A	A	U	B	A
MIL-L-5020A	U	U	U	U	A	A	B	C	B	A	U	A	A
MIL-J-5161F	U	U	U	U	B	A	U	U	C	A	U	A	A
MIL-C-5545A	U	U	U	U	B	B	B	C	C	C	U	A	A
MIL-H-5559A	B	A	A	A	A	B	B	B	C	C	B	B	B
MIL-F-5566	A	B	A	A	B	B	B	B	U	A	A	A	A
MIL-G-5572	U	U	U	U	A		U	U	B	A	U	A	A
MIL-F-5602	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-H-5606B	U	U	U	U	A	A	B	B	B	A	U	A	A
MIL-J-5624G, JP-3	U	U	U	U	A	A	U	U	C	B	U	B	A
MIL-J-5624G, JP-4	U	U	U	U	A	A	U	U	C	B	U	B	A
MIL-J-5624G, JP-5	U	U	U	U	A	A	U	U	C	B	U	B	A
MIL-L-6081C	U	U	U	U	A	A	B	B	B	A	U	A	A
MIL-L-6082C	U	U	U	U	A	A	B	B	A	A	C	A	A
MIL-H-6083C	U	U	U	U	A	A	B	B	B	A	U	A	A
MIL-L-6085A	U	U	U	U	B	B	U	U	C	B	U	B	A
MIL-L-6086B	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-A-6091	A	A	A	A	B		A	A	U	A	A	A	A
MIL-L-6387A	U	U	U	U	B	B	U	U	B	B	U	B	A
MIL-C-6529C	U	U	U	U	B	B	B	C	C	C	U	A	A
MIL-F-7024A	U	U	U	U	A	B	U	U	B	A	U	A	A
MIL-H-7083	B	B	A	A	A	B	B	B	U	C	B	B	B
MIL-G-7118A	U	U	U	U	B	B	C	C	C	B	U	A	A
MIL-G-7187	U	U	U	U	A	A	U	U	A	A	U	A	A
MIL-G-7421A	U	U	U	U	B	B	C	C	B	B	U	B	A
MIL-H-7644	B	A	B	A	B	B	B	B	C	C	U	B	A
MIL-L-7645	U	U	U	U	B	B	B	C	C	C	U	A	A
MIL-G-7711A	U	U	U	U	A	A	U	U	A	A	C	A	A
MIL-L-7808F	U	U	U	U	B		U	U	U	B	U	B	A
MIL-L-7870A	U	U	U	U	A	A	B	U	U	A	U	A	A
MIL-C-8188C	U	U	U	U	B	B	U	U	U	B	U	B	B
MIL-A-8243B	B	A	A	A	A	B	B	B	C	C	B	B	B
MIL-L-8383B	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-H-8446B	U	U	U	U	B	C	B		U	B	U	A	A
MIL-I-8660B	A	A	A	A	A	A	A	A	A	A	U	A	A
MIL-L-9000F	U	U	U	U	A	A	B	C	C	B	U	B	A
MIL-T-9188B	U	U	A	A	U	U	U	U	U	U	U	C	U
MIL-L-9236B	U	U	U	U	B	B	U	U	U	B	U	B	A
MIL-E-9500	A	A	A	A	A		A	A	U	A	A	A	A
MIL-L-10295A	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-L-10324A	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-G-10924B	U	U	U	U	A	A	U	B	B	A	U	A	A
MIL-L-11734B	U	U	C	U	A	B	C	C	C	B	C	A	A
MIL-O-11773	U	U	C	U	A	B	C	C	C	B	C	A	A
MIL-P-12098	B	A	B	A	B	B	B	B	C	C	U	B	A
MIL-H-13862	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-H-13866A	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-H-13910B	B	A	B	A	B	B	B	B	U	C	U	B	A
MIL-H-13919A	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-L-14107B	U	U	U	U	C		A			U	U	A	A
MIL-L-15016	U	U	U	U	A		B	B	A	A	U	B	A
MIL-L-15017	U	U	U	U	A	A	B	B	A	A	U	B	A
MIL-L-15018B	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-L-15019C	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-L-15719A	C	B	B	B	B	B	B	B	U	U	U	B	A
MIL-G-15793	U	U	U	U	A	B	C	C	C	B	U	B	A
MIL-F-16884	U	U	U	U	A		C	C	C	A	U	A	A
MIL-F-16929A	U	U	C	U	A	B	C	C	C	B	C	A	A
MIL-L-16958A	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-F-17111	U	U	U	U	A	A	B	U	C	A	U	B	A
MIL-L-17331D	U	U	U	U	A	A	B	B	A	A	U	A	A
MIL-L-17353A	U	U	U	U	A	B	C	C	B	B	C	A	A
MIL-L-17672B	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-L-18486A	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-G-18709A	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-H-19457B	U	U	A	A	U	U	U	U	U	U	U	U	U
MIL-F-19605	U	U	U	U	A	A	C	C	C	A	U	A	A
MIL-L-19701	U	U	C	U	A	B	C	C	C	B	C	A	A
MIL-L-21260	U	U	U	U	A	A	B	B	A	A	U	A	A
MIL-G-21568A	B	A	A	A	A	A	A	A	A	A	U	B	A
MIL-H-22072	B	A	A	A	A	B	B	B	C	C	B	B	B
MIL-H-22251		B	A	A	B		B	B		U	U		
MIL-L-22396	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-L-23699A	U	U	U	U	B	B	C	C	C	B	U	B	A
MIL-G-23827A	U	U	C	U	A	B	C	C	C	B	C	A	A
MIL-G-25013D	U	U	U	U	A	A	B	B	C	B	U	B	A
MIL-F-25172	U	U	U	U	A	A	C	C	C	A	U	A	A
MIL-L-25336B	U	U	C	U	A	B	C	C	C	B	C	A	A
MIL-F-25524A	U	U	U	U	A	A	C	C	C	A	U	A	A
MIL-G-25537A	U	U	U	U	A	A	B	B	B	A	U	A	A
MIL-F-25558B	U	U	U	U	A	A	B	B	B	A	U	A	A
MIL-F-25576C	U	U	U	U	A	A	C	C	C	A	U	A	A
MIL-H-25598	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-F-25656B	U	U	U	U	A	A	U	U	C	B	U	B	A
MIL-L-25681C	B	B	A	A	B	A	B	B	C	B	U	B	A
MIL-G-25760A	U	U	U	U	B	B	C	C	B	B	U	B	A
MIL-L-25968	U	U	C	U	A	B	C	C	C	B	C	A	A
MIL-L-26087A	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-G-27343	A	A	A	A	A	A	A	A	A	A	U	A	A
MIL-P-27402		B	A	A	B		B	B		U	U		
MIL-H-27601A	U	U	U	U	B	B	B	C	C	C	U	B	A
MIL-G-27617		B	A	A	U						U	A	A
MIL-I-27686D	B	A	A	A	A	B	B	B	C	C	B	B	B
MIL-L-27694A	A	A	A	A	A	A	A	A	A	A	U	A	A
MIL-L-46000A	U	U	C	U	A	B	C	C	C	B	C	A	A

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS–MINOR RUBBER CO. (continued)

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco No. 7033 Qualatex AX-22011 Duro AX-16750 Amtex No. 15030	SBR, GRS Ironsides AX-20065	Butyl Butene AX-90560	EPR, EPT, EPDM Resist-O (Nordel®) No. AX-80660	Buna N, Nitrile, NBR Oil Ace AX-41060 Mincer No. 4045	Hydrin Epi Chloro Hydrin Compound No. GF-0960	Neoprene® Matchless AX-1060 Mirprene No. 1050	Hypalon® Chlorosol No. 19040	Urethane Polyurethane Polycast No. UR-2970	Polysulfide Thiokol® No. 23945	Silicone Thermoflex No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK-8870	Fluoro Elastomers Viton®, Fluorel® Vi-Chem No. EV-9970
MIL-H-46001A	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-L-46002	U	U	U	U	A	A	A	A	A	A	C	A	A
MIL-H-46004	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-P-46046A	B	A	B	A	B	B	B	B	C	C	U	B	A
MIL-H-81019B	U	U	U	U	A	A	B	B	B	A	C	A	A
MIL-S-81087	A	A	A	A	A	A	A	A	A	B	U	B	A
MIL-H-83282	U	U	U	U	A		B	B	B	A	U	A	A
Milk	A	A	A	A	A		A	A	U	B	A	A	A
Mineral Oils	U	U	U	U	A	A	B	B	A	B	B	A	A
Mobil 24 DTE	U	U	U	U	A		B	U	B		U	A	A
Mobil HF	U	U	U	U	A		B	U	B		U	A	A
Mobil Delvac 1100, 1110, 1120, 1130	U	U	U	U	A		B	U	B		U	A	A
Mobil Nyvac 20 and 30	A	A	A	A	A		A	A			A	A	A
Mobil Velocite C	U	U	U	U	A		B	U	B		U	A	A
Mobilgas WA200, Type A, Automatic trans. fluid	U	U	U	U	A		B	U		A	U	A	A
Mobil Oil SAE 20	U	U	U	U	A		B	B	A	A	U	A	A
Mobiltherm 600	U	U	U	U	A		B	U	B	C	U	A	A
Mobilux	U	U	U	U	A		B	U	B	C	U	A	A
Mono Bromobenzene	U	U	U	U	U		U	U	U	A	U	B	A
Mono Chlorobenzene	U	U	U	U	U	U	U	U	U	U	U	B	A
Mono Ethanolamine	B	B	B	B	U		U	U	U	U	B	U	U
Monomethyl Aniline	U	U			U		U	U	U	U			B
Monomethylether	B	B	A	A	A		A			B			
Monomethyl Hydrazine		B	A	A	B		B	B		U	U		
Mononitrotoluene & Dinitrotoluene (40/60 Mix.)	U	U	U	U	U		U	U	U	U	U	C	C
Monovinyl Acetylene	B	B	A	A	A		B	B		C	B		A
Mopar Brake Fluid		A	B	A	C		B	B		U	C	U	U
Mustard Gas	A		A	A			A	A			A		
N													
Naphtha	U	U	U	U	C	A	U	U	C	B	U	B	A
Naphthalene	U	U	U	U	U		U	U	B	B	U	A	A
Naphthenic Acid	U	U	U	U	B		U	U		B	U	A	A
Natural Gas	C	C	U	U	A	A	A	A	B	B	A	C	A
Neatsfoot Oil	U	U	B	B	A		U	U	A	U	B	A	A
Neon	A	A	A	A	A		A	A	A	A	A	A	A
Neville Acid	U	U	B	B	U		U	U		A	U	B	A
Nickel Acetate	A	U	A	A	B		B	U	U	U	U	U	U
Nickel Chloride	A	A	A	A	A		B	A	C	A	A	A	A
Nickel Salts	A	A	A	A	A		B	A	C		A	A	A
Nickel Sulfate	B	B	A	A	A		A	A	C	C	A	A	A
Niter Cake	A	A	A	A	A		A	A	A	C	A	A	A
Nitric Acid (1) 3 Molar	U	U	A	B	U		U	U	U	U	U	C	A
Nitric Acid (1) Concentrated	U	U	C	U	U	U	U	U	U	U	U	U	A
Nitric Acid Dilute	U	U	B	B	U	U	A	A	C	U	B	B	A
Nitric Acid (1) Red Fuming (RFNA)	U	U	B	U	U	U	U	U	U	U	U	U	C
Nitric Acid (1) Inhibited Red Fuming (IRFNA)	U	U	B	U	U		U	U	U	U	U	U	B
Nitrobenzene	U	U	U	U	U	U	U	U	U	U	U	U	B
Nitrobenzine			C	C			U	U				A	A
Nitroethane	B	B	B	B	U		C	C	U		U	U	U
Nitrogen	A	A	A	A	A	A	A	A	A	A	A	A	A
Nitrogen (Textroxide (N_2O_4) (1)	U	U	C	U	U		U	U	U	U	U	U	U
Nitromethane	B	C	B	B	U		C	C	U		U	U	U
Nitropropane	U	U	B	B	U		U	U	U		U	U	U
O													
O-A-548A	B	A	A	A	A	B	B	B	C	C	B	B	B
O-T-634b	U	U	U	U	C	C	U	U	U	C	U	B	A
Octachloro Toluene	U	U	U	U	U		U	U	U	U	U	B	A
Octadecane	U	U	U	U	A		B	B	A	A	U	A	A
N-Octane	U	U	U	U	B		U	U	U	B	U	B	A
Octyl Alcohol	B	B	B	A	B		B	B	U	B	B	B	A
Oleic Acid	U	U	B	B	C		C	C	B	U	U		B
Oleum (Fuming Sulfuric Acid)	U	U	U	U	U		U	U	U	U	U		A
Oleum Spirits	U	U	U	U	B		C	U	C		U	B	A
Olive Oil	U	U	B	B	A	B	B	B	A	U	U	A	A
Oronite 8200	U	U	U	U	B		A	U	A		U	A	A
Oronite 8515	U	U	U	U	B		A	U	A		U	A	A
Orthochloro Ethyl Benzene	U	U	U	U	U		U	U	U	B	U	B	A
Ortho-Dichlorobenzene	U	U	U	U	U		U	U	U	B	U	B	A
OS 45 Type III (OS45)	U	U	U	U	B		A	B	U		U	B	A
OS 45 Type IV (OS45-1)	U	U	U	U	B		A	B	U		U	B	A
OS 70	U	U	U	U	B		A	B	U		U	B	A
Oxalic Acid	B	B	A	A	B	C	B	B		U	B	A	A
Oxygen, Cold	B	U	A	A	B	B	A	B	A	U	A	A	A
Oxygen, Cold 200-400°F	U	U	U	U	U	U	U	U	U	U	B	U	B
Ozone	U	U	B	A	U	A	C	A	A	A	A	B	A
P													
P-S-661b	U	U	U	U	A	A	C	C	C	A	U	A	A
P-D-680	U	U	U	U	A	A	C	C	C	A	U	A	A
Paint Thinner, Duco	U	U	U	U	U		U	U	U	B	U	B	B
Palmitic Acid	B	B	B	B	A	B	B	C	A	U	U	A	A
Para-dichlorobenzene	U	U	U	U	U		U	U	U	U	U	B	A
Par-al-Ketone	U	U	U	U	U		U	U	U	B	U	U	U
Parker O Lube	U	B	U	U	A		A	A	A	A	B	A	A
Peanut Oil	U	U	C	C	A	A	B	B	B	U	A	A	A
Pentane, 2 Methyl	U	U	U	U	A		B	B	U	A	U	C	A
Pentane, 2-4 dimethyl	U	U	U	U	A		B	B	U	A	U	C	A
Pentane, 3 Methyl	U	U	U	U	A		B	B	U	A	U	C	A
N-Pentane	U	C	U	U	A		A	B	U	A	U	C	A
Perchloric Acid	U	U	B	B	U	C	B	B	U	U	U	A	A
Perchloroethylene	U	U	U	U	C	B	U	U	U	B	U	B	A

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS—MINOR RUBBER CO. (continued)

LEGEND

A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco No 7033 Qualatex AX-22011 Duro AX-167150 Amtex No 15030	SBR, GRS Ironsides AX-20065	Butyl Butene AX-90560	EPR, EPT, EPDM Resist-O (Nordel®) No. AX-60660	Buna N, Nitrile, NBR Oil Ace AX-41060 Mincar No. 4045	Hydrin Epi Chloro-Hydrin Compound No. GF-0960	Neoprene® Matchless AX-1060 Mirprene No. 1050	Hypalon® Chlorosol No. 19040	Urethane, Polyurethane Polycast No. UR-2970	Polysulfide Thiokol® No. 23945	Silicone Thermoflex No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK-8870	Fluoro Elastomers Viton® Fluorel® Vi-Chem No. EV 9970
Petroleum Oil, Crude	U	U	U	U	A		B	B	A	U	U	A	A
Petroleum Oil, Below 250°F	U	U	U	U	A	A	B	B	B	U	B	B	A
Petroleum Oil, Above 250°F	U	U	U	U	U	B	U	U	U	U	U	U	B
Phenol	U	U	U	B	U		U	U	U	U	U	B	A
Phenol, 70%/30% H_2O	U	U	U	U	U		U	U	U	U	U	B	A
Phenol, 85%/15% H_2O	U	U	U	U	U		U	U	U	U	U	B	A
Phenylbenzene	U	U	U	U	U		U	U	U	B	U	B	A
Phenyl Ethyl Ether	U	U	U	U	U		U	U	U	B	U	U	U
Phenyl Hydrazine	A	B	U	U	U		U	U		U			A
Phorone	U	U	B	B	U		U	U	U	U	U	U	U
Phosphoric Acid 20%	B	C	B	A	U		B	B	A	U	B	B	A
Phosphoric Acid 45%	U	U	B	B	U		B	B	A	U	U	B	A
Phosphoric Acid, 3 Molar	B	B	B	A	U		C	B		U	B	B	A
Phosphoric Acid, Concentrated	U	U	C	B	U		U	C	A	U	C	B	A
Phosphorous Trichloride	U	U	A	A	U		U	U				A	A
Pickling Solution	U	U	C	C	U	U	U	U	U	U	U	U	B
Picric Acid, H_2O Solution	B	B	B	B	B		B	B	B	U	U	B	A
Picric Acid, Molten	B	B	B	B	B		B	B		U	U	B	A
Pinene	U	U	U	U	B		C	U	B	B	U	B	A
Pine Oil	U	U	U	U	B		U	U		B	U	A	A
Piperidine	U	U	U	U	U		U	U	U	U	U	U	U
Plating Solutions, Chrome	U	U	A	A			U	U		U	U		A
Plating Solutions, Others		A	A	A	A			A			U		A
Pneumatic Service	U	U	A	A	A		A	A	A	U	U	U	A
Polyvinyl Acetate Emulsion			A	A			B	B			U		
Potassium Acetate	A	U	A	A	B		B	U	U	U	U	U	U
Potassium Chloride	A	A	A	A	A	A	A	A	A	A	A	A	A
Potassium Cupro Cyanide	A	A	A	A	A		A	A	A	A	A	A	A
Potassium Cyanide	A	A	A	A	A	A	A	A	A	A	A	A	A
Potassium Dichromate	B	B	A	A	A		A	A	B	A	A	A	A
Potassium Hydroxide	B	B	A	A	B	A	B	A	B	B	C	C	B
Potassium Nitrate	A	A	A	A	A	A	A	A	A	A	A	A	A
Potassium Salts	A	A	A	A	A		A	A	A	A	A	A	A
Potassium Sulphate	B	B	A	A	A	A	A	B	A	B	A	A	A
Potassium Sulphite	B	B	A	A	A		A	B	A	B	A	A	A
Prestone Antifreeze	A	A	A	A	A		A	A	U	C	A	A	A
PRL-High Temp. Hydr. Oil	U	U	U	U	B		B	U	B	B	B	A	A
Producer Gas	U	U	U	U	A		B	B	A	U	B	B	A
Propane	U	U	U	U	A	A	B	B	C	A	U	B	A
Propane Propionitrile	U	U	U	U	A		B	B	U	A	U	C	A
Propyl Acetate	U	U	B	B	U	U	U	U	U	B	U	U	U
N-Propyl Acetone	U	U	A	A	U	U	U	U	U	B	U	U	U
Propyl Alcohol	A	A	A	A	A	A	A	A	U	A	A	A	A
Propyl Nitrate	U	U	B	B	U		U	U			U	U	U
Propylene	U	U	U	U	U		U	U	U	B	U	B	A
Propylene Oxide	U	U	B	B	U		U	U	U		U	U	U
Pyranol, Transformer Oil	U	U	U	U	A		B	B	B	U	U	A	A
Pyranol	U	U	U	U	A	U	U	U	B	U	U	A	A
Pydraul, 10E, 29ELT	U	U	B	B	U		U	U	U		U	U	A
Pydraul, 30E, 50E, 65E, 90E	U	U	B	B	U		U	U	U		A	A	A
Pydraul, 115E	U	U	B	B	U		U	U	U		U	C	A
Pydraul, 230E, 312C, 540C	U	U	U	U	U		U	U	U		U	U	A
Pyridine Oil	U	U	B	B	U	U	U	U		U	U	U	U
Pyrogard 42, 43, 53, 55 (Phosphate Ester)	U	U	A	A	U		U	U	U	U	U	U	A
Pyrogard, C, D	U	U	U	U	A		B	U	U		B	B	A
Pyroligneous Acid	U	U	B	B	U		U	U	U	B		U	U
Pyrolube	U	U	B	B	U		U	U	U		B	B	A
Pyrrole	C	C	U	U	U		U	U		U	B	U	U
R													
Radiation	C	C	U	C	C		C	C	C	U	C	U	U
Rapeseed Oil	U	U	A	A	B	A	B	U	B	U	U	A	A
Red Oil (MIL-H-5606)	U	U	U	U	A	A	B	B	B	A	U	A	A
Red Line 100 Oil	U	U	U	U	A		B	B	A	A	U	A	A
RJ-1 (MIL-F-25558)	U	U	U	U	A	A	B	B	B	A	U	A	A
RP-1 (MIL-R-25576)	U	U	U	U	A	A	B	B	B	A	U	A	A
S													
Sal Ammoniac	A	A	A	A	A		A	A	A	A	B	A	A
Salicylic Acid	A	B	A	A	B							A	A
Salt Water	A	A	A	A	A		A	A	U	U	A	A	A
Santo Safe 300	U	U	C	C	U		U				A	A	A
Sewage	B	B	B	B	A		B	A	U	U	B	A	A
Shell Alvania Grease #2	U	U	U	U	A		B	U	A	A	B	A	A
Shell Carnea 19 and 29	U	U	U	U	A		U	U	B			A	A
Shell Diala	U	U	U	U	A		B	U	B		U	A	A
Shell Iris 905	U	U	U	U	A		B	U	A	A	U	A	A
Shell Iris 3XF Mine Fluid (Fire resist. hydr.)	U	U	U	U	A		B	B	U			A	A
Shell Iris Tellus #27, Pet. Base	U	U	U	U	A		B	U	A	B	U	A	A
Shell Iris Tellus #33	U	U	U	U	A		B	U	A	B	U	A	A
Shell Iris UMF (5% Aromatic)	U	U	U	U	A		B	U	A	B	U	A	A
Shell Lo Hydrax 27 and 29	U	U	U	U	A		B	U	B		U	A	A
Shell Macoma 72	U	U	U	U	A		B	U	B		U	A	A
Silicate Esters	U	U	U	U	B		A	A	A		U	A	A
Silicone Greases	A	A	A	A	A	A	A	A	A	A	C	A	A
Silicone Oils	A	A	A	A	A	A	A	A	A	A	C	A	A
Silver Nitrate	A	A	A	A	B		A	A	A	B	A	A	A
Sinclair Opaline CX-EPLube	U	U	U	U	A		B	B	A	A	U	A	A
Skelly, Solvent B, C, E	U	U	U	U	A		U	U				A	A
Skydrol 500	U	U	B	A	U	U	U	U	U	U	C	C	U
Skydrol 7000	U	U	A	A	U	U	U	U	U	U	C	C	B
Soap Solutions	B	B	A	A	A	A	A	A	A	U	A	A	A
Socony Mobile Type A	U	U	U	U	A		B	U	B		U	B	A
Socony Vacuum AMV AC781 (Grease)	U	U	U	U	A		B	U	B		U	B	A
Socony Vacuum PD959B	U	U	U	U	A		B	B	A	A	U	A	A
Soda Ash	A	A	A	A	A	A	A	A		U	A	A	A

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS–MINOR RUBBER CO. (continued)

LEGEND
A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco No 7033 Qualster AX 22011 Duro AX 16750 Amtex No 15030	SBR, GRS Ironsides AX 20065	Butyl Butene AX 90560	EPR, EPT, EPDM Resist O (Nordel®) No AX 60560	Buna N, Nitrile, NBR Oil Ace AX 41060 Mincer No 4045	Hydrin Epi Chloro Hydrin Compound No. GF 0960	Neoprene® Matchless AX 1060 Mirprene No 1050	Hypalon® Chlorosol No. 19040	Urethane, Polyurethane Polycast No. UR 2970	Polysulfide Thiokol® No 23945	Silicone Thermoflex No. 2850R	Fluorosilicone Fluorosilicone Compound No WK 8870	Fluoro Elastomers Viton®, Fluorel® Vi-Chem No. EV 9970
Sodium Acetate	A	U	A	A	B		B	U	U	U	U	U	U
Sodium Bicarbonate (Baking Soda)	A	A	A	A	A	A	A	A		C	A	A	A
Sodium Bisulfite	A	B	A	A	A	A	A	A		C	A	A	A
Sodium Borate	A	A	A	A	A	A	A	A		A	A	A	A
Sodium Carbonate (Soda Ash)	A	A	A	A	A	A	A	A		U	A	A	A
Sodium Chloride	A	A	A	A	A	A	A	A	A	C	A	A	A
Sodium Cyanide	A	A	A	A	A	A	A	A		A	A	A	A
Sodium Hydroxide	A	A	A	A	B	B	B	A	B	U	B	B	B
Sodium Hypochlorite	C	C	B	B	B	A	B	B	U	U	B	B	A
Sodium Metaphosphate	A	A	A	A	A		B	B				A	A
Sodium Nitrate	B	B	A	A	B	A	B	A			U		
Sodium Perborate	B	B	A	A	B		B	B		B	B	A	A
Sodium Peroxide	B	B	A	A	B		B	B	U		U	A	A
Sodium Phosphate (Mono)	A	A	A	A	A		A	A	A		U		A
Sodium Phosphate (Dibasic)	A	A	A	A	A		B	A	A		U		A
Sodium Phosphate (Tribasic)	A	A	A	A	A		B	A	A		A		A
Sodium Salts	A	A	A	A	A		B	A	A	A	A	A	A
Sodium Silicate	A	A	A	A	A		A	A					A
Sodium Sulphate	B	B	A	A	A	A	A	A	A	B	A	A	A
Sodium Sulphide	B	B	A	A	A		A	A	A	B	A	A	A
Sodium Sulfite	B	B	A	A	A		A	A	A	B	A	A	A
Sodium Thiosulfate	B	B	A	A	B		A	A	A	B	A	A	A
Sovasol #1, 2, and 3	U	U	U	U	A		B	B	B	B	U	A	A
Sovasol #73 and 74	U	U	U	U	B		B	B	B	B	U	A	A
Soybean Oil	U	U	C	C	A	A	C	C	B	U	A	A	A
Spry	U	U	B	B	A		B	U	A	U	A	A	A
SR-6 Fuel	U	U	U	U	B		U	U	B	A	U	A	A
SR-10 Fuel	U	U	U	U	A		U	U	B	A	U	A	A
Standard Oil Mobilube GX90-EP Lube	U	U	U	U	A		B	B	A	B	U	A	A
Stannic Chloride	A	A	B	B	A		U	U			B	A	A
Stannic Chloride 50%	A	A	B	B	A		U	U			B	A	A
Stannous Chloride	A	A	A	A	A		A	A			B	A	A
Stauffer 7700	U	U	U	U	B		U	U		A	U	B	A
Steam, Below 350°F	U	U	B	A	U		U	U	U	U	U	U	U
Steam, Above 350°F	U	U	U	C	U	U	U	U	U	U	U	U	U
Stearic Acid	B	B	B	B	B	B	B	B	A		B		
Stoddard Solvent	U	U	U	U	A	A	C	U	A	B	U	A	A
Styrene	U	U	U	U	U		U	U		U	U	C	B
Styrene (Monomer)	U	U	U	U	U		U	U		U	U	C	B
Sucrose Solutions	A	A	A	A	A		B	B	U	U	A	A	A
Sulfite Liquors	B	B	B	B	B	B	B	B		U	U	B	A
Sulfur	U	U	A	A	U	C	A	A		U	A	A	A
Sulfur Chloride	U	U	U	U	U		U	U		U	C	A	A
Sulfur Dioxide, Wet	B	B	A	A	U		B	C		U	B	B	A
Sulfur Dioxide, Dry	C	C	B	A	U		U	U		U	B	B	A
Sulfur Dioxide, Liquidified under pressure	U	U	B	A	U		U	U		U	B	B	U
Sulfur Hexafluoride	U	U	A	A	B	A	A	B		C	B	B	C
Sulfur Liquors	B	B	B	B	B		B	B		U	U	B	A
Sulfur Molten	U	U	C	C	U		C	U	U	U	C	C	A
Sulfur Trioxide	B	U	B	B	U		U	U		U	B	B	A
Sulfuric Acid Dilute	C	C	C	B	U	B	B	C	C	U	U	C	A
Sulfuric Acid Concentrated	U	U	U	B	U	U	U	B	U	U	U	U	A
Sulfuric Acid 20% Oleum	U	U	U	U	U	U	U	U	U	U	U	U	A
Sulfuric Acid 3 Molar	C	C	C	B	U		C	C	C	U	U	C	A
Sulfurous Acid	B	B	B	B	B		B	A	U	U	U		A
Sunoco SAF 10	U	U	U	U	A		B	B	A	A	U	A	A
Sunoco #3661	U	U	U	U	A		B	B	A	A	U	A	A
Sunoco All purpose grease	U	U	U	U	A		B	B	A	A	U	A	A
Sunsafe (Fire resist. hydr. fluid)	U	U	U	U	A		B	B	U			A	A
Super Shell Gas	U	U	U	U	A		B	U	B	B	U	B	A
Swan Finch EP Lube	U	U	U	U	A		U	U	A	A	U	A	A
Swan Finch Hypoid-90	U	U	U	U	A		B	U	A	A	U	A	A
T													
TT-N-95a	U	U	U	U	A	A	C	C	C	A	U	A	A
TT-N-97B	U	U	U	U	B	B	C	C	C	A	U	B	A
TT-I-735b	A	A	A	A	A	B	B	B	B	A	A	A	A
TT-S-735, Type I	U	U	U	U	A	A	B	C	B	A	U	A	A
TT-S-735, Type II	U	U	U	U	A	A	C	C	C	A	U	A	A
TT-S-735, Type III	U	U	U	U	A	A	C	C	C	A	U	A	A
TT-S-735, Type IV	U	U	U	U	A	A	A	A	A	A	C	A	A
TT-S-735, Type V	U	U	U	U	A	A	B	B	B	A	C	A	A
TT-S-735, Type VI	U	U	U	U	A	A	B	B	B	A	C	A	A
TT-T-656b	U	U	A	A	U	U	U	U	U	U	U	C	U
Tannic Acid	A	B	A	A	A		B	B	A	A	B		A
Tannic Acid, 10%	A	B	A	A	A		A	A			B	A	A
Tar Bituminous	U	U	U	U	B	B	C	U			B	A	A
Tartaric Acid	A	B	B	B	A	B	B	A	A	U	A	A	A
Terpineol	U	U	C	C	B		U	U	B	A		A	A
Tertiary Butyl Alcohol	B	B	B	B	B		B	B	U	B	B	B	A
Tertiary Butyl Catechol	U	C	B	B	U		B	B	U	U		A	A
Tertiary Butyl Mercaptan	U	U	U	U	U		U	U	U	U	U		A
Tetrabromomethane	U	U	U	U	U		U	U			U	B	A
Tetrabutyl Titanate	B	B	B	A	B		B	A				A	A
Tetrachloroethylene	U	U	U	U	U		U	U	U	U		B	A
Tetraethyl Lead	U	U	U	U	B		C	U				U	A
Tetraethyl Lead "Blend"	U	U	U	U	B		U	U				B	A
Tetrahydrofuran	U	U	B	B	U		U	U		A			U
Tetralin	U	U	U	U	U		U	U		U	U	A	A
Texaco 3450 Gear Oil	U	U	U	U	A		U	U	A	A	U	A	A
Texaco Capella A and AA	U	U	U	U	A		B	U	B		U	A	A
Texaco Meropa #3	U	U	U	U	A		B	U	B		U	A	A
Texaco Regal B	U	U	U	U	A		U	U	A	A	U	A	A
Texaco Uni-Temp. Grease	U	U	U	U	A		B	U	A	A	B	A	A
Texamatic "A" Transmission Oil	U	U	U	U	A		B	U	B		U	B	A
Texamatic 1581 Fluid	U	U	U	U	A		B	U	B		U	B	A
Texamatic 3401 Fluid	U	U	U	U	A		B	U	B		U	B	A
Texamatic 3525 Fluid	U	U	U	U	A		B	U	B		U	B	A
Texamatic 3528 Fluid	U	U	U	U	A		B	U	B		U	B	A

(continued)

TABLE 2.13: VARIOUS ELASTOMERS AND RUBBERS—MINOR RUBBER CO. (continued)

LEGEND
A – RECOMMENDED
B – MINOR TO MODERATE EFFECT
C – MODERATE TO SEVERE
U – UNSATISFACTORY
BLANK – INSUFFICIENT DATA

CHEMICAL	Natural Rubber Mirco No. 7033 Quelster AX 22011 Duro AX 16750 Amtex No. 15030	SBR GRS Ironsides AX 20065	Butyl Butene AX 90560	EPR, EPT, EPDM Resist O Nordel® No. AX 60660	Buna N, Nitrile, NBR Oil Ace AX 41060 Mincer No. 4045	Hydrin Epi Chloro Hydrin Compound No. GF 0960	Neoprene® Matchless AX 1060 Mirprene No. 1050	Hypalon® Chlorosol No. 19040	Urethane, Polyurethane Polycast No. UR 2970	Polysulfide Thiokol® No. 23945	Silicone Thermoflex No. 2850R	Fluorosilicone Fluorosilicone Compound No. WK 8870	Fluoro Elastomers Viton® Fluorel® Vi-Chem No. EV 9970
Texas 1500 Oil	U	U	U	U	A		B	U	A	A	B	A	A
Thiokol TP-90B		U	A	A	U		B	B				B	A
Thiokol TP-95		U	A	A	U		B	B				B	A
Thionyl Chloride	U	U	U	U			U						A
Tidewater Oil-Beedol	U	U	U	U	A		B	U	A	A	B	A	A
Tidewater Oil-Multigear 140, EP Lube	U	U	U	U	A		B	B	A	A	U	A	A
Titanium Tetrachloride	U	U	U	U	C		U	U	U	C	U	B	A
Toluene	U	U	U	U	U	U	U	U	U	U	U	B	A
Toluene Diisocyanide	U	U	B	B	U		U	U			U	U	U
Transformer Oil	U	U	U	U	A		B	U	A	A	B	A	A
Transmission Fluid Type A	U	U	U	U	A	A	B	B	A	A	B	A	A
Triacetin	B	C	A	A	B		B	B	U	B		U	U
Triaryl Phosphate	U	U	A	A	U		U	U	U	B	C	B	A
Tributoxyethyl Phosphate	B	B	A	A	U		U	U	U	A		B	A
Tributyl Mercaptan	U	U	U	U	U		U	U		U	U	C	A
Tributyl Phosphate	B	U	B	A	U		U	U	U	A		U	U
Trichloroacetic Acid	C	U	B	B	B		U	U	U			U	C
Trichloroethane	U	U	U	U	U		U	U	U	U	U	B	A
Trichloroethylene	U	U	U	U	C	U	U	U	U	U	U	B	A
Tricresyl Phosphate	U	U	A	A	U	U	U	U	U	B	C	B	B
Triethanol Amine	B	B	B	B	C		A	A	U	U		U	U
Triethyl Aluminum													B
Triethyl Borane													A
Trifluoroethane	U	U	U	U	U		U	U	U	U	U	B	A
Trinitrotoluene	U	U	U	U	U		B	B		B		B	B
Trioctyl Phosphate	U	U	A	A	U		U	U	U	B	C	B	B
Tripoly Phosphate	U	U	A	A	U		B	U	U	B	C	B	B
Tung Oil (China Wood Oil)	U	U	C	U	A		B	C	C	B	U	B	A
Turbine Oil	U	U	U	U	B	A	U	U	A	A	U	B	A
Turbine Oil #15 (MIL-L-7808A)	U	U	U	U	B		U	U	U	A	U	B	A
Turbo Oil #35	U	U	U	U	A		B	U	A	A	U	A	A
Turpentine	U	U	U	U	A	A	U	U	U	B	U	B	A
Type I Fuel (MIL-S-3136)	U	U	U	U	A	A	B	B	B	A	U	A	A
Type II Fuel (MIL-S-3136)	U	U	U	U	B	A	U	U	B	B	U	B	A
Type III Fuel (MIL-S-3136)	U	U	U	U	A	A	U	U	B	A	U	A	A
U													
Ucon Hydrolube J-4		A	A	A	A		B		U		A	B	A
Ucon Lubricant LB-65	B	B	A	A	A		A	B	U		A	A	A
Ucon Lubricant LB-135	A	A	A	A	A		A	A			A	A	A
Ucon Lubricant LB-285	A	A	A	A	A		A	A			A	A	A
Ucon Lubricant LB-300	A	A	A	A	A		A	A			A	A	A
Ucon Lubricant LB-625	A	A	A	A	A		A	A			A	A	A
Ucon Lubricant LB-1145	A	A	A	A	A		A	A			A	A	A
Ucon Lubricant 50-HB55	A	A	A	A	A		A	A			A	A	A
Ucon Lubricant 50-HB100	A	A	A	A	A		A	A		A	A	A	A
Ucon Lubricant 50-HB260	A	A	A	A	A		A	A		A	A	A	A
Ucon Lubricant 50-HB660	A	A	A	A	A		A	A		A	A	A	A
Ucon Lubricant 50-HB5100	A	A	A	A	A		A	A			A	A	A
Ucon Oil LB-385	A	A	A	A	A		A	A			A	A	A
Ucon Oil LB-400X	A	A	A	A	A		A	A			A	A	A
Ucon Oil 50-HB-280X (Polyacrylon Glycol Deriv.)	A	A	A	A	A		A	A			A	A	A
Univis 40 (Hydr. Fluid)	U	U	U	U	A		B	B	A	A	U	A	A
Univolt #35 (Mineral Oil)	U	U	U	U	A		B	U	A	A	U	A	A
Unsymmetrical Dimethyl Hydrazine (UDMH)	A	B	A	A	B		B	A		U	U	U	U
V													
VV B 680	B	A	B	A	B	B	B	B	C	C	U	B	A
VV G 632	U	U	U	U	A	A	A	A	A	A	C	A	A
VV G 671c	U	U	U	U	A	A	A	A	A	A	C	A	A
VV H 910	B	A	B	A	C	B	B	B	U	U	U	B	A
VV I 530a	U	U	U	U	A	A	B	B	B	A	C	A	A
VV K 211d	U	U	U	U	A	A	C	C	C	A	U	A	A
VV K 220a	U	U	U	U	A	A	B	C	B	A	U	A	A
VV-L-751b	U	U	U	U	B	B	B	C	C	C	U	A	A
VV L 800	U	U	U	U	A	A	B	B	B	A	C	A	A
VV L 820b	U	U	U	U	A	A	B	B	B	A	C	A	A
VV-L-825a, Type I	U	U	U	U	A	A	A	A	A	A	C	A	A
VV-L-825a, Type II	U	U	U	U	A	A	A	A	A	A	C	A	A
VV L-825a, Type III	U	U	U	U	B	B	B	C	C	C	U	A	A
VV-O-526	U	U	U	U	A	A	A	A	A	A	C	A	A
VV-P-216a	U	U	U	U	A	A	B	B	B	A	C	A	A
VV-P-236	U	U	U	U	B	B	B	C	C	C	U	A	A
Varnish	U	U	U	U	B		U	U	C	A	U	B	A
Vegetable Oil	U	U	C	C	A	A	C	B		U	A	A	A
Versilube	A	A	A	A	A	A	A	A	A	B	C	A	A
Vinegar	B	B	A	A	B		B	A	U	B	A	C	A
Vinyl Chloride				B			U	U					A
W													
Wagner 21B Brake Fluid		A	B	A	C		B	B		U	C	U	U
Water	A	A	A	A	A	B	A	A	A	U	A	A	A
Wemco C	U	U	U	U	A		B	U	A	A	U	A	A
Whiskey and Wines	A	A	A	A	A		A	A	U	U	A	A	A
White Pine Oil	U	U	U	U	B		U	U		B	U	A	A
White Oil	U	U	U	U	A		B	U	A	A	U	A	A
Wolmar Salt	A	A	A	A	A		B	A	A	A	A	A	A
Wood Alcohol	A	A	A	A	A		A	A	U	B	A	A	U
Wood Oil	U	U	U	U	A		B	C	C	B	U	B	A
X													
Xylene	U	U	U	U	U	U	U	U	U	B	U	A	A
Xylidenes-Mixed-Aromatic Amines	U	U	U	U	C		U	U	U	U	U	U	U
Xylol	U	U	U	U	U		U	U	U	B	U	A	A
Xenon	A	A	A	A	A		A	A	A	A	A	A	A
Z													
Zeolites	A	A	A	A	A		A	A				A	A
Zinc Acetate	A	U	A	A	B		B	U	U	U	U	U	U
Zinc Chloride	A	A	A	A	A		A	A		C		A	A
Zinc Salts	A	A	A	A	A		A	A	A	U	A	A	A
Zinc Sulfate	B	B	A	A	A		A	A		U	A	A	A

TABLE 2.14: VARIOUS RUBBER AND ELASTOMERIC TANK LININGS—ACME-FISHER

Linings Recommended to Resist Various Chemicals

LININGS:
A - Abrasion Resistant Natural
B - Soft Natural
C - Semi-Hard Natural
D - Hard Natural
E - Neoprene
F - Polyvinyl Chloride (Koroseal)
G - Chloro-Butyl
H - Ethylene Propylene
NR - Not Recommended

CHEMICALS	CONCENTRATION	TEMPERATURE	LINING
INORGANIC ACIDS		°F	
Arsenic	Any	175	DB
Battery Acid (Sulphuric)		High Bake Phenolic	
Carbonic	To Saturation	175	DB
Chlorine Water	To Saturation	125	D-H
Cupric Acid (Copper Sulrate)		140	F
Fluoboric	Any	175	DB
Fluosilicic	Any	175	DBE
Hydrobromic	Any	175	DB
Hydrochloric	Any	180	DB
Hydrofluoric	To 50%	175	DB
Hydrofluoric Max. Conc.		225	G
Hydrogen Sulfide Water	To Saturation	160	DB
Nitric	10%	90	DEF
Nitric	25%	70	F
Perchloric	To Saturation	120	DF
Phosphoric	To 85%	180	EDB
Sulfonic Acid		180	DB
Sulphuric	To 50%	160	DB
Sulfurous	To Saturation	160	D
SALTS & ALKALIES		°F	
Abrasive Solutions		180	A
Aluminum Salts	To Saturation	175	DB
Alums	To Saturation	175	DB
Ammonium Hydroxide	To Saturation	160	D
Ammonium Persulfate	To Saturation	175	DB
Other Ammonium Salts	To Saturation	175	DB
Barium Salts	To Saturation	175	DB
Barium Sulfide		180	DB
Calcium Bisulfite	To Saturation	175	DB
Bleach Liquor	To Saturation	140	D
Calcium Hydrochlorite	To Saturation	175	D
Other Calcium Salts	To Saturation	175	DB
Copper Salts	To Saturation	175	DE
Iron Salts	To Saturation	175	DB
Lead Salts	To Saturation	175	DB
Mercuric Chloride		180	D
Nickel Acetate	To Saturation	160	DE
Potassium Hydroxide	To Saturation	175	DB
Potassium Dichromate	To Saturation	160	DF
Other Potassium Salts	To Saturation	180	DBE
Sodium Hydroxide	To Saturation	160	DB
Sodium Bisulfite	To Saturation	160	DF
Sodium Hydrochlorite	To Saturation	150	D
Sodium Hypochlorite	16%	225	G-H
Other Sodium Salts	To Saturation	180	DBE
Sulphur Chloride		NR	
Silver Nitrate	To Saturation	175	D-B
Tin Salts	Any	175	DE
Zinc Salts	To Saturation	175	DE

(continued)

TABLE 2.14: VARIOUS RUBBER AND ELASTOMERIC TANK LININGS—ACME-FISHER (continued)

CHEMICALS	CONCENTRATION	TEMPERATURE	LINING
PLATING SOLUTIONS		°F	
Brass		140	F-B-D
Cadmium			
Chromium			
Copper			
Gold			
Lead			
Nickel			
Silver			
Tin			
Zinc			
ORGANIC MATERIALS		°F	
Acetate Solvents		NR	
Aliphatic Solvents	Trace to Any	180	E
Acetic Acid	Any	160	D
Acetic Anhydride	To 25%	150	D
Acetone	Any	150	DB
Alcohols	Any	175	DB
Castor Oil		150	D
Citric Acid		180	DF
Coconut Oil		150	D
Cottonseed Oil		150	D
Dye Stuffs		150	D
Citric Acid	To Saturation	160	F
Ethylene Glycol	Any	160	DB
Formaldehyde	40%	100	D
Formic Acid	Any	100	D
Fumaric Acid		180	BDF
Furfural		100	D
Gallic Acid	To Saturation	160	DB
Glucose	Any	175	DB
Glue	Any	175	DB
Glycerine	Any	175	DB
Lactic Acid	Any	160	D
Malic Acid	To Saturation	150	DB
Minerals Oils		160	ED
Oxalic Acid		180	D
Soaps	Any	175	DB
Tannic Acid	To Saturation	175	DB
Triethanolmine	Any	175	DB
Vinegar		150	DF

The temperatures given are somewhat conservative; however if higher operating temperatures are anticipated, tests should be conducted to satisfy users particular problem.

Cements, Mortars, and Asphalt

TABLE 3.1: EPOXY-BASE FLOOR SURFACING SYSTEMS–STONHARD

STONCLAD is a three-component, epoxy-base floor surfacing system. It was specifically designed for surfacing and patching industrial floors exposed to corrosive spillages and abrasive, wheeled traffic. STONCLAD-HT is a three-component, epoxy-base floor surfacing system. It was specifically designed for surfacing and patching industrial floors exposed to corrosive spillages and abrasives, wheeled traffic at temperatures above 140°F (60°C), but less than 250°F (122°C).

The test procedure used was to totally immerse cured samples of STONCLAD in the chemicals listed for a period of 90 days at normal room temperatures. (This is an exceptionally severe test, since most floors subject to chemical spillages such as these are "flushed down" periodically with water as part of the normal floor maintenance operation.)

The resultant resistance of STONCLAD to the various chemicals is rated using the symbols listed below. (It is assumed that normal "good housekeeping procedures" are used, including a daily flushing down with clean water.)

RATING CODE

E — Excellent
G — Good
F — Fair
NR — Not Recommended

OS — Suitable for use where "occasional spillages" occur, when followed by immediate water flushing.

Chemical Resistance Guide for STONCLAD

ACIDS

CHEMICAL	RATING
Acetic — 5%	G
Acetic — 10%	F
Acetic — 20%	OS
Acetic — Glacial	NR
Benzoic — Sat. 3%	E
Boric — Sat. 30%	E
Butyric — 10%	F
Chromic — 10%	G
Chromic — 15%	F
Chromic — 20%	OS
Citric — 50%	E
Cresylic	OS
Diglycolic	G
Fatty	G
Formic — up to 10%	OS
Formic — over 10%	NR
Fluoboric	G
Heptanoic	OS
Hydrochloric — 15%	E
Hydrochloric — 37%	G
Hydrofluoric — 5%	G
Hydrofluoric — 10%	F
Hydrofluoric — 15%	OS
Hypochlorous — 5%	E
Lactic — up to 20%	F
Lactic — over 25%	OS
Maleic — 30%	G
Maleic — 40%	F
Maleic — 60%	OS
Malic — 50%	E
Monochloroacetic –5%	F
Monochloroacetic — 10%	OS
Nitric — 10%	E
Nitric — 20%	G
Nitric — 30%	F
Nitric — over 40%	NR

(continued)

TABLE 3.1: EPOXY-BASE FLOOR SURFACING SYSTEMS—STONHARD (continued)

ACIDS (continued)

CHEMICAL	RATING
Oleic	E
Oxalic — Sat.	E
Pelargonic	OS
Perchloric — 35%	F
Phosphoric — up to 50%	F
Phosphoric — 70%	OS
Phosphoric — Conc. 85%	NR
Picric — Sat.	E
Phthalic	F
Succinic — Sat.	E
Sulfuric — 20%	E
Sulfuric — 50%	G
Sulfuric — 70%	F
Sulfuric — 98%	NR
Tannic — Sat.	E
Tartaric — Sat.	E

ALKALIES AND SALTS

CHEMICAL	RATING
Aluminum Chloride — 50%	E
Ammonium Chloride — 50%	E
Ammonium Hydroxide — up to 20%	E
Ammonium Hydroxide — 40%	G
Ammonium Nitrate — Sat.	E
Ammonium Persulfate	E
Ammonium Sulfate — Sat.	E
Calcium Chloride — 50%	E
Calcium Hydroxide — Sat.	E
Calcium Hypochlorite — up to 15%	G
Copper Fluoroborate	E
Ferric Chloride	G
Ferrous Sulfate	G
Potassium Hydroxide — up to 40%	E
Sodium Benzoate	E
Sodium Carbonate (Soda Ash)—Sat.	E
Sodium Bicarbonate — Sat.	E
Sodium Bisulfate — Sat.	E
Sodium Bisulfite — Sat.	E
Sodium Chloride (Salt)	E
Sodium Glutamate	E
Sodium Hydroxide — up to 50%	E
Sodium Hypochlorite — up to 10%	G
Sodium Propionate	E
Sodium Sulfate — Sat.	E
Sodium Sulfide — Sat.	E
Trisodium Phosphate — Sat.	E
Zinc Nitrate	G

SOLVENTS AND OTHER CHEMICALS

SUBSTANCE	RATING
Acetone	OS
Acrylonitrile	OS
Aniline	NR
Alcohol (Methyl)	OS
Alcohol (Ethyl, Propyl, Isopropyl, Butyl)	G
Amyl Acetate	E
Beer	E
Benzene	OS
Butyl Acetate	G
Butyl Lactate	G
Bromine	NR
Carbon Disulfide	NR
Carbon Tetrachloride	E
Chlorobenzene	E
Corn Oil	E
Cyclohexane	E
Cyclohexanol	E
Cyclohexanone	OS
Chloroform	NR
Diacetone Alcohol	E
Diethyl Phthalate	E
Dimethyl Phthalate	E
Ethyl Acetate	OS
Ethylene Glycol	E
Ether	OS
Ethylene Dichloride	NR
Formaldehyde	E
Gasoline	E
Glycerine	E
Glyoxal	E
Hydrogen Peroxide — 10%	E
JP5 Jet Fuel	E
Juices — Fruit	E
Juices — Vegetable	E
Kerosene	OS

(continued)

TABLE 3.1: EPOXY-BASE FLOOR SURFACING SYSTEMS—STONHARD (continued)

SOLVENTS AND OTHER CHEMICALS (continued)

SUBSTANCE	RATING	SUBSTANCE	RATING
Lanolin	E	Peanut Butter	E
Lard	F	Perchloroethylene	F
Linseed Oil	E	Phenol — 5%	NR
		Pyridine	NR
Mayonnaise	G	Skydrol	E
Methyl Ethyl Ketone	NR	Sucrose — Sat. (Sugar)	E
Methyl Isobutyl Ketone	NR		
Methyl Salicylate — 50% in Toluene	NR	Toluene	F
Methylene Chloride	NR	Triacetin	E
Milk	E	Trichloroethane	G
Mineral Spirits	E	Trichloroethylene	OS
Muriatic Acid (See Hydrochloric Acid)		Triethanolamine	E
Mustard	E	Triethylene Glycol	E
		Urea	E
Naphtha	F	Vinegar (Household)	E
Naphthalene	G		
		Water	E
Oils — Cutting	E	Wine	E
Oils — Mineral	E		
Oils — Vegetable	G	Xylene	G

Chemical Resistance Guide for STONCLAD HT

ACIDS

CHEMICAL	RATING	CHEMICAL	RATING
Acetic — 5%	E	Lactic — up to 20%	F
Acetic — 10%	G	Lactic — over 25%	OS
Acetic — 30%	OS		
Acetic — Glacial	NR	Maleic — 10%	E
		Maleic — 30%	G
Benzoic — Sat	E	Maleic — 40%	F
Boric — Sat	E	Maleic — Sat	OS
Butyric — 10%	F	Malic — 30%	E
		Malic — 50%	E
Chromic — 10%	G	Monochloroacetic —5%	G
Chromic — 15%	G	Monochloroacetic — 10%	F
Chromic — 30%	F	Monochloroacetic — 20%	OS
Citric — Sat	E		
Cresylic	OS	Nitric — 20%	E
		Nitric — 30%	G
Diglycolic	G	Nitric — over 40%	NR
Fatty	E	Oleic	E
Formic — up to 10%	F	Oxalic — Sat	E
Formic — over 10%	NR		
Fluoboric	G	Pelargonic	OS
		Perchloric — 35%	F
Heptanoic	OS	Phosphoric — up to 50%	F
Hydrochloric — 15%	E	Phosphoric — 70%	OS
Hydrochloric — 37%	G	Phosphoric — Conc. 85%	NR
Hydrofluoric — 5%	E	Picric — Sat	E
Hydrofluoric — 10%	G	Phthalic	F
Hydrofluoric — 15%	OS		
Hypochlorous — 5%	E	Succinic —Sat	E

(continued)

TABLE 3.1: EPOXY-BASE FLOOR SURFACING SYSTEMS–STONHARD (continued)

ACIDS (continued)

CHEMICAL	RATING	CHEMICAL	RATING
Sulfuric — 50%	E	Tartaric — Sat	E
Sulfuric — 70%	F	Trichloroacetic — 5%	G
Sulfuric — 98%	NR	Trichloroacetic — 10%	F
		Trichloroacetic — 20%	OS
Tannic — Sat	E		

ALKALIES AND SALTS

CHEMICAL	RATING	CHEMICAL	RATING
Aluminum Chloride — 50%	E	Potassium Hydroxide — up to 40%	E
Ammonium Chloride — Sat	E	Sodium Carbonate (Soda Ash)—Sat	E
Ammonium Hydroxide — up to 20%	E	Sodium Bicarbonate — Sat	E
Ammonium Hydroxide — up to 40%	G	Sodium Bisulfate — Sat	E
Ammonium Nitrate	E	Sodium Bisulfite — Sat	E
Ammonium Sulfate — Sat	E	Sodium Chloride (Salt)	E
Calcium Chloride — Sat	E	Sodium Hydroxide — up to 50%	E
Calcium Hypochlorite — up to 15%	G	Sodium Hypochlorite — up to 10%	G
Copper Fluoroborate	E	Sodium Sulfate — Sat	E
		Sodium Sulfide — Sat	E
Ferric Chloride — Sat	G	Trisodium Phosphate — Sat	E
Ferrous Sulfate	G		
		Zinc Nitrate	G

SOLVENTS AND OTHER CHEMICALS

SUBSTANCE	RATING	SUBSTANCE	RATING	SUBSTANCE	RATING
Acetone	OS	Formaldehyde	E	Naphtha	E
Acrylonitrile	OS			Naphthalene	G
Aniline	NR	Gasoline	E		
Alcohol (Methyl)	OS	Glycerine	E	Oils — Cutting	E
Alcohol (Ethyl, Propyl, Isopropyl, Butyl)	G	Glyoxal	E	Oils — Mineral	E
				Oils — Vegetable	G
Amyl Acetate	E	Hydrogen Peroxide — 10%	E		
				Peanut Butter	E
Beer	E	JP5 Jet Fuel	E	Perchloroethylene	E
Benzene	F	Juices — Fruit	E	Phenol — 5%	NR
Butyl Acetate	G	Juices — Vegetable	E	Pyridine	NR
Butyl Lactate	G				
Bromine	NR	Kerosene	G	Sucrose — Sat. (Sugar)	E
Carbon Disulfide	NR	Lanolin	E	Toluene	G
Carbon Tetrachloride	E	Lard	F	Triacetin	E
Chlorobenzene	E	Linseed Oil	E	Trichloroethane	G
Corn Oil	E			Trichloroethylene	G
Cyclohexane	E	Methanol	NR	Triethanolamine	E
Cyclohexanol	E	Mayonnaise	G	Triethylene Glycol	E
Cyclohexanone	OS	Methyl Ethyl Ketone	OS		
Chloroform	NR	Methyl Isobutyl Ketone	OS	Urea	E
		Methyl Salicylate — 50% in Toluene	NR		
Diacetone Alcohol	E	Methylene Chloride	NR	Vinegar (Household)	E
Diethyl Phthalate	E	Milk	E		
Dimethyl Phthalate	E	Mineral Spirits	E	Water	E
		Muriatic Acid (See Hydrochloric Acid)		Wine	E
Ethyl Acetate	OS	Mustard	E	Xylene	E
Ethylene Glycol	E				
Ether	OS				
Ethylene Dichloride	NR				

TABLE 3.2: EPOXY FLOORING COMPOUNDS—ATLAS

REZKLAD C is a monolithic overlay designed specifically for use in applications where hydrofluoric acid and high concentrations of sodium hydroxide are encountered. REZKLAD C has been formulated to incorporate toughness, ability to tolerate temperature cycling and good physical strength. This material is installed directly on the concrete slab to give a durable, corrosion-resistant topping.

CHEMICAL RESISTANCE OF REZKLAD C FLOORING COMPOUND

	R.T.	140°F
Acetic Acid, below 5%	R	C
Acetic Acid, 5% to 10%	C	N
Acetic Acid, 10% to 50%	N	N
Acetone	N	N
Alum or Aluminum Sulfate	R	R
Ammonium Chloride, Nitrate, Sulfate, 50%	R	R
Ammonium Hydroxide, 10%	R	R
Ammonium Hydroxide, 30%	R	C
Aniline	N	N
Aqua Regia	N	N
Barium Chloride, Sulfate	R	R
Beer	R	R
Benzene	N	N
Benzene Sulfonic Acid, 10%	R	R
Benzoic Acid	R	R
Black Liquor	R	R
Bleaching Liquor, below 2%	C	C
Bleaching Liquor, conc.	N	N
Boric Acid	R	R
Butyl Acetate	N	N
Butyl Alcohol	R	C
Butyric Acid	N	N
Calcium Chloride, Nitrate, Sulfate	R	R
Calcium Hydroxide	R	R
Calcium Hypochlorite	C	N
Chlorine, Dry	C	N
Chlorine, Wet	C	C
Chlorine Water	C	N
Chloroacetic Acid, 10%	N	N
Chloroform	R	C
Chromic Acid, 5%	C	N
Chromic Acid, 5% to 10%	N	N
Citric Acid, 10%	R	N
Copper Chloride, Nitrate, Sulfate	R	R
Ether	R	-
Ethyl Acetate	N	N
Ethyl Alcohol	R	C
Ethylene Dichloride	N	N
Ethylene Glycol	R	R
Fatty Acids	C	C
Ferric Chloride, Nitrate, Sulfate	R	C
Fluosilicic Acid	R	R
Formaldehyde, below 37%	R	C
Formic Acid, 90%	C	C
Grape Juice	R	C
Hydrobromic Acid, 20%	R	C
Hydrochloric Acid, to 20%	R	C
Hydrochloric Acid, 20% to 36%	C	N
Hydrofluoric Acid, to 20%	R	R
Hydrofluoric Acid, 20% to 70%	R	C
Hydrogen Peroxide	R	-
Hypochlorous Acid, to 5%	C	N
Jet Fuel	R	N
Kerosene	R	N
Lactic Acid, below 5%	C	N
Lactic Acid, 5% to 10%	C	N
Lactic Acid, above 10%	N	N
Lard	N	N
Lux Liquid	R	C
Magnesium Chloride, Nitrate, Sulfate	R	R
Maleic Acid, 25%	N	N
Methyl Alcohol	R	C
Methylene Chloride	N	N
Methyl Ethyl Ketone	N	N
Milk	R	R
Mineral Oil	R	R
Nickel Chloride, Nitrate, Sulfate	R	R
Nitric Acid, below 5%	C	N
Nitric Acid, 5% to 10%	C	N
Oils, Vegetable	C	C
Oleic Acid	N	N
Oxalic Acid	R	N
Perchloroethylene	N	N
Petroleum	C	C
Phenol, below 5%	N	N
Phosphoric Acid, to 25%	R	C
Phosphoric Acid, 25% to 50%	R	C
Phosphoric Acid, above 50%	N	N
Picric Acid, to 5%	R	C
Potassium Chloride, Nitrate, Sulfate	R	R
Potassium Hydroxide, below 25%	R	R
Potassium Hydroxide, 25% to 50%	R	C
Sodium Bicarbonate, Carbonate	R	R
Sodium Chloride, Nitrate, Phosphate	R	R
Sodium Sulfate, Sulfide	R	R
Sodium Hydroxide, to 25%	R	R
Sodium Hydroxide, 25% to 50%	R	C
Sodium Hypochlorite, below 6%	C	N
Sodium Hypochlorite, 16%	N	N
Stannic Chloride	R	C
Stearic Acid	R	N
Sugar, Salt Solution	C	C
Sulfuric Acid, below 40%	R	C
Sulfuric Acid, 50%	R	C
Sulfuric Acid, above 50%	C	N
Sulfurous Acid, below 10%	R	R
Toluene	C	N
Toluene Sulfonic Acid	C	C
Tomato Juice	R	R
Trichloroethylene	N	N
Trisodium Phosphate	R	R
Turpentine	C	N
Urea, to 20%	R	R
Urine	R	C
Vegetable Oil	C	C
Vinegar	R	C
Water, Fresh	R	R
Water, Distilled	R	R
Water and Sewage	R	R
Xylene	C	N
Zinc Chloride, Nitrate, Sulfate	R	R

R - Recommended

N - Not Recommended

C - Conditional. May be serviceable if the contaminant is immediately removed or washed off the surface.

(continued)

TABLE 3.2: EPOXY FLOORING COMPOUNDS—ATLAS (continued)

REZKLAD 250 is the trowelable counterpart to sprayable REZKLAD 125S. REZKLAD 250 utilizes a room temperature curing, aromatic amine hardening system, thus the reason for its outstanding chemical resistance. In addition, this material has been formulated to incorporate outstanding physical properties. REZKLAD 250 upgrades the surface of existing concrete floors and provides positive protection at a reasonable cost. Rezklad 250 complies with ASTM C722, Specification for Chemical-Resistant Monolithic Surfacings.

CHEMICAL RESISTANCE OF REZKLAD 250

	Rezklad 250 RT	Rezklad 250 150°F
Acetic Acid, below 5%	R	R
Acetic Acid, 5% to 10%	R	R
Acetic Acid, 10% to 50%	R	C
Acetone	C	NR
Alum or Aluminum Sulfate	R	R
Ammonium Chloride, nitrate, sulfate, 50%	R	R
Ammonium Hydroxide, 10%	R	R
Ammonium Hydroxide, 30%	R	C
Aniline	C	NR
Aqua Regia	NR	NR
Barium Chloride, Sulfate	R	R
Beer	R	R
Benzene	R	NR
Benzene Sulfonic Acid, 10%	R	R
Benzoic Acid	R	R
Black Liquor	R	R
Bleaching Liquor, below 2%	R	R
Bleaching Liquor, conc.	NR	NR
Boric Acid	R	R
Butyl Acetate	C	--
Butyl Alcohol	C	--
Butyric Acid	C	NR
Calcium Chloride, Nitrate, Sulfate	R	R
Calcium Hydroxide	R	R
Calcium Hypochlorite	R	C
Chlorine, Dry	C	--
Chlorine, Wet	C	--
Chlorine Water	R	--
Chloroacetic Acid, below 10%	R	R
Chloroform	R	--
Chromic Acid, below 5%	R	C
Chromic Acid, 5% to 10%	C	NR
Citric Acid, to 40%	R	R
Copper Chloride, Nitrate, Sulfate	R	R
Ether	R	--
Ethyl Acetate	C	--
Ethyl Alcohol	C	--
Ethylene Dichloride	NR	--
Ethylene Glycol	R	R
Fatty Acids	C	C
Ferric Chloride, Nitrate, Sulfate	R	R
Fluosilicic Acid, 30%	A	A
Formaldehyde, below 37%	R	R
Formic Acid, 90%	R	C
Grape Juice	R	R
Hydrobromic Acid, 20%	R	C
Hydrochloric Acid, to 20%	R	R
Hydrochloric Acid, 20% to 36%	R	C
Hydrofluoric Acid, to 20%	A	A
Hydrofluoric Acid, 20% to70%	A	NR
Hydrogen Peroxide	R	--
Hypochlorous Acid, to 5%	R	C
Jet Fuel	R	--
Kerosene	R	--
Lactic Acid, below 5%	R	R

	Rezklad 250 RT	Rezklad 250 150°F
Lactic Acid, 5% to 10%	R	R
Lactic Acid, above 10%	R	C
Lard	R	R
Lux Liquid	R	R
Magnesium Chloride, Nitrate, Sulfate	R	R
Maleic Acid	R	R
Methyl Alcohol	C	--
Methylene Chloride	NR	--
Methyl Ethyl Ketone	C	--
Milk	R	R
Mineral Oil	R	R
Nickel Chloride, Nitrate Sulfate	R	R
Nitric Acid, below 5%	R	R
Nitric Acid, 5% to 10%	C	C
Oils, Vegetable	C	C
Oleic Acid	C	C
Oxalic Acid	R	R
Perchloroethylene	R	C
Petroleum	R	R
Phenol, below 5%	C	--
Phosphoric Acid, to 25%	RB	RB
Phosphoric Acid, 25% to 50%	CB	NR
Phosphoric Acid, above 50%	NR	--
Picric Acid, to 5%	R	NR
Potassium Chloride, Nitrate, Sulfate	R	R
Potassium Hydroxide, below 25%	R	R
Potassium Hydroxide, 25% to 50%	C	C
Sodium Bicarbonate, Carbonate	R	R
Sodium Chloride, Nitrate, Phosphate	R	R
Sodium Sulfate, Sulfide	R	R
Sodium Hydroxide, to 25%	R	R
Sodium Hydroxide, 25% to 50%	C	C
Sodium Hypochlorite, below 6%	R	R
Sodium Hypochlorite, 16%	C	NR
Stannic Chloride	R	NR
Stearic Acid	R	R
Sugar, Salt Solution	R	R
Sulfuric Acid, to 80%	R	R
Sulfuric Acid, above 80%	C	NR
Sulfurous Acid, below 10%	R	R
Toluene	R	NR
Toluene Sulfonic Acid	R	C
Tomato Juice	R	R
Trichloroethylene	C	NR
Trisodium Phosphate	R	R
Turpentine	R	--
Urea, to 20%	R	R
Urine	R	C
Vegetable Oil	R	R
Vinegar	R	R
Water, Fresh	R	R
Water, Distilled	R	R
Water and Sewage	R	R
Xylene	R	NR
Zinc Chloride, Nitrate, Sulfate	R	R

R - Recommended

NR - Not Recommended

C - Conditional. May be serviceable if the contaminant is immediately removed or washed off the surface.

A - Silica filler will be attacked. Sealing the surface may prolong the life.

B - May contain traces of hydrofluoric acid or acid fluorides. Silica filler may be attacked. See "A".

TABLE 3.3: EPOXY MORTAR AND FLOOR TOPPINGS—PENNWALT

CHEMICAL RESISTANCE OF PENNTROWEL® EPOXY TOPPINGS

The following products have the chemical resistance shown on this chart:

PENNTROWEL® Epoxy Topping Compounds
PENNTROWEL® Epoxy Brick Mortar
THIN SET® Adhesive
TUFCHEM® Sprayable Epoxy

The 160°F (71°C) temperature limit is to be used for splash and spill conditions. No epoxy type monolithic surfacing materials should be employed in continuous thermal conditions above 140°F (60°C), or intermittent above 160°F (71°C). Where there is steady flow of hot liquids on the floor for 20 minutes or more or where there is steady radiant heat on the floor, the 160°F (71°C) temperature limitation in this resistance guide is to be corrected to 140°F (60°C).

KEY:

(horizontal lines) Resistant to 160°F (71°C)	* The highest temperature tested, may and/or could be revised basis of further test.
(dotted) Resistant to 90°F (32°C)	C Carbon filled
(solid black) Not Resistant	** Resistant to 70°F (21°C)

Chemical	Resistance
Acetaldehyde	Resistant to 160°F (71°C)
Acetic Acid 5%	Resistant to 160°F (71°C)
Acetic Acid 5-10%	Resistant to 90°F (32°C)
Acetic Acid, glacial	Not Resistant
Acetic anhydride	Not Resistant
Acetone	Resistant to 90°F (32°C) *
Acetylene	Resistant to 90°F (32°C)
Acrylic acid	Not Resistant
Adipic Acid	Resistant to 160°F (71°C)
Alcohol, ethyl	Resistant to 160°F (71°C)
Allyl chloride	Resistant to 160°F (71°C)
Aluminum chloride, below 50%	Resistant to 160°F (71°C)
Aluminum sulfate, saturated	Resistant to 160°F (71°C)
Amidosulfonic acid	Resistant to 160°F (71°C)
Ammonia, aqueous 10%	Resistant to 160°F (71°C)
Ammonia, aqueous 30%	Resistant to 90°F (32°C) *
Ammonia, anhydrous	Resistant to 160°F (71°C)
Ammonium chloride, carbonate, sulfate 50%	Resistant to 160°F (71°C)
Ammonium hydroxide 30%	Resistant to 90°F (32°C) *
Ammonium nitrate 50%	Resistant to 160°F (71°C)
Ammonium persulfate 50%	Resistant to 160°F (71°C)
Ammonium phosphate	Resistant to 160°F (71°C)
Ammonium sulfide solution	Resistant to 160°F (71°C)
Amyl acetate	Resistant to 160°F (71°C)
Aniline	Not Resistant
Antifreeze	Resistant to 90°F (32°C) *
Aqua regia	Not Resistant
Barium chloride, saturated	Resistant to 160°F (71°C)
Beer	Resistant to 160°F (71°C)
Benzaldehyde	Not Resistant
Benzene	Resistant to 160°F (71°C)
Benzenesulfonic acid	Not Resistant
Benzoic acid	Resistant to 90°F (32°C)
Benzole-alcohol mixture	Resistant to 160°F (71°C)
Benzoyl chloride	Resistant to 160°F (71°C)
Benzyl acetate	Resistant to 90°F (32°C)
Benzyl alcohol	Not Resistant
Benzyl chloride 150°C	Resistant to 160°F (71°C)
Bleach (see Sodium hypochlorite)	
Blood	Resistant to 160°F (71°C)
Boric acid, any	Resistant to 160°F (71°C)
Bromine	Resistant to 160°F (71°C)
Butyl acetate	Resistant to 160°F (71°C)
Butyl alcohol	Resistant to 160°F (71°C)
Butyric acid	Not Resistant
Calcium bisulfite liquor	Resistant to 160°F (71°C)
Calcium chlorate	Not Resistant
Calcium chloride, below 50%	Resistant to 160°F (71°C)
Calcium chloride 50%	Resistant to 160°F (71°C)
Calcium hydroxide	Resistant to 160°F (71°C)

(continued)

TABLE 3.3: EPOXY MORTAR AND FLOOR TOPPINGS—PENNWALT (continued)

Calcium hypochlorite	
Calcium nitrate, saturated	
Calcium sulfate	
Carbon dioxide	
Carbon disulfide	*
Carbon monoxide	
Carbon tetrachloride	*
Caustic (see Sodium hydroxide)	
Chlorinated lime	
Chlorine (dry)	
Chlorine (wet) 500 ppm	
Chlorine water	
Chloroacetic acid 100%	
Chloracetic acid 10%	
Chloronaphthalene	
Chloronitrobenzene	
Chromic acid 5%	
Chromic acid 5-10%	*
Citric acid 40%	
Coolant brines	
Copper acetate, saturated	
Copper chloride, nitrate, sulfate	
Cottage cheese	
Cottonseed oil	
Cresols	
Crude oil	
Cyclohexane	*
Cyclohexanone	
Dichloroethylene	
Diesel fuel	
Diethylene glycol	
Diethylenetriamine	
Dimethylaminoethanol	
Dimethyl formamide	*
Dinitrobenzene	
Diphenyl or diphenyl oxide	
Ether	
Ethyl acetate	
Ethyl alcohol	
Ethylamine, 40% aq. sol.	
Ethyl chloride	
Ethylene dichloride	
Ethylene glycol	
Fatty acids	
Ferric chloride, below 50%	
Ferric chloride, anhydrous	
Ferric nitrate or sulfate	
Fluorine up to approx. 50%	
Fluosilicic acid 30%	C
Formaldehyde, below 37%	
Formic acid 90%	
Fumaric acid	
Furfural	
Furfuryl alcohol	
Gallic acid	
Gasoline	*
Glycerine	
Glycol	
Glycol acetate	
Glycolic acid	
Heptanoic acid, any	*
Hexachlorocyclopentadiene	
Household ammonia (see ammonium hydroxide)	
Hydrochloric acid, any	
Hydrochloric acid, below 10%	
Hydrochloric acid 10-32%	
Hydrofluoboric acid	C
Hydrofluoric acid 10-20%	C
Hydrofluoric acid 20-70%	C
Hydrogen peroxide 50%	
Hydrogen sulfide	
Hydroquinone	
Hydrosilicofluoric acid	
Hypochlorous acid	
Iron sulfate, saturated	
Jet fuel	
Kerosene	
Lactic acid 85%	
Lard	
Magnesium bisulfite	
Magnesium chloride, saturated	
Magnesium sulfate, saturated	
Maleic acid, below 40%	
Maleic acid 40%	
Maleic anhydride	
Mercuric chloride, saturated	
Mercury	
Methacrylic acid	

(continued)

TABLE 3.3: EPOXY MORTAR AND FLOOR TOPPINGS—PENNWALT (continued)

Methyl acetate	
Methyl alcohol	
Methyl amine 40%	
Methyl "Cellosolve"	
Methyl chloride	
Methy cyclohexanol	
Methyl ethyl ketone	*
Methyl naphthalene	
Methylene chloride	
Milk	
Mineral oil	
Miscible oil	
Monochlorobenzene	
Motor oil (see Crude oil)	
Muriatic acid (see Hydrochloric acid)	
Naphthalene	
Nickel chlorate, nitrate or sulfate	
Nitric acid 5%	
Nitric acid 70%	
Nitric oxide gases	
Nitrobenzene	
Nitrosylsulfuric acid	
Nitropropane	*
Oils (saponifiable)	
Oleic acid	
Oleum	
Oxalic acid	
Oxygen	
Paradimethylaminobenzophenone	
Paraffin	
Perchloric acid	
Perchloroethylene	
Petargonic acid	
Petroleum	
Phenol, below 5%	**
Phosgene	
Phosphoric acid 85%	
Phosphorous chlorides	
Phthalic anhydride	
Picric acid 5%	
Picric acid 50%	
Potassium bromide, saturated	
Potassium carbonate, saturated	
Potassium chlorate, 50%	
Potassium chloride, nitrate or sulfate	
Potassium cyanide, saturated	
Potassium ferricyanide, saturated	
Potassium hydroxide 50%	
Potassium nitrate, saturated	
Potassium permanganate, below 5%	
Potassium peroxide 5%	
Potassium persulfate, saturated	
Potassium sulfate saturated	
Potassium sulfide	
Prussic acid	
Pyridine	
Quinoline sulfate	
Saccharin solutions	
Salicylic acid	
Salt, saturated	
Sodium acetate, saturated	
Sodium bichromate	
Sodium chloride, carbonate, bicarbonate, phosphate, nitrate, sulfate or chlorate	
Sodium hydroxide 50%	
Sodium hypochlorite, below 6% Cl_2	
Sodium hypochlorite 27%	*
Sodium peroxide 5%	
Stannic chloride	
Steam	
Stearic acid, any	
Sugar, saturated	
Sulfur chloride	
Sulfur dioxide	
Sulfuric acid 80%	
Sulfuric acid 98%	
Sulfurous acid, below 10%	
Sulfur monochloride	
Sulfuryl chloride	
Tannin	
Tar, tar oils	
Tartaric acid, cold saturated	
Tetrachloroethane	
Tetrachloromethane	
Tetrahydrofuran	*
Toluene	
Toluenesulfonic acid	

(continued)

TABLE 3.3: EPOXY MORTAR AND FLOOR TOPPINGS—PENNWALT (continued)

Town gas	hatched
Trichloroacetic acid	dotted
Trichloroethylene	dotted *
Triethanolamine	hatched
Trisodium phosphate	hatched
Turpentine	hatched
Urea 20%	hatched
Urine	dotted *
Vegetable oil	hatched
Vinegar	hatched
Water, fresh	hatched
Water, distilled	hatched
Xylene	hatched
Zinc chloride 50%	hatched

Solutions Common to the Plating Industry
Floor and Wall Service (Not for Immersion)

Acid Copper	hatched
Acid Zinc	hatched
Aluminum bright dip – # 41 Phosphoric acid heat Bath alumabrite Concentrate # 41	hatched
Aluminum Pickle – Northwest Al, Alume D. S.	hatched
Aluminum Pickling, Enthone – Nitric acid with Enthone actane # 70	solid black
Alkaline tin	hatched
Anodizing Electrolyte – 15 - 18% sulfuric acid	hatched
Brass bright dip - 50% nitric, 50% sulfuric	blank **
Cadmium bright dip - with nitric acid with Kenvert conversion additive	hatched
Cadmium plating bath	hatched
Calolume L. Cadmium cyanide bath	hatched
Chrome plating bath - approx. 45^{02} CR to gallon 45^{02} sulfuric	hatched
Chromium	hatched
Copper Fluoroborate	hatched
Copper Lume, Copper cyanide	hatched
Copper plating bath - cyanide with #625 Allied Research additive	hatched
Copper plating bath -straight cyanide	hatched
Enthone stripper - S18	solid black
Iron Chloride	hatched
Rochelle salt, Copper cyanide	hatched
Udylite bright nickel # 425	hatched
Watt's nickel	hatched
Zincalume, Cyanide zinc	hatched
Delchem 946	blank **
Enthone Stripper	solid black
Nuvite Take-off Stripper	solid black
A-29-S Stripper	solid black

Note: Top service temperature for continuous service is 140°F (60°C). Exposures to 160°F (71°C) acceptable for not more than 20 minutes.

TABLE 3.4: EPOXY SURFACING CEMENTS—STERNSON

The following chart is a general guide to the resistance of the Talychem family of surfacing cements to a wide range of chemical service conditions.

R	-	recommended to 71°C. Contact Sternson Limited for higher temperature recommendations.
C	-	use Talychem C
32	-	highest temperature tested. May be revised with further tests.
30% 50%	-	specific chemical tested.
D	-	may discolour surface, will not lose properties.
*	-	contact Sternson Limited for recommendation.
NR	-	not recommended.

Acetaldehyde	R
Acetic Acid, below 5%	RD
Acetic Acid, 5-10%	D
Acetic Acid, glacial	NR
Acetic anhydride	NR
Acetone	*
Acetylene	32
Acrylic Acid/ 98% Sulphuric Acid, 2% concentration	27I
Adipic Acid, any	R
Alcohol	R
Allyl chloride	R
Aluminum chloride, below 50%	RD
Aluminum sulphate, saturated solution	RD
Amidosulfonic acid	R
Ammonia, aqueous, 10%	R
Ammonia, aqueous, 30%	32
Ammonia, anhydrous	R
Ammonium Chloride, Carbonate, Sulphate 50%	R
Ammonium Hydroxide 30%	32
Ammonium Nitrate, below 50%	RD
Ammonium Nitrate, 50%	RD
Ammonium persulphate, 50%	R
Ammonium phosphate	R
Ammonium sulphide solution	R
Amyl acetate	R
Aniline	32
Antifreeze	32
Aqua regia	NR
Barium chloride, saturated	RD
Barium hydroxide, saturated	R
Barium nitrate, 10%	RD
Beer	R
Benzaldehyde	NR
Benzene	R
Benzenesulphonic acid	NR
Benzoic acid	32
Benzole-alcohol-mixture	R
Benzoyl Chloride	RD
Benzyl acetate	32
Benzyl alcohol	NR
Benzyl chloride 150°C	R
Bleach (see Sodium Hypochlorite)	
Bleaching liquors, 0-2%	R
Bleach liquors, conc.	NR
Blood	R
Boric Acid, any	R
Brine (see Sodium Chloride)	
Bromine	RD
Butozyl	NR
Butyl Acetate	R
Butyl Alcohol	R
Butyric acid	*
Calcium bisulphite liquor	R
Calcium chlorate	NR
Calcium chloride, below 50%	RD
Calcium chloride, 50%	RD
Calcium Hypochlorite (See Sodium Hypochlorite)	
Calcium nitrate, saturated	RD

(continued)

TABLE 3.4: EPOXY SURFACING CEMENTS–STERNSON (continued)

Calcium sulphate	RD
Carbon Dioxide	R
Carbon disulphide	32
Carbon monoxide	R
Carbon Tetrachloride	32
Caustic (See Sodium Hydroxide)	
Chlorinated lime	R
Chlorine (Dry)	R
Chlorine (Wet) 5000 ppm	R
Chlorine Water	R
Chloroacetic acid, 100%	NR
Chloroacetic, 10%	32
Chloroform	R
Chloronaphthalin	32
Chloronitrobenzene	32
Chromic acid, below 5%	R
Chromic acid, 5%	R
Chromic acid, 5 to 10%	32
Citric Acid, below 5%	R
Citric Acid, 5-40%	R
Coolant brines	32
Copper acetate, saturated	R
Copper chloride, nitrate or sulphate	R
Cottage Cheese	R
Cottonseed Oil	R
Cresols	NR
Crude Oil	R
Cyclohexane	*
Cyclohexanone	R
Dichloroethylene	NR
Diesel Fuel	R
Diethylene Glycol	R
Diethylenetriamine	R
Dimethylaminoethanol	R
Dimethyl Formamide	32
Dinitro-benzene	R
Diphenyl or diphenyl oxide	R
Ether	R
Ethyl Acetate	*
Ethyl Alcohol	R
Ethylamine, 40% aqueous sol.	32
Ethyl chloride	NR
Ethylene dichloride	NR
Ethylene glycol	RD
Fatty acids	32
Ferric chloride, below 50%	R
Ferric chloride, anhydrous	R
Ferric nitrate or sulphate	R
Fluorine up to approx. 50%	NR

Fluosilicic Acid, 30%	RC
Formaldehyde, below 37%	R
Formic acid, 90%	NR
Fumaric acid, any	32
Furfural	R
Furfuryl alcohol	32
Gallic acid	R
Gasoline	*
Glycerine	R
Glycol	32
Glycol acetate	32
Glycolic Acid	NR
Heptanoic Acid, any	*
Hexachlorocyclopentadiene	NR
Household ammonia (See Ammonium hydroxide)	
Hydrobromic acid, any	RD
Hydrochloric acid, below 10%	R
Hydrochloric acid, 10 to 32%	RD
Hydrofluoboric acid	RC
Hydrofluoric acid, below 10%	RC
Hydrofluoric acid, 10 to 20%	RC
Hydrofluoric acid, 20 to 70%	32C
Hydrogen peroxide, 50%	RD
Hydrogen sulphide	R
Hydroquinone	R
Hydrosilicofluoric acid	32C
Hypochlorous acid	R
Iron sulphate, saturated	R
Jet Fuel	R
Kerosene	R
Lactic Acid, below 20%	RD
Lactic Acid, 20 to 85%	RD
Lard	R
Lead Acetate, 25%	RD
Lead Chloride, saturated	RD
Magnesium bisulphite	R
Magnesium chloride, saturated	RD
Magnesium sulphate, saturated	RD
Maleic acid, below 40%	RD
Maleic acid, 40%	32D
Maleic anhydride	R
Mercuric chloride, saturated	NR
Mercury	R
Methanol	*
Methyl acetate	32
Methyl alcohol	R
Methyl amine, 40%	R
Methyl "Cellosolve"	R
Methyl chloride	NR

(continued)

TABLE 3.4: EPOXY SURFACING CEMENTS—STERNSON (continued)

Methylcyclohexanol	R
Methyl ethyl ketone	*
Methyl naphthalene	R
Methylene chloride	NR
Milk	R
Milk of lime	R
Mineral Oil	R
Miscible Oil	R
Molybdic Acid, saturated	RD
Monochlorobenzene	32
Motor Oil (see Crude Oil)	
Muriatic acid (see Hydrochloric Acid)	
Naphthalin	R
Nickel Chloride, nitrate or sulphate	RD
Nitric acid, below 2 1/2%	R
Nitric acid, 2 1/2 to 5%	R
Nitric acid, 70% (conc.)	NR
Nitric oxide gases	NR
Nitrobenzene	*
Nitrosylsulphuric, acid	NR
Nitropropane	32
Oils (saponifiable)	R
Oleic acid, any	R
Oleum	NR
Oxalic acid, any	R
Oxygen	R
Paradimethyl-amino-benzophenone	32
Paraffin	R
Perchloric acid, any	*
Perchloroethylene	R
Pelargonic acid, any	R
Petroleum	R
Phenol, below 5%	21 *
Phosgene	32
Phosphoric acid, below 2%	RD
Phosphoric acid, 2 to 5%	RC
Phosphoric acid, 5 to 50%	RC
Phosphoric acid, 50 to 85%	RC
Phosphorus chlorides	R
Phthalic anhydride	R
Picric acid, 50%	*
Picric acid, 5%	32
Potassium bromide, saturated	R
Potassium carbonate, saturated	R
Potassium chlorate, 50%	32
Potassium chloride, nitrate or sulphate	R
Potassium cyanide, saturated	R
Potassium ferricyanide, saturated	R
Potassium hydroxide, below 25%	R
Potassium hydroxide, 25 to 50%	R
Potassium nitrate, saturated	R
Potassium permanganate, below 5%	RD
Potassium peroxide, 5%	R
Potassium persulphate, saturated	R
Potassium sulphate, saturated	R
Potassium sulphide	R
Prussic acid	R
Pyridine	32
Quinoline sulphate	R
Red Oil	*
Rochelle Salt, 25%	R
Saccharin solutions	R
Salicylic acid	32
Salt, saturated solution	R
Sodium acetate, saturated	R
Sodium bichromate	*D
Sodium chloride, carbonate, bicarbonate, phosphate, nitrate, sulphate, sulphide or chlorate	R
Sodium hydroxide, below 25%	R
Sodium hydroxide, 25 to 50%	R
Sodium Hypochlorite, 50 ppm Cl_2	R
Sodium Hypochlorite, 5000 ppm Cl_2	R
Sodium Hypochlorite, below 6% Cl_2	R
Sodium Hypochlorite, 27%	32D
Sodium Hypochlorite, 16%	32D
Sodium peroxide, 5%	32
Stannic chloride	32
Steam	R
Stearic acid, any	R
Sugar, saturated solution	R
Sulphur chloride	NR
Sulphur dioxide	R
Sulphuric acid, below 10%	R
Sulphuric acid, 10 to 20%	R
Sulphuric acid, 20 to 40%	RD
Sulphuric acid, 40 to 50%	RD
Sulphuric acid, 50 to 60%	RD
Sulphuric acid, 60 to 70%	RD
Sulphurous acid, below 10%	RD
Sulphur monochloride	32
Sulfuryl chloride	32
Tannin	R
Tar, tar oils	32
Tartaric acid, cold saturated	R
Tetrachloroethane	NR
Tetrachloromethane	NR
Tetrahydrofuran	32 *

(continued)

TABLE 3.4: EPOXY SURFACING CEMENTS—STERNSON (continued)

Toluene	R	Urine	32
Toluenesulphonic acid	R	Vegetable oil	R
Town gas	R	Vinegar	R
Trichloroacetic acid	32	Water, fresh	R
Trichloroethylene	32 *	Water, distilled	R
Triethanolamine	R	Xylene	R
Trisodium phosphate, any	R	Zinc chloride, 50%	RD
Turpentine	R	Zinc nitrate, 50%	RD
Urea, 20%	R	Zinc sulphate, 50%	RD

TALYCHEM SYSTEMS ARE RESISTANT TO MOST PLATING OPERATION ENVIRONMENTS AS - CHROME, COPPER, CADMIUM, NICKEL ....

TABLE 3.5: FURAN GROUT—ATLAS

Black FURNANE Chemical Resistance

	Furan C	Furan H
Acetic acid, up to 10%	■	■
Acetic acid, glacial	■	■
Alum	■	■
Aluminum Sulfate	■	■
Ammonium Hydroxide	■	■
Animal Oils	■	■
Bakery Products	■	■
Beer	■	■
Benzoic acid	■	■
Boric acid	■	■
Butter	■	■
Butyric acid	■	■
Calcium Chloride	■	■
Calcium Hydroxide	■	■
Carbonated water	■	■
Casein	■	■
Cheese, all	■	■
Chlorine water	□	□
Chloroacetic acid, 10%	■	■
Cider	■	■
Citric acid	■	■
Citrus Fruits	■	■
Coffee	■	■
Corn Syrup	■	■
Egg Yolk	■	■
Ethyl Alcohol	■	■
Ethylene Glycol	■	■
Fluosilicic acid	■	■
Formaldehyde	■	■
Formic acid	■	■
Glycerine	■	■
Fruit Extracts	■	■
Glucose	■	■
Horse Radish	■	■
Hydrochloric acid	■	■
Hydrofluoric acid	■	■
Hydrofluosilicic acid	■	■
Hydrogen Peroxide	□	□
Ice Cream	■	■
Jams & Jellies	■	■
Kerosene	■	■
Lactic Acid	■	■
Ketchup	■	■
Linseed Oil	■	■
Magnesium Hydroxide	■	■
Margarine	■	■
Magnesium Sulfate	■	■
Maleic acid	■	■
Malt	■	■
Malt Liquors	■	■
Methyl Alcohol	■	■
Milk, Fresh	■	■
Milk, Sour	■	■
Mineral Oil	■	■
Mineral Spirits	■	■
Muriatic acid	■	■
Molasses	■	■
Mustard	■	■
Nitric acid	□	□
Oleic acid	■	■
Olive Oil	■	■
Oxalic acid	■	■
Pectin	■	■
Phenol	■	■
Phosphoric Acid	■	■
Pickels	■	■
Picric acid	□	□
Potassium Bicarbonate	■	■
Potassium Carbonate	■	■
Potassium Hydroxide, up to 30%	■	■
Potassium Hydroxide, 30% and over	■	■
Salad Oils	■	■
Salicylic acid	■	■
Shortening	■	■
Silver Nitrate	■	■
Smokehouse Residues	■	■
Sodium Bicarbonate	■	■
Sodium Carbonate	■	■
Sodium Chloride	■	■
Sodium Hydroxide, up to 30%	■	■
Sodium Hydroxide, 30% and over	■	■
Sodium Hypochlorite, up to 3%	⧄	□
Sodium Nitrate	■	■
Sodium Sulfate	■	■
Sodium Sulfite	■	■
Sodium Thiosulfate	■	■
Soft Drinks	■	■
Soft Drink Concentrates	■	■
Soups	■	■
Soya Oil	■	■
Stearic acid	■	■
Sugar	■	■
Sulfuric acid, up to 50%	■	■
Sulfuric acid, 80%	■	□
Sulfuric acid, 93%	□	□
Syrup	■	■
Tannic acid	■	■
Tartaric acid	■	■
Tea	■	■
Trichloroethylene	■	■
Trisodium Phosphate	■	■
Tung Oil	■	■
Urea	■	■
Urine	■	■
Vinegar	■	■
Yeast	■	■

KEY

C 80° F

H 200° F in cases where chemical boils below this limitation, resistance is intended to be shown up to the boiling point

■ RECOMMENDED

⧄ CONDITIONAL may be suitable but consult Atlas before using

□ NOT RECOMMENDED

TABLE 3.6: FURAN POLYMER CONCRETE—QUAKER OATS CHEMICALS

Furan polymer concrete is a strong, concrete-type material with outstanding corrosion resistance made by bonding size-graded aggregates with a furfuryl alcohol-based "furan" resin.

Corrosion tests have been conducted on 1 inch x 2 inch furan polymer concrete test cylinders made with Quaker's QO FA-RoK resin/catalyst system by totally immersing them in several key media at 150°F for one year. Results of these tests indicate that furan polymer concrete should be suitable for use in environments that have been serviced for many years by furan mortars and furan FRP equipment.

Furan polymer concrete is attacked by strong oxidizing agents, a few aggressive solvents and chemicals that attack silica. However, it may perform satisfactorily with some of these media where the service is a splash/spill wash down exposure or where materials such as very dilute sodium hypochlorite are used as cleaning agents.

The following is a partial list of solvents and other corrosive chemicals typically handled by furans.

Acetic acid
Acetone
Acrylic acid
Acrylonitrile
Ammonium salts
Animal oils
Battery acid
Benzene
Benzyl chloride
Carbon disulfide
Carbon tetrachloride
Chloride salts
Chlorophenol
Dichloroethane
Ethanol
Ethyl acetate
Fatty acids
Hydrochloric acid
Lactic acid
Methanol
Methyl ethyl ketone
Mineral oils
Oleic acids
Oleic compounds
Pnosphate salts
Phosphoric acid
Potassium hydroxide
Pulp mill liquors
Sodium hydroxide
Stearic acid
Sulfate salts
Sulfuric acid
Tall oil
Toluene
Trichloroethylene
Urea
Vegetable oils
Zinc chloride

TABLE 3.7: POLYESTER GROUT—RADIATION TECHNOLOGY

CHEMICAL RESISTANCE OF RADGROUT-H

Radgrout-H was immersed in each of the following chemical solutions at room temperature, and aged continuously as indicated. The specimens were then examined and the observations are shown below.

Solution	Weight Change (%) 14 Days	90 Days	355 Days	Appearance Change
Concentrated Ammonium Hydroxide	None	—	1.1%	Very Slightly Darker
10% Ammonium Hydroxide	None	3%	0.5%	Very Slightly Darker
10% Sulphuric Acid	None	None	0.2%	Very Slightly Darker
Concentrated Nitric Acid	None	—	1.8%	Slightly Yellow
10% Nitric Acid	None	0.2%	0.6%	None
Concentrated Hydrochloric Acid	None	—	0.7%	Slightly Darker
10% Hydrochloric Acid	None	<0.1%	1.1%	None
25% Aqueous Calcium Chloride	None	0.4%	0.4%	Very Slightly Darker
Distilled Water	None	0.5%	0.5%	None
Brake Fluid	0.1%	0.5%	0.6%	None
Gasoline	None	<0.1%	0.4%	None
Toluene	<0.1%	0.3%	1.1%	Slightly Darker
Methyl Alcohol	0.5%	0.2%	0.5%	None
Motor Oil	0.4%	0.7%	0.7%	Very Slightly Darker

TABLE 3.8: SULFUR CONCRETE AND COATING—SULCON SYSTEMS

SULCON sulphur concrete is a material which uses molten sulphur as the binding agent for aggregate, thus replacing the cement and water components of regular portland cement concrete. Sulphur concrete's unique characteristics include: (1) high strength; (2) excellent corrosion resistance against almost all acids and metal salts; (3) rapid set and strength gain; (4) the ability to be remelted and reused without change to its physical and structural properties. SUCOAT is a spray-on sulphur coating.

Industrial testing results of sulfur concrete materials

Environment	Number of different environments	Status as of June 1, 1982[1]
Sulfuric acid..................	12	3, 2, 1.
Copper sulfate-sulfuric acid....	5	1.
Magnesium chloride.............	4	2.
Hydrochloric acid..............	3	3, 2, 1.
Nitric acid....................	3	1.
Zinc sulfate-sulfuric acid......	3	2, 3.
Copper slimes..................	2	Attacked by slimes.
Nickel sulfate.................	2	2.
Vanadium sulfate-sulfuric acid..	2	3.
Uranium sulfate-sulfuric acid...	2	3.
Potash brines..................	2	1.
Manganese oxide-sulfuric acid...	2	1 for slabs, but coupon deteriorated in cell at 95° C.
Hydrochloric acid-nitric acid...	2	1.
Mixed nitric-citric acid........	1	2.
Ferric chloride-sodium chloride-hydrochloric acid.............	1	2 at 90° C.
Boric acid.....................	1	2.
Sodium hydroxide...............	1	Attacked by >10 pct NaOH.
Citric acid....................	1	1.
Acidic and biochemical..........	1	2.
Sodium chlorate-hypochlorite....	1	Attacked by solution at 50° to 60° C.
Ferric-chlorate ion............	1	2.
Sewage.........................	1	3.
Hydrofluoric acid..............	1	3, only graphite aggregate SC held up.
Glyoxal-acetic acid-formaldehyde	1	3.
Chromic acid...................	1	Deteriorated at 82° C and 90 pct concentration; marginal at lower temperature and concentration.

[1]Test results showed no sign of corrosion or deterioration for (1) >3 yr, (2) 1-3 yr, and (3) <1 yr's exposure.

Source: W.C. McBee, T.A. Sullivan, and B.W. Jong, "Industrial Evaluation of Sulfur Concrete in Corrosive Environments," Bureau of Mines Report of Investigations (1983).

CHEMICAL RESISTANCE OF SUCOAT® COATING

This table is a general guide to the chemical resistance of SUCOAT to selected solids, liquids and aqueous solutions.

	Recommended	Not Recommended In Extended Service
Acetic Acid - 10%	x	
Acetic Acid - Glacial		x
Acetone		x
Acetyl Chloride	x	
Alum	x	
Aluminum Chloride	x	
Aluminum Nitrate	x	
Aluminum Sulfate	x	
Ammonium Chloride	x	
Ammonium Hydroxide		x
Ammonium Nitrate	x	
Ammonium Sulfate	x	
Antimony Chloride	x	
Barium Chloride	x	
Barium Hydroxide		x
Barium Nitrate	x	
Benzene (Benzol)		x
Benzoic Acid	x	
Benzyl Chloride		x
Boric Acid	x	
Butyl Acetate		x
Calcium Bisulfite	x	

(continued)

TABLE 3.8: SULFUR CONCRETE AND COATING—SULCON SYSTEMS (continued)

	Recommended	Not Recommended In Extended Service
Calcium Carbonate	x[1]	
Calcium Chloride	x	
Calcium Hydroxide	x[1]	
Calcium Nitrate	x	
Calcium Sulfate	x	
Carbon Disulfide		x
Carbon Tetrachloride		x
Chlorine Gas, Dry		x
Chlorine Gas, Wet		x
Chlorine Water		x
Chlorobenzene		x
Chloroform		x
Chromic Acid - 10%		x
Citric Acid	x	
Cupric Chloride	x	
Cupric Sulfate	x	
Diethyl Ether		x
Ethyl Acetate		x
Ethyl Alcohol (Ethanol)	x	
Ethylene Dichloride		x
Ethylene Glycol		x
Formaldehyde	x	
Formic Acid Solutions	x	
Gasoline		x
Glycerine	x	
Hexane		x
Hydriodic Acid		x
Hydrobromic Acid		x
Hydrochloric Acid	x	
Hydrocyanic Acid	x	
Hydrofluoric Acid - 10%		x
Hydrofluoric Acid - 48%		x
Hydrogen Peroxide, 30%		x
Hydrogen Sulfide Gas, Dry	x	
Hydrogen Sulfide Gas, Wet	x	
Hypochlorous Acid	x	
Iron Chlorides	x	
Iron Nitrates	x	
Iron Sulfates	x	
Isopropyl Ether		x
Kerosene		x
Lead Acetate	x	
Lead Chloride	x	
Lead Nitrate	x	
Linseed Oil	x[1]	
Magnesium Chloride	x	
Magnesium Hydroxide		x
Magnesium Nitrate	x	
Magnesium Sulfate	x	
Methyl Alcohol (Methanol)	x	
Methyl Ethyl Ketone (MEK)		x
Methyl Sulfate		x
Mineral Oil		x
Nickel Chloride	x	
Nickel Nitrate	x	
Nickel Sulfate	x	
Nitric Acid, 5%	x	
Nitric Acid, 20%	x	
Nitric Acid, 40%-Ambient Temps.	x	
Nitrobenzene		x
Oils, Vegetables	x[1]	
Oxalic Acid	x	
Phenol, 5% Solution		x

x[1] Consult a representative for a specific recommendation.

(continued)

TABLE 3.8: SULFUR CONCRETE AND COATING–SULCON SYSTEMS (continued)

	Recommended	Not Recommended In Extended Service
Phosphoric Acid	x	
Phosphorous Acid	x	
Phosphorous Trichloride		x
Phthalic Acid	x	
Potassium Dichromate	x	
Potassium Carbonate		x
Potassium Chloride	x	
Potassium Hydroxide		x
Potassium Nitrate	x	
Pyridine		x
Salicylic Acid	x	
Seawater, Brine	x	
Silver Nitrate	x	
Sodium Dichromate	x	
Sodium Bisulfite, 30%	x	
Sodium Chloride	x	
Sodium Chromate	x	
Sodium Hydroxide		x
Sodium Hypochlorite		x
Sodium Nitrate	x	
Sodium Sulfate	x	
Sodium Sulfide		x
Sodium Sulfite	x	
Sodium Thiosulfite	x	
Sulfur Dioxide, Dry	x	
Sulfur Dioxide, Wet	x	
Sulfur Trioxide, Wet		x
Sulfuric Acid, 5%	x	
Sulfuric Acid, 50%	x	
Sulfuric Acid, 80%	x	
Sulfuric Acid, Fuming		x
Sulfurous Acid	x	
Tartaric Acid	x	
Tin Chlorides	x	
Tin Sulfate	x	
Toluene (Toluol)		x
Trisodium Phosphate (TSP)		x
Urea	x	
Water	x	
Xylene (Xylol)		x
Zinc Chloride	x	
Zinc Nitrate	x	
Zinc Sulfate	x	

TABLE 3.9: URETHANE ASPHALT MEMBRANE—PENNWALT

PENNGUARD Adhesive/Membrane is a two-component urethane asphalt composition used in the installation of the PENNGUARD Block Lining System. As an adhesive, it serves to bond the PENNGUARD Block to a prepared substrate, and as a membrane, it serves as a moisture and chemical-resistant barrier. TUFCHEM II Membrane is an improved, two component, urethane asphalt based membrane system, that can be used, within its limitations, to protect concrete and steel surfaces from chemical attack and abrasion.

CHEMICAL RESISTANCE OF
URETHANE ASPHALT MEMBRANES

PENNGUARD® Adhesive/Membrane
TUFCHEM® II Membrane

Key: R - Resistant
NR - Not Resistant
C - Conditional

Acetic Acid 25%	R	Aluminum Hydroxide	NR
Chromic Acid 35%	NR	Calcium Hydroxide, sat.	R
Citric Acid 35%	R	Sodium Hydroxide 35%	R
Hydrochloric Acid 35%	NR	Aluminum Chloride 35%	C
Nitric Acid 35%	NR	Calcium Chloride 35%	R
Oleic Acid	NR	Calcium Sulfate, sat.	R
Phosphoric Acid 35%	R	Magnesium Chloride 35%	R
Sulfuric Acid 35%	NR	Potassium Chromate 35%	R
		Sodium Carbonate 35%	R
		Sodium Chloride, sat.	R
Acetone	NR	Sodium Phosphate, sat.	R
Benzene	NR	Sodium Sulfate, sat.	R
Carbon Tetrachloride	NR	Ammonium Nitrate	R
Ethyl Acetate	NR		
Ethylene Glycol	R		
Methyl Chloride	NR		
Methanol	R		
Propanol	R		
Toluene	NR		
Xylene	NR		
Water	R		

Chemical resistance was determined by immersion in a solution of the listed chemicals for one year at 132°F (55.5°C).

TABLE 3.10: POLYESTER AND EPOXY FLOORING COMPOUNDS—ATLAS

The REZKLAD epoxy-based system consists of a Concrete Primer and Flooring Compound, plus an Expansion Joint Compound and Surface Sealer available for use where necessary. The CLADKOTE Flooring Compound is a modified polyester, resin-based monolithic overlay for concrete. The composite of resins and siliceous reinforcing material cures to a tough, chemical resistant topping. CLADKOTE C utilizes a 100% carbon filler specifically designed for service in hydrofluoric acid and fluoride salts.

CHEMICAL RESISTANCE OF Rezklad® FLOORING MATERIALS

	REZKLAD Epoxy		CLADKOTE Polyester	
	C	H	C	H
Acetic acid, up to 10%	▒	■	□	▒
Alum	□	□	□	□
Aluminum Chloride	□	□	□	□
Aluminum Nitrate	□	□	□	□
Aluminum Sulfate	□	□	□	□
Ammonium Chloride	□	□	□	□
Ammonium Hydroxide	□	□	▒	■
Ammonium Nitrate	□	□	□	□
Ammonium Sulfate	□	□	□	□
Aniline	■	■	■	■
Barium Chloride	□	□	□	□
Barium Nitrate	□	□	□	□
Barium Sulfide	□	□	□	■
Benzene	■	■	■	■
Benzene Sulfonic acid, 10%	□	□	□	□
Benzoic acid	□	□	□	□
Boric acid	□	□	□	□
Bromine water	■	■	□	▒
Butyl Alcohol	□	□	□	□
Cadmium Chloride	□	□	□	□
Cadmium Nitrate	□	□	□	□
Cadmium Sulfate	□	□	□	□
Calcium Bisulfite	□	□	□	□
Calcium Chloride	□	□	□	□
Calcium Hydroxide	□	□	■	■
Calcium Nitrate	□	□	□	□
Chlorine Dioxide, water solution	■	■	□	□
Chlorine water	▒	■	□	▒
Chloroacetic acid, 10%	■	■	■	■
Chloroform	■	■	▒	▒
Chromic acid, up to 5%	▒	■	□	□
Chromic acid, 10%	■	■	□	■
Citric acid	□	□	□	□
Copper Chloride	□	□	□	□
Copper Nitrate	□	□	□	□
Copper Sulfate	□	□	□	□
Dichloroacetic acid, 10%	□	■	□	■
Dichlorobenzene	■	■	■	■
Ethyl Alcohol	□	□	□	■
Ethyl Sulfate	■	■	▒	■
Ethylene Chloride	■	■	■	■

	REZKLAD Epoxy		CLADKOTE Polyester	
	C	H	C	H
Ethylene Glycol	□	□	□	□
Fluosilicic acid	■	■	*	*
Formaldehyde	□	□	□	□
Formic acid	▒	▒	□	■
Gasoline	□	▒	□	□
Glycerine	□	□	□	□
Gold Cyanide	□	□	□	□
Hydrobromic acid	□	▒	□	□
Hydrochloric acid	□	▒	□	□
Hydrocyanic acid	□	□	□	□
Hydrofluoric acid *	■	■	*	*
Hydrofluosilicic acid	■	■	*	*
Hydrogen Peroxide	▒	▒	□	▒
Iron Chloride	□	□	□	□
Isopropyl Ether	□	■	□	■
Kerosene	□	▒	□	□
Lactic acid	▒	■	□	□
Lead Acetate	□	□	□	□
Lead Nitrate	□	□	□	□
Magnesium Chloride	□	□	□	□
Magnesium Hydroxide	□	▒	■	■
Magnesium Nitrate	□	□	□	□
Magnesium Sulfate	□	□	□	□
Maleic acid	■	■	□	□
Methyl Alcohol	□	□	□	□
Methyl Ethyl Ketone	■	■	■	■
Methyl Sulfate	■	■	▒	■
Mineral Spirits	□	▒	□	□
Muriatic acid	□	▒	□	□
Nickel Chloride	□	□	□	□
Nickel Nitrate	□	□	□	□
Nickel Sulfate	□	□	□	□
Nitric acid, up to 5%	▒	■	□	■
Nitric acid, 20%	■	■	▒	■
Oleic acid	□	■	□	□
Oxalic acid	□	■	□	□
Perchloric acid	■	■	■	■
Phenol	■	■	□	■
Phosphoric acid	□	▒	□	□
Phthalic acid	□	□	□	□
Picric acid	□	▒	□	□

	REZKLAD Epoxy		CLADKOTE Polyester	
	C	H	C	H
Potassium Bicarbonate	□	□	□	■
Potassium Carbonate	□	□	□	■
Potassium Chloride	□	□	□	□
Potassium Cyanide	□	□	□	■
Potassium Ferricyanide	□	□	□	■
Potassium Ferrocyanide	□	□	□	■
Potassium Hydroxide, up to 30%	▒	▒	■	■
Potassium Nitrate	□	□	□	□
Potassium Sulfate	□	□	□	□
Pyridine	■	■	■	■
Salicylic acid	□	□	□	□
Silver Nitrate	□	□	□	□
Sodium Acetate	□	▒	□	□
Sodium Bicarbonate	□	□	▒	▒
Sodium Carbonate	□	□	■	■
Sodium Chloride	□	□	□	□
Sodium Cyanide	□	□	■	■
Sodium Hydroxide, up to 30%	□	▒	■	■
Sodium Hypochlorite, up to 3%	▒	■	□	■
Sodium Hypochlorite, 15% and over	■	■	□	■
Sodium Nitrate	□	□	□	□
Sodium Sulfate	□	□	□	□
Sodium Sulfide	□	□	▒	▒
Sodium Sulfite	□	□	□	□
Sodium Thiosulfate	□	□	□	□
Soya Oil	□	▒	□	□
Stearic acid	□	■	□	□
Sulfuric acid, up to 50%	□	▒	□	□
Sulfurous acid	□	□	□	□
Tannic acid	□	□	□	□
Tartaric acid	□	□	□	□
Tin Chloride	□	□	□	□
Tin Sulfate	□	□	□	□
Toluene	▒	■	▒	■
Trichloroethylene	■	■	■	■
Trisodium Phosphate	□	□	□	■
Tung Oil	□	▒	□	□
Urea	□	□	□	□
Xylene	▒	■	□	■
Zinc Chloride	□	□	□	□
Zinc Sulfate	□	□	□	□

*Cladkote C Recommended

KEY

C 80°F.

H Up to the temperature limitation of the material. In cases where chemical boils below this limitation, resistance is intended to be shown up to the boiling point.

□ RECOMMENDED

▒ CONDITIONAL, may be suitable but consult Atlas before using.

■ NOT RECOMMENDED

TABLE 3.11: VARIOUS CEMENTS—ATLAS

Corrosion Resistance of Various Cements

	ALKOR; Furan		VITROBOND; Sulfur		CARBO-KOREZ; Phenolic		VITROPLAST; Polyester		VITREX; Silicate		ALFANE; Epoxy	
	C	H	C	H	C	H	C	H	C	H	C	H
Acetaldehyde	■	■	▨	□	■	■	□	□	■	■	■	▨
Acetic acid, up to 10%	■	■	■	■	■	■	■	▨	▨	▨	▨	□
Acetic acid, glacial	■	■	□	□	■	■	□	□	O	O	□	□
Alum	■	■	■	■	■	■	■	■	■	■	■	■
Aluminum Chloride	■	■	■	■	■	■	■	■	■	■	■	■
Aluminum Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Aluminum Sulfate	■	■	■	■	■	■	■	■	■	■	■	■
Ammonium Chloride	■	■	■	■	■	■	■	■	■	■	■	■
Ammonium Hydroxide	■	■	□	□	□	□	▨	□	□	□	■	□
Ammonium Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Ammonium Sulfate	■	■	■	■	■	■	■	■	■	■	■	■
Amyl Acetate	■	■	□	□	■	■	□	□	■	■	▨	□
Amyl Alcohol	■	■	□	□	■	■	■	▨	■	■	■	■
Aniline	□	□	□	□	■	□	□	□	▨	□	□	□
Aqua Regia	□	□	□	□	□	□	□	□	■	■	□	□
Barium Chloride	■	■	■	■	■	■	■	■	■	■	■	■
Barium Hydroxide	■	■	□	□	□	□	□	□	□	□	■	■
Barium Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Barium Sulfide	■	■	□	□	□	□	■	□	□	□	■	■
Benzene	■	■	□	□	■	■	■	□	■	■	▨	▨
Benzene sulfonic acid	■	■	■	■	■	■	■	■	■	■	■	■
Benzoic acid	■	■	■	■	■	■	■	■	■	■	■	■
Boric acid	■	■	■	■	■	■	■	■	■	■	■	■
Bromine water	□	□	□	□	■	▨	■	▨	□	□	□	□
Butyl Acetate	■	■	□	□	■	■	□	□	■	■	▨	□
Butyl Alcohol	■	■	■	■	■	■	■	■	■	■	■	■
Butyric acid	■	■	■	□	■	■	■	□	■	■	□	□
Cadmium Chloride	■	■	■	▨	■	■	■	■	■	■	■	■
Cadmium Nitrate	■	■	■	▨	■	■	■	■	■	■	■	■
Cadmium Sulfate	■	■	■	▨	■	■	■	■	■	■	■	■
Calcium Bisulfite	■	■	■	■	■	■	■	■	■	■	■	■
Calcium Chloride	■	■	■	■	■	■	■	■	■	■	■	■
Calcium Hydroxide	■	■	□	□	□	□	□	□	□	□	■	■
Calcium Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Carbon Disulfide	■	■	□	□	■	■	□	□	■	■	□	□
Carbon Tetrachloride	■	■	□	□	■	■	■	□	■	■	■	▨
Chlorine Dioxide, water solution	□	□	□	□	□	□	■	■	□	□	□	□
Chlorine gas, dry	▨	□	▨	□	▨	□	■	□	■	■	▨	□
Chlorine gas, wet	□	□	□	□	▨	□	■	□	■	■	▨	□
Chlorine water	□	□	□	□	■	▨	■	▨	■	■	□	□
Chloroacetic acid, 10%	■	■	▨	□	■	■	□	□	■	■	□	□
Chlorobenzene	■	■	□	□	■	■	▨	□	■	■	▨	□
Chloroform	■	■	□	□	■	□	□	□	■	■	□	□
Chromic acid, up to 5%	□	□	■	▨	■	□	■	■	▨	▨	▨	□
Chromic acid, 10%	□	□	■	▨	□	□	■	□	▨	▨	□	□
Chromic acid, 20%	□	□	■	▨	□	□	■	□	▨	▨	□	□

	ALKOR; Furan		VITROBOND; Sulfur		CARBO-KOREZ; Phenolic		VITROPLAST; Polyester		VITREX; Silicate		ALFANE; Epoxy	
	C	H	C	H	C	H	C	H	C	H	C	H
Chromic acid, 50% and over	□	□	□	□	□	□	□	□	■	■	□	□
Citric acid	■	■	■	■	■	■	■	■	■	■	■	□
Copper Chloride	■	■	■	▨	■	■	■	■	■	■	■	■
Copper Nitrate	■	■	■	▨	■	■	■	■	■	■	■	■
Copper Sulfates	■	■	■	▨	■	■	■	■	O	O	■	■
Dichloroacetic acid, 10%	■	■	▨	□	■	■	■	□	■	■	□	□
Dichlorobenzene	■	■	□	□	■	■	□	□	■	■	▨	□
Diethyl ether	■	■	□	□	■	■	▨	□	■	■	▨	□
Ethyl Acetate	■	■	□	□	■	■	□	□	■	■	▨	□
Ethyl Alcohol	■	■	■	■	■	▨	■	■	■	■	■	■
Ethyl Sulfate	■	■	□	□	■	■	▨	□	■	■	■	▨
Ethylene Chloride	■	■	□	□	■	■	□	□	■	■	□	□
Ethylene Glycol	■	■	■	■	■	■	■	■	■	■	■	■
Fluosilicic acid	X	X	X	X	■	■	□	□	□	□	□	□
Formaldehyde	■	■	■	■	■	■	■	■	■	■	■	■
Formic acid	■	■	▨	□	■	■	■	□	■	■	▨	▨
Gasoline	■	■	□	□	■	■	■	■	■	■	■	▨
Glycerine	■	■	■	■	■	■	■	■	■	■	■	■
Gold Cyanide	■	■	■	■	■	■	■	■	■	■	■	■
Hexane	■	■	□	□	■	■	■	■	■	■	■	■
Hydrobromic acid	□	□	■	■	□	□	■	■	■	■	■	■
Hydrochloric acid	■	■	■	■	■	■	■	■	■	■	■	■
Hydrocyanic acid	■	■	■	■	■	■	■	■	■	■	■	■
Hydrofluoric acid	X	X	X	X	■	■	X	X	□	□	□	□
Hydrofluosilicic acid	X	X	X	X	■	■	X	X	□	□	□	□
Hydrogen Peroxide	□	□	□	□	□	□	■	▨	□	□	▨	▨
Hydrogen Sulfide gas, dry	■	■	■	■	■	■	■	■	■	■	■	■
Hydrogen Sulfide gas, wet	■	■	■	■	■	■	■	■	■	■	■	■
Iron Chlorides	■	■	■	■	■	■	■	■	■	■	■	■
Iron Nitrates	■	■	■	■	■	■	■	■	■	■	■	■
Iron Sulfates	■	■	■	■	■	■	■	■	■	■	■	■
Isopropyl Ether	■	■	□	□	■	■	■	□	■	■	■	□
Kerosene	■	■	□	□	■	■	■	■	■	■	■	▨
Lactic acid	■	■	■	■	■	■	■	■	■	■	▨	□
Lead Acetate	■	■	■	■	■	■	■	■	■	■	■	■
Lead Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Linseed Oil	■	■	■	▨	■	■	■	■	■	■	■	▨
Magnesium Chloride	■	■	■	■	■	■	■	■	■	■	■	■
Magnesium Hydroxide	■	■	□	□	□	□	□	□	□	□	■	■
Magnesium Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Magnesium Sulfate	■	■	■	■	■	■	■	■	O	O	■	■
Maleic acid	■	■	■	▨	■	■	■	■	■	■	□	□
Mercuric Acetate	■	■	■	■	■	■	■	■	■	■	■	■
Methyl Acetate	■	■	□	□	■	■	□	□	■	■	■	□
Methyl Alcohol	■	■	■	■	■	▨	■	■	■	■	■	■
Methyl Ethyl Ketone	■	■	□	□	■	■	□	□	■	■	□	□

(continued)

TABLE 3.11: VARIOUS CEMENTS—ATLAS (continued)

	ALKOR; Furan		VITROBOND; Sulfur		CARBO-KOREZ; Phenolic		VITROPLAST; Polyester		VITREX; Silicate		ALFANE; Epoxy	
	C	H	C	H	C	H	C	H	C	H	C	H
Methyl Sulfate	■	■	□	□	■	■	◩	□	■	■	■	◩
Mineral Oil	■	■	□	□	■	■	■	■	■	■	■	■
Mineral Spirits	■	■	□	□	■	■	■	■	■	■	■	■
Muriatic acid	■	■	■	■	■	■	■	■	■	■	■	■
Nickel Chloride	■	■	■	■	■	■	■	■	■	■	■	■
Nickel Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Nickel Sulfate	■	■	■	■	■	■	■	■	O	O	■	■
Nitric acid, up to 5%	□	□	■	■	■	□	■	□	◩	◩	■	□
Nitric acid, 20%	□	□	■	■	□	□	◩	□	◩	◩	□	□
Nitric acid, 40%	□	□	■	□	□	□	□	□	■	■	□	□
Nitric acid, 50% and over	□	□	□	□	□	□	□	□	■	■	□	□
Nitrobenzene	■	■	□	□	■	■	□	□	■	■	◩	◩
Oleic acid	■	■	■	◩	■	■	■	■	■	■	■	□
Oxalic acid	■	■	■	■	■	■	■	■	■	■	■	□
Perchloric acid	□	□	□	□	□	□	□	□	■	■	□	□
Phenol	■	■	□	□	■	◩	■	□	■	■	□	□
Phosphoric acid	■	■	■	■	■	■	■	■	■	■	■	◩
Phosphorous acid	■	■	■	■	■	■	■	■	■	■	■	◩
Phosphorous Trichloride	◩	□	□	□	◩	□	□	□	■	■	□	□
Phthalic acid	■	■	■	□	■	■	■	■	■	■	■	■
Picric acid	□	□	□	□	□	□	■	■	■	■	■	◩
Potassium Bicarbonate	■	■	■	◩	■	■	■	◩	□	□	■	■
Potassium Carbonate	■	■	■	□	■	□	■	□	□	□	■	■
Potassium Chloride	■	■	■	■	■	■	■	■	■	■	■	■
Potassium Cyanide	■	■	■	□	■	□	■	□	□	□	■	■
Potassium Ferricyanide	■	■	■	□	■	□	■	□	□	□	■	■
Potassium Ferrocyanide	■	■	■	□	■	□	■	□	□	□	■	■
Potassium Hydroxide, up to 30%	■	X	□	□	□	□	□	□	□	□	■	■
Potassium Hydroxide, 30% and over	X	X	□	□	□	□	□	□	□	□	◩	□
Potassium Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Potassium Sulfate	■	■	■	■	■	■	■	■	■	■	■	■
Pyridine	◩	□	□	□	◩	□	□	□	□	□	□	□
Rochelle salt	■	■	■	■	■	■	■	■	■	■	■	■
Salicylic acid	■	■	■	■	■	■	■	■	■	■	■	■
Silver Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Sodium Acetate	■	■	■	■	■	■	■	■	■	■	■	■
Sodium Bicarbonate	■	■	■	◩	■	■	■	◩	□	□	■	■
Sodium Carbonate	■	■	■	□	■	□	■	□	□	□	■	■
Sodium Chloride	■	■	■	■	■	■	■	■	O	O	■	■
Sodium Cyanide	■	■	■	□	■	□	■	□	□	□	■	■
Sodium Hydroxide, up to 30%	■	X	□	□	□	□	□	□	□	□	■	■
Sodium Hydroxide, 30% and over	X	X	□	□	□	□	□	□	□	□	■	□
Sodium Hypochlorite, up to 3%	◩	□	□	□	◩	□	■	■	□	□	◩	□
Sodium Hypochlorite, 15% and over	□	□	□	□	□	□	■	■	□	□	□	□

	ALKOR; Furan		VITROBOND; Sulfur		CARBO-KOREZ; Phenolic		VITROPLAST; Polyester		VITREX; Silicate		ALFANE; Epoxy	
	C	H	C	H	C	H	C	H	C	H	C	H
Sodium Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Sodium Sulfate	■	■	■	■	■	■	■	■	O	O	■	■
Sodium Sulfide	■	■	□	□	□	□	■	□	□	□	■	■
Sodium Sulfite	■	■	■	■	■	■	■	■	■	■	■	■
Sodium Thiosulfate	■	■	■	■	■	■	■	■	■	■	■	■
Soya Oil	■	■	■	◩	■	■	■	■	■	■	■	◩
Stearic acid	■	■	■	◩	■	■	■	■	■	■	■	□
Sulfur Dioxide gas, dry	■	■	■	■	■	■	■	■	■	■	■	■
Sulfur Dioxide gas, wet	■	■	■	■	■	■	■	■	■	■	■	■
Sulfur Trioxide gas, dry	■	■	■	■	■	■	■	■	■	■	■	■
Sulfur Trioxide gas, wet	□	□	◩	□	■	□	□	□	■	■	□	□
Sulfuric acid, up to 50%	■	■	■	■	■	■	■	■	O	O	■	◩
Sulfuric acid, 80%	■	□	■	◩	■	□	◩	□	O	O	□	□
Sulfuric acid, 93%	□	□	◩	□	■	□	□	□	O	O	□	□
Sulfuric acid, over 93%	□	□	□	□	□	□	□	□	O	O	□	□
Sulfuric acid, Fuming	□	□	□	□	□	□	□	□	O	O	□	□
Sulfurous acid	■	■	■	■	■	■	■	■	■	■	■	■
Tannic acid	■	■	■	■	■	■	■	■	■	■	■	■
Tartaric acid	■	■	■	■	■	■	■	■	■	■	■	■
Tin Chloride	■	■	■	■	■	■	■	■	■	■	■	■
Tin Sulfate	■	■	■	■	■	■	■	■	■	■	■	■
Toluene	■	■	□	□	■	□	◩	□	■	■	■	◩
Trichloroethylene	■	■	□	□	■	■	□	□	■	■	□	□
Trisodium Phosphate	■	■	◩	□	■	□	■	□	□	□	■	■
Tung Oil	■	■	■	◩	■	■	■	■	■	■	■	◩
Urea	■	■	■	■	■	■	■	■	■	■	■	■
Xylene	■	■	□	□	■	■	■	□	■	■	◩	□
Zinc Chloride	■	■	■	■	■	■	■	■	■	■	■	■
Zinc Nitrate	■	■	■	■	■	■	■	■	■	■	■	■
Zinc Sulfate	■	■	■	■	■	■	■	■	O	O	■	■

Code:

■ = Recommended.

◩ = Conditional, may be suitable.

□ = Not recommended.

X = Carbon-filled variation must be used.

O = Possible failure through crystalline growth in joints.

C = 80°F.

H = Up to the temperature limitation of the cement. In cases where chemical boils below this limitation, resistance is intended to be shown up to the boiling point.

TABLE 3.12: VARIOUS MORTARS—KOCH ENGINEERING

CORROSION-PROOF MORTARS

PERMANITE® Resin Mortar:
An all-purpose furan resin mortar. Satisfactory for non-oxidizing acids, alkalies, and organic solvents. Available in quick setting or slow setting type to suit the installation.

ACIDSIL Mortar:
An improved sodium silicate type mortar with greater water resistance and higher physical strength. Resistant to crystallization cracking, and vitrification to 1900°F.

ACIDSIL K Mortar:
An improved potassium silicate type mortar with greater water resistance and higher physical strength. Resistant to crystallization cracking and vitrification to 1900°F.

ACIDSIL HK Mortar:
An alumina calcine mortar with great water resistance and bearing strength. Resistant to crystallization cracking, and vitrification to 2700°F.

RESIBOND Mortar:
A selected polyester resin mortar with excellent adhesion to ceramics and metals. Satisfactory for dilute acids, alkalies, and oxidizing agents. Recommended for chlorine, chrome chlorine, dioxide and peroxide.

RESIBOND HF Mortar:
A selected polyester resin mortar with excellent adhesion to ceramics and metals. Satisfactory for dilute acids including those that contain fluorides, mild alkalies and many organic solvents.

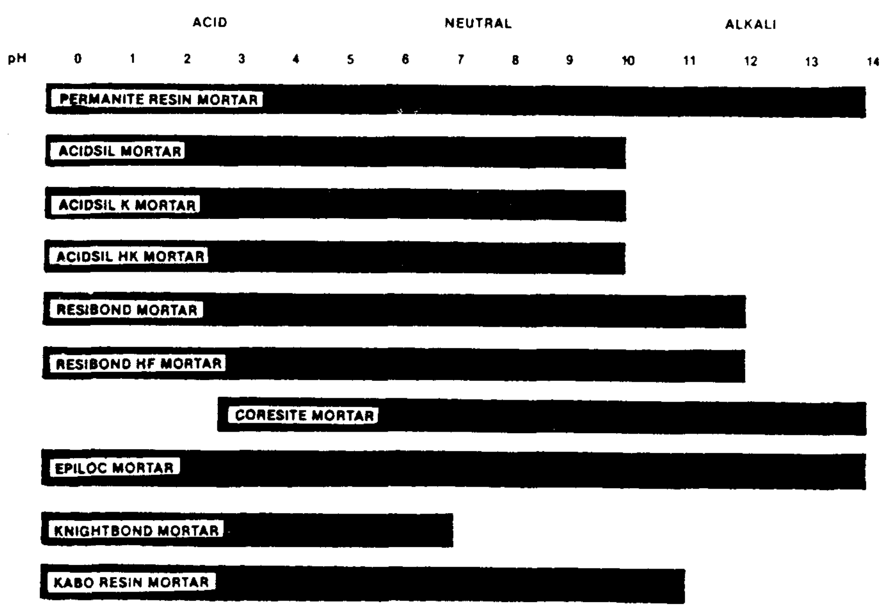
CORESITE Mortar:
An especially compounded hydraulic type mortar. Resistant to chemical attack by acids, alkalies, salt solutions, and organic solvents. Not recommended for handling strong acids or concentrated alkalies.

EPILOC Mortar:
A selected epoxy mortar with excellent adhesion to metal surfaces. Resistant to many nonoxidizing acids, alkalies, salts, and organic solvents.

KNIGHTBOND Cement:
A plasticized sulfur cement. Satisfactory for all acids and many solvents. Set immediately upon cooling. Available with either silica or carbon filler.

KABO:
An improved phenolic resin mortar. Resistant to non-oxidizing acids, weak alkalies, and most organic solvents. Supplied with either silica or carbon filler.

CHEMICAL RESISTANCE



(continued)

TABLE 3.12: VARIOUS MORTARS–KOCH ENGINEERING (continued)

Chemical Resistance of PERMANITE Mortar

(Meets ASTM specification 267 for chemical-resistant mortar)

Meaning of Symbols

E—Excellent resistance; suitable for general service—all concentrations and temperatures.

G—Good resistance; suitable for most services—most concentrations and temperatures to 212°F.

F—Fair resistance; suitable for some services—dilute concentrations and temperatures to 90°F.

NR—Not recommended for this service under most conditions.

Chemical	Resistance
Acetic Acid (to 85%)	E
Acetic Acid, Glacial	G
Acetic Anhydride	G
Acetaldehyde	E
Acetone	E
Aluminum Chloride	E
Aluminum Sulfate	E
Ammonium Bromide	E
Ammonium Carbonate	E
Ammonium Chloride	E
Ammonium Fluoride	E
Ammonium Hydroxide	E
Ammonium Nitrate	E
Ammonium Phosphate	E
Ammonium Sulfate	E
Amyl Acetate	E
Aniline	F
Aniline Hydrochloride	G
Aqua Regia	NR
Barium Chloride	E
Barium Hydroxide	E
Beer	E
Benzene	E
Benzene, Monochlor	E
Benzene, o-Dichlor	E
Benzene, 1, 2, 4—Trichlor	E
Benzoyl Chloride	E
Benzyl Alcohol	G
Borax	E
Boric Acid	E
Bromine	NR
Bromine Water	G
Butyl Alcohol	E
Calcium Bisulfite	E
Calcium Chloride	E
Calcium Hydroxide	E
Calcium Hypochlorite	F
Carbon Bisulfide	E
Carbon Tetrachloride	E
Castor Oil	E
Chlorine (dry)	G
Chlorine (wet)	G
Chlorine Water	G
Chloroform	E
Chromic Acid (dilute)	F
Chromic Acid (concentrated)	NR
Citric Acid	E
Coconut Oil	E
Copper Cyanide	E
Copper Sulfate	E
Corn Oil	E
Cottonseed Oil	E
Cresylic Acid	NR
Cupric Chloride	E
Dibutyl Phthalate	E
Ethyl Acetate	E
Ethyl Alcohol	E
Ethyl Ether	E
Ethylene Dichloride	E
Ferric Acid Salts (to 45% conc.)	E
Ferric Salts	E
Ferrous Salts	E
Formaldehyde	E
Formic Acid	E
Fuel Oil	E
Furfural	E
Furfuryl Alcohol	E
Gasoline	E
Glycerine	E
Hydrobromic Acid	E
Hydrochloric Acid	E
Hydrofluoric Acid (to 50% conc.)	E
Hydrofluoric Acid (50 to 70% conc.)	G
Hydrofluosilicic Acid	E
Hydrogen Peroxide (to 3% conc.)	F
Hydrogen Peroxide (over 3% conc.)	NR
Hydrogen Sulfide	E
Iodine	NR
Isoamyl Alcohol	E
Isopropyl Alcohol	E
Kerosene	E
Lactic Acid	E
Lead Acetate	E
Magnesium Chloride	E
Magnesium Sulfate	E
Maleic Acid	E
Manganese Sulfate	E
Methyl Alcohol	E
Methyl Ethyl Ketone	E
Mineral Oils	E
Nickel Chloride	E
Nickel Sulfate	E
Nitric Acid	NR
Oleic Acid	E
Oxalic Acid	E
Paraffin	E
Petroleum Ether	E
Phenol	E
Phosphoric Acid (to 70% conc.)	E
Phosphoric Acid (70 to 85% conc.)	G
Potassium Bisulfate	E
Potassium Carbonate	E
Potassium Chloride	E
Potassium Hydroxide	E
Potassium Iodide	E
Potassium Sulfate	E
Pyridine	F
Pyridine Sulfate	G
Sodium Bicarbonate	E
Sodium Bisulfate	E
Sodium Carbonate	E
Sodium Chloride	E
Sodium Chlorite, Acid Soln.	F
Sodium Hydroxide	E
Sodium Hypochlorite	NR
Sodium Iodide	E
Sodium Sulfate	E
Sodium Sulfide	E
Sodium Sulfite	E
Sodium Thiosulfate	E
Stearic Acid	E
Sulfur Monochloride	E
Sulfuric Acid (to 50% conc.)	E
Sulfuric Acid (50 to 60% conc.)	G
Sulfuric Acid (over 60% conc.)	F
Sulfurous Acid	E
Tannic Acid	E
Tartaric Acid	E
Tin Chloride	E
Trichlorethylene	E
Trisodium Phosphate	E
Toluene	E
Turpentine	E
Vegetable Oils	E
Vinegar	E
Water, Distilled	E
Water, Salt	E
Wine	E
Whiskey	E
Xylene	E
Zinc Chloride	E
Zinc Sulfate	E

(continued)

TABLE 3.12: VARIOUS MORTARS–KOCH ENGINEERING (continued)

Chemical Resistance of ACIDSIL and ACIDSIL HK Mortars

(Meets ASTM specification 267 for chemical-resistant mortar)

Acetaldehyde	R
Acetic Acid	R
Acetic Anhydride	R
Acetone	R
Alcohol, Amyl	R
Alcohol, Butyl	R
Alcohol, Ethyl	R
Alcohol, Iso-Propyl	R
Alcohol, Methyl	R
Allyl Chloride	R
Aluminum Bromide	R
Aluminum Chloride	R
Aluminum Fluoride	NR
Aluminum Sulfate	R
Ammonia	NR
Ammonium Bicarbonate	R
Ammonium Bromide	R
Ammonium Carbonate	R
Ammonium Chloride	R
Ammonium Fluoride	NR
Ammonium Nitrate	R
Ammonium Phosphate	R
Ammonium Sulphate	R
Amyl Acetate	R
Amyl Chloride	R
Aniline	**
Antimony Oxychloride	R
Antimony Trichloride	R
Aqua Regia	R
Arsenic Acid	R
Barium Carbonate	R
Barium Chloride	R
Barium Hydroxide	**
Benzaldehyde	R
Benzene	R
Benzoic Acid	R
Bismuth Carbonate	R
Boric Acid	R
Bromine	R
Butyl Acetate	R
Butyric Acid	R
Calcium Chlorate	R
Calcium Chloride	R
Calcium Hydroxide	NR
Calcium Hypochlorite	NR
Calcium Nitrate	R
Calcium Sulfate	R
Carbon Bisulphide	R
Carbon Tetrachloride	R
Carbonic Acid	R
Chloracetic Acid	R
Chloral	R
Chlorine	R
Chlorine Dioxide	R
Chlorobenzene	R
Chloroform	R
Chlorosulfonic Acid	R
Chromic Acid	R
Chromic Chloride	R
Citric Acid	R
Copper Acetate	R
Copper Chloride	R
Copper Cyanide	R
Copper Nitrate	R
Copper Sulfate	R
Creosote	R
Cresylic Acid	R
Dibutyl Phthalate	R
Ether	R
Ethyl Acetate	R
Ethyl Bromide	R
Ethyl Chloride	R
Ethylene Chlorhydrin	R
Ethylene Dichloride	R
Ethylene Glycol	R
Ethylene Oxide	R
Fatty Acids	R
Ferric Chloride	R
Ferric Nitrate	R
Ferric Sulfate	R
Ferrous Chloride	R
Ferrous Sulfate	R
Fluorine	NR
Fluosilicic Acid	**
Formaldehyde	R
Formic Acid	R
Furfural	R
Gasoline	R
Glycerine	R
Hydriodic Acid	R
Hydrobromic	R
Hydrochloric Acid	R
Hydrocyanic Acid	R
Hydrofluoric Acid	NR
Hydrogen Peroxide	R
Hydrogen Sulphide	R
Hypochlorous Acid	R
Iodine	R
Lactic Acid	R
Lead Acetate	R
Lead Chloride	R
Lead Nitrate	R
Linseed Oil	R
Magnesium Carbonate	R
Magnesium Chloride	R
Magnesium Hydroxide	**
Magnesium Nitrate	R
Magnesium Sulfate	R
Maleic Acid	R
Manganese Chloride	R
Manganese Sulfate	R
Mercuric Chloride	R
Mercuric Cyanide	R
Mercurous Nitrate	R
Mercury	R
Methyl Acetate	R
Methyl Chloride	R
Methyl Ethyl Ketone	R
Methylene Chloride	R
Mineral Oil	R
Mixed Acids	R
Naphtha	R
Naphthalene	R
Naphthenic Acid	R
Nickel Chloride	R
Nickel Nitrate	R
Nickel Sulfate	R
Nitric Acid	R
Nitrobenzene	R
Nitroglycerine	R
Nitrophenol	R
Nitrous Acid	R
Nitrosyl Chloride	R
Oleic Acid	R
Oxalic Acid	R
Paraffin	R
Perchloric Acid	R
Phenol	R
Phosgene	**
Phosphoric Acid (to 70%)	R
Phosphoric Acid (above 70%)	**
Phosphorous Bromide	R
Phosphorous Chloride	R
Phosphorous Oxichloride	R
Phthalic Anhydride	R
Picric Acid	R
Potassium Bicarbonate	R
Potassium Bromide	R
Potassium Carbonate	NR
Potassium Chlorate	R
Potassium Chloride	R
Potassium Cyanide	NR
Potassium Ferrocyanide	R
Potassium Dichromate	R
Potassium Fluoride	NR
Potassium Hydroxide	NR
Potassium Nitrate	R
Potassium Oxalate	R
Potassium Permanganate	R
Potassium Peroxide	NR
Potassium Sulfate	R
Potassium Sulphide	NR
Propylene Dichloride	R
Pyridine	**
Salicylic Acid	R
Silver Nitrate	R
Sodium Acetate	R
Sodium Bicarbonate	R
Sodium Bisulfate	R
Sodium Bisulphite	R
Sodium Bromide	R
Sodium Carbonate	NR
Sodium Chlorate	R
Sodium Chloride	R
Sodium Chromate	R
Sodium Cyanide	NR
Sodium Dichromate	R
Sodium Ferricyanide	R
Sodium Fluoride	NR
Sodium Hydroxide	NR
Sodium Hypochlorite	NR
Sodium Nitrate	R
Sodium Nitrite	R
Sodium Oxalate	R
Sodium Peroxide	NR
Sodium Sulfate	R
Sodium Sulphide	NR
Sodium Sulphite	**
Sodium Thiosulfate	R
Steam	**
Sulphur	R
Sulphur Chloride	R
Sulphur Dioxide	R
Sulphur Trioxide	R
Sulphuric Acid	R
Oleum	R
Sulphurous Acid	R
Tannic Acid	R
Tartaric Acid	R
Tin Chloride	R
Tin Sulfate	R
Toluene	R
Trichloracetic Acid	R
Trichloroethylene	R
Trisodium Phosphate	NR
Vegetable Oils	R
Water	R
Xylene	R
Zinc Chloride	R
Zinc Sulfate	R

R — Resistant. NR — Not Resistant **Consult M.A. Knight for specific recommendation.

(continued)

TABLE 3.12: VARIOUS MORTARS—KOCH ENGINEERING (continued)

Chemical Resistance of RESIBOND Mortar

(Meets ASTM specification 267 for chemical-resistant mortar)

E — Excellent resistance; all concentrations and temperatures to 250°F.
G — Good resistance; most concentrations and temperatures to 165°F.
F — Fair resistance; dilute concentrations and temperatures to 90°F.
NR — Not recommended for this service under most conditions.

Acetic Acid (to 50%)	E	Hydrofluoric Acid	*
Acetic Acid (Glacial)	G	Hydrogen Peroxide (30%)	E
Acetone	NR	Magnesium Chloride	E
Aluminum Chloride	E	Magnesium Hydroxide	E
Aluminum Sulfate	E	Methyl Alcohol	E
Ammonium Carbonate	E	Methyl Ethyl Ketone	NR
Ammonium Chloride	E	Naphtha (VM & P)	G
Ammonium Hydroxide (to 7%)	G	Nickel Chloride	E
Ammonium Hydroxide (conc.)	NR	Nickel Sulfate	E
Ammonium Nitrate	E	Nitric Acid (to 20%)	E
Ammonium Sulfate	E	Nitric Acid (to 40%)	G
Aniline	F	Nitric Acid (conc.)	NR
Barium Hydroxide	G	Oxalic Acid	E
Benzene	F	Perchloric Acid (20%)	E
Benzoic Acid	E	Phenol	NR
Boric Acid	E	Phosphoric Acid	E
Calcium Chloride	E	Potassium Chloride	E
Calcium Hydroxide	E	Potassium Cyanide	E
Calcium Hypochlorite	E	Potassium Hydroxide (dilute)	*
Carbon Disulfide	F	Potassium Hydroxide (conc.)	NR
Carbon Tetrachloride	G	Pyridine	F
Chloroform	G	Sodium Bicarbonate	E
Chlorine Dioxide Bleach	E	Sodium Carbonate	E
Chlorine Gas	G	Sodium Chloride	E
Chlorine Water	E	Sodium Hydroxide (dilute)	*
Chrome Plating Solution	G	Sodium Hydroxide (conc.)	NR
Citric Acid	E	Sodium Hypochlorite (under 12 pH)	G
Copper Sulfate	E	Sodium Hypochlorite (over 12 pH)	NR
Ethyl Acetate	F	Sulfur Dioxide	E
Ethyl Alcohol	E	Sulfuric Acid (to 70%)	E
Ethyl Ether	E	Sulfuric Acid (conc.)	NR
Ethylene Dichloride	NR	Sulfurous Acid	E
Ethylene Glycol	E	Toluene	F
Ferric Chloride	E	Trichlorethylene	NR
Ferric Nitrate	E	Triethanolamine	E
Ferric Sulfate	E	Trisodium Phosphate	G
Formaldehyde (37%)	E	Water	E
Furfural	NR	Xylene	F
Glycerine	E	Zinc Chloride	E
Hydrochloric Acid	E	Zinc Sulfate	E

*Consult M.A. Knight for specific recommendation.

(continued)

TABLE 3.12: VARIOUS MORTARS—KOCH ENGINEERING (continued)

Chemical Resistance of RESIBOND HF Mortar

(Meets ASTM specification 267 for chemical-resistant mortar)

E — Excellent resistance; all concentrations and temperatures to 250°F.
G — Good resistance; most concentrations and temperatures to 165°F.
F — Fair resistance; dilute concentrations and temperatures to 90°F.
NR — Not recommended for this service under most conditions.

Acetic Acid (to 50%)	E	Hydrofluoric Acid	E
Acetic Acid (Glacial)	G	Hydrogen Peroxide (30%)	E
Acetone	NR	Magnesium Chloride	E
Aluminum Chloride	E	Magnesium Hydroxide	E
Aluminum Sulfate	E	Methyl Alcohol	E
Ammonium Carbonate	E	Methyl Ethyl Ketone	NR
Ammonium Chloride	E	Naphtha (VM & P)	G
Ammonium Hydroxide (to 7%)	G	Nickel Chloride	E
Ammonium Hydroxide (conc.)	NR	Nickel Sulfate	E
Ammonium Nitrate	E	Nitric Acid (to 20%)	E
Ammonium Sulfate	E	Nitric Acid (to 40%)	G
Aniline	F	Nitric Acid (conc.)	NR
Barium Hydroxide	G	Oxalic Acid	E
Benzene	F	Perchloric Acid (20%)	E
Benzoic Acid	E	Phenol	NR
Boric Acid	E	Phosphoric Acid	E
Calcium Chloride	E	Potassium Chloride	E
Calcium Hydroxide	E	Potassium Cyanide	E
Calcium Hypochlorite	E	Potassium Hydroxide (dilute)	*
Carbon Disulfide	F	Potassium Hydroxide (conc.)	NR
Carbon Tetrachloride	G	Pyridine	F
Chloroform	G	Sodium Bicarbonate	E
Chlorine Dioxide Bleach	E	Sodium Carbonate	E
Chlorine Gas	G	Sodium Chloride	E
Chlorine Water	E	Sodium Hydroxide (dilute)	*
Chrome Plating Solution	G	Sodium Hydroxide (conc.)	NR
Citric Acid	E	Sodium Hypochlorite (under 12 pH)	G
Copper Sulfate	E	Sodium Hypochlorite (over 12 pH)	NR
Ethyl Acetate	F	Sulfur Dioxide	E
Ethyl Alcohol	E	Sulfuric Acid (to 70%)	E
Ethyl Ether	E	Sulfuric Acid (conc.)	NR
Ethylene Dichloride	NR	Sulfurous Acid	E
Ethylene Glycol	E	Toluene	F
Ferric Chloride	E	Trichlorethylene	NR
Ferric Nitrate	E	Triethanolamine	E
Ferric Sulfate	E	Trisodium Phosphate	G
Formaldehyde (37%)	E	Water	E
Furfural	NR	Xylene	F
Glycerine	E	Zinc Chloride	E
Hydrochloric Acid	E	Zinc Sulfate	E

*Consult M.A. Knight for specific recommendation.

(continued)

TABLE 3.12: VARIOUS MORTARS—KOCH ENGINEERING (continued)

Chemical Resistance of CORESITE Mortar

Acids:

Acetic	*
Arsenic	R
Boric	R
Carbonic	R
Chloride Dioxide Water	R
Chromic (Dilute)	R
Citric	R
Formic	R
Hydrochloric	NR
Hydrofluoric	NR
Hydrogen Peroxide	R
Hydrogen Sulfide Water	R
Hypochlorous (Cl_2 water)	R
Lactic	R
Nitric	NR
Oxalic	*
Phosphoric	NR
Sulfuric	NR
Sulfurous (SO_2 water)	*
Tannic	R
Tartaric	R

Alkalies:

Ammonium Hydroxide	*
Calcium Hydroxide	R
Calcium Hypochlorite	R
Magnesium Hydroxide	R
Potassium Hydroxide (15%)	R
Potassium Hydroxide (Conc.)	*R
Sodium Hydroxide (15%)	R
Sodium Hydroxide (Conc.)	*R
Sodium Hypochlorite	R
Sodium Peroxide	R

Salts:

Aluminum Sulfate	R
Ammonium Chloride	R
Ammonium Nitrate	R
Ammonium Sulfate	R
Borax	R
Calcium Bisulfite	R
Calcium Chloride	R
Calcium Hypochlorite	R
Copper Sulfate	R
Magnesium Sulfate	R
Nickel Acetate	R
Potassium Cyanide	R
Potasium Dichromate	R
Potassium Nitrate	R
Sodium Bicarbonate	R
Sodium Bisulfate	*
Sodium Bisulfite	*
Sodium Carbonate	R
Sodium Chloride	R
Sodium Sulfate	R
Sodium Sulfide	R
Sodium Sulfite	R
Trisodium Phosphate	R
Zinc Sulfate	R

Organic Materials:

Alcohol	R
Blood	R
Crude Petroleum	R
Ethylene Glycol	R
Formaldehyde	R
Gasoline	R
Glucose	R
Glue	R
Glycerine	R
Milk	R
Mineral Oils	R
Molasses	R
Phenol	R
Soaps	R
Starch	R
Sugar Syrup	R
Triethanolamine	*
Vegetable Oils	R

*Consult M.A. Knight for specific recommendation.

R - Resistant
NR - Not Resistant

(continued)

TABLE 3.12: VARIOUS MORTARS–KOCH ENGINEERING (continued)

Chemical Resistance of KNIGHTBOND No. 6 Mortar (Meets ASTM specification 267 for chemical-resistant mortar)

CHEMICAL	MAX. CONC. % by wt.	MAX.TEMP. °F.
Acetaldehyde	50	70
Acetic Acid	100	70
Acetic Anhydride	NR	Any
Acetone	50	70
Alcohol, Amyl	NR	Any
Alcohol, Ethyl	50	70
Alcohol, Isopropyl	50	70
Alcohol, Methyl	75	70
**Aluminum Fluoride	Any	200
Aluminum Sulphate	Any	200
Ammonia	NR	70
Ammonium Carbonate	Any	70
Ammonium Chloride	25	200
Ammonium Nitrate	25	200
Ammonium Sulphate	25	200
Aniline	NR	70
Arsenic Acid	Any	200
Barium Chloride	Any	200
Barium Hydroxide	NR	70
Barium Sulphide	NR	70
Benzene	NR	70
Bromine	NR	70
Butyl Acetate	NR	70
Calcium Chlorate	Any	200
Calcium Chloride	Any	200
Calcium Hydroxide	NR	70
Calcium Hypochlorite	NR	70
Calcium Sulphate	Any	200
Carbonic Acid	5	200
Carbon Bisulfide	NR	70
Carbon Tetrachloride	NR	70
Chloracetic Acid	Any	70
Chlorine	NR	70
Chloroform	NR	70
Chromic Acid	35	70
Chromic Acid	10	160
Copper Chloride	Any	200
Copper Cyanide	Any	200
Copper Nitrate	Any	200
Copper Sulphate	NR	
Cresylic Acid	NR	70
Ether	NR	70
Ethyl Acetate	NR	70
Ethylene Dichloride	NR	70
Ethylene Glycol	50	140
Fatty Acids	NR	70
Ferric Chloride	Any	200
Ferric Nitrate	Any	200
Ferric Sulphate	Any	200
Ferrous Chloride	Any	200
Ferrous Sulphate	Any	200
Fluorine	NR	70
**Fluosilicic Acid	40	200
Formaldehyde	35	150
Formic Acid	70	100
Furfural	50	70
Hydrobromic Acid	40	200
Hydrochloric Acid	30	200
Hydrocyanic Acid	10	70
**Hydrofluoric Acid	Any	200
Hydrogen Peroxide	30	70
Hypochlorous Acid	NR	70
Lactic Acid	25	200
Lead Acetate	Any	200
Magnesium Chloride	Any	200
Magnesium Nitrate	Any	200
Magnesium Sulphate	Any	200
Mercuric Chloride	Any	200
Mercuric Cyanide	Any	200
Mercurous Nitrate	Any	200
MEK	15	160
Mixed Acids	55	70
Naphtha	NR	70
Nickel Chloride	Any	200
Nickel Nitrate	Any	200
Nickel Sulphate	Any	200
Nitric Acid	50	70
Nitric Acid	25	160
Nitrous Acid	NR	70
Oxalic Acid	Any	200
Perchloric Acid	25	70
Phenol	50	70
Phosphoric Acid	85	200
Phthalic Anhydride	Any	200
Potassium Bicarbonate	10	70
Potassium Bromide	Any	200
Potassium Chlorate	Any	200
Potassium Dichromate	Any	200
Potassium Ferrocyanide	25	70
Potassium Permanganate	Any	200
Potassium Sulphate	Any	200
Silver Nitrate	15	200
Sodium Acetate	Any	200
Sodium Bisulphate	Any	200
Sodium Bisulphite	Any	200
Sodium Carbonate	25	70
Sodium Chloride	Any	200
Sodium Cyanide	25	70
Sodium Ferricyanide	25	70
**Sodium Fluoride	Any	200
Sodium Hydroxide	NR	70
Sodium Hypochlorite	NR	70
Sodium Nitrate	Any	200
Sodium Nitrite	25	70
Sodium Sulphite	10	70
Sodium Sulphide	NR	70
Stannic Chloride	Any	130
Stannous Chloride	Any	200
Sulphur Dioxide	Any	200
Sulphur Trioxide	NR	70
Sulphuric Acid	85	100
Sulphuric Acid	60	200
Sulphurous Acid	10	70
Trichloroethylene	NR	70
Trisodium Phosphate	10	70
Zinc Chloride	Any	200
Zinc Sulphate	Any	200

Use **KNIGHTBOND #7 Sulphur-Carbon Cement because hydrofluoric acid and fluorides attack fillers containing silica. NR — Not Recommended for this service under most conditions.

(continued)

TABLE 3.12: VARIOUS MORTARS—KOCH ENGINEERING (continued)

Chemical Resistance of KABO Resin Mortar with Carbon Filler

CHEMICAL	RESISTANCE
Acetaldehyde	E
Acetic Acid	E
Acetic Anhydride	G
Acetone	E
Alcohol, Amyl	C
Alcohol, Ethyl	E
Alcohol, Iso Propyl	E
Alcohol, Methyl	E
Aluminum Chloride	E
Aluminum Hydroxide	E
Aluminum Sulphate	E
Ammonia	NR
Ammonium Bicarbonate	F
Ammonium Carbonate	F
Ammonium Chloride	E
Ammonium Fluoride	E
Ammonium Nitrate	E
Ammonium Sulphate	E
Amyl Acetate	F
Aniline	F
Antimony Trichloride	E
Arsenic Acid	E
Barium Carbonate	E
Barium Chloride	E
Barium Hydroxide	F
Barium Sulphide	E
Benzaldehyde	E
Benzene	E
Benzenesulfonic Acid	E
Benzoic Acid	E
Bismuth Carbonate	E
Boric Acid	E
Bromine	NR
Butyl Acetate	F
Butyric Acid	G
Calcium Chlorate	E
Calcium Chloride	E
Calcium Hydroxide	NR
Calcium Hypochlorite	F
Calcium Sulphate	E
Camphor	E
Carbonic Acid	E
Carbon Bisulphide	E
Carbon Tetrachloride	E
Chloracetic Acid	G
Chlorine	G
Chlorobenzene	E
Chloroform	E
Chromic Acid	F
Citric Acid	E
Copper Chloride	E
Copper Cyanide	E
Copper Nitrate	E
Copper Sulphate	E
Creosote	E
Ether	E
Ethyl Acetate	E
Ethyl Chloride	E
Ethylene Chlorhydrin	G
Ethylene Glycol	E
Fatty Acids	E
Ferric Chloride	E
Ferric Nitrate	E
Ferric Sulphate	E
Ferrous Chloride	E
Ferrous Sulphate	E
Fluorine	NR
Fluosilicic Acid	E
Formaldehyde	E
Formic Acid	E
Furfural	F
Hydrochloric Acid	E
Hydrofluoric Acid	E
Hydrogen Peroxide	F
Hydrogen Sulphide	E
Hypochlorous Acid	G
Iodine	NR
Lactic Acid	E
Lead Acetate	E
Linseed Oil	E
Magnesium Carbonate	E
Magnesium Chloride	E
Magnesium Hydroxide	F
Magnesium Nitrate	E
Magnesium Sulphate	E
Maleic Acid	G
Mercuric Chloride	E
Mercuric Cyanide	E
Mercurous Nitrate	E
Methyl Chloride	E
MEK	E
Mixed Acids	NR
Naphtha	E
Naphthalene	E
Nickel Chloride	E
Nickel Nitrate	E
Nickel Sulphate	E
Nitric Acid (Dilute)	F
Nitric Acid (Conc.)	NR
Nitrobenzene	E
Nitrous Acid	NR
Nitrosyl Chloride	NR
Oleic Acid	E
Oxalic Acid	E
Perchloric Acid	F
Phenol	G
Phosphoric Acid	E
Phthalic Anhydride	E
Picric Acid — Alcoholic	E
Potassium Bromide	E
Potassium Carbonate (Dilute)	G
Potassium Carbonate (Conc.)	F
Potassium Chlorate	E
Potassium Dichromate	E
Potassium Ferrocyanide	E
Potassium Hydroxide	NR
Potassium Permanganate	C
Silver Nitrate	E
Sodium Acetate	E
Sodium Bicarbonate	E
Sodium Bisulphate	E
Sodium Bisulphite	E
Sodium Carbonate (Dilute)	G
Sodium Carbonate (Conc.)	F
Sodium Chloride	E
Sodium Cyanide	E
Sodium Ferricyanide	E
Sodium Fluoride	E
Sodium Hydroxide	NR
Sodium Hypochlorite	NR
Sodium Nitrate	E
Sodium Nitrite	E
Sodium Sulphate	E
Sodium Sulphite	E
Sodium Sulphide	NR
Sulphur	E
Sulphur Chloride	NR
Sulphur Dioxide	E
Sulphur Trioxide	NR
Sulphuric Acid (to 60%)	E
Sulphuric Acid (60-85%)	G
Sulphuric Acid (Conc.)	F
Oleum	NR
Sulphurous Acid	E
Tannic Acid	E
Tartaric Acid	E
Tin Chloride	E
Toluene	E
Trichloroethylene	G
Trisodium Phosphate (Dilute)	G
Trisodium Phosphate (Conc.)	F
Zinc Chloride	E
Zinc Sulphate	

E — Excellent resistance; suitable for general service—all concentrations and temperatures.

F — Fair resistance; suitable for some services—dilute concentrations and temperatures to 90° F.

G — Good resistance; suitable for most services—most concentrations and temperatures to 212° F.

NR — Not recommended for this service under most conditions.

TABLE 3.13: VARIOUS MORTARS— PENNWALT

CHEMICAL RESISTANCE OF PENNWALT MORTARS

The following products have the same chemical resistance as other products on the chart:

FURALAC® Red Panel Mortar same as FURALAC Green Panel Mortar
Gunite Mix SDX® same as CORLOK B Mortar
FURALAC™ Concrete same as FURALAC Standard Mortar
TUFCHEM™ Silicate Concrete same as CORLOK B Mortar

KEY
- Resistant (diagonal hatching)
- Not Recommended (stippled)
- Limited Resistance (horizontal lines)
- Conditional, Test Required (cross-hatching)
- Not Tested (blank)

TYPE MORTAR	SILICA & SILICATE					RESIN** FURAN			RESIN** MODIFIED PHENOLIC		RESIN** PHENOLIC		SULFUR	
PENNWALT NAME	K14*	PENCHLOR*	CORLOK* B	HB*	H.E.S.*	FURALAC* Standard	FURALAC* Green Panel	FN*	ASPLIT* CV	ASPLIT* CN	Silica Filled Regular	Carbon Filled Regular	Sulfur	Carbon Sulfur
MAXIMUM SERVICE TEMP.	2500°F***	1650°F*†	1650°F†	1650°F	1650°F*	350°F	350°F	428°F	300°F	360°F	375°F	375°F	200°F	200°F
Acetaldehyde	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Acetic Acid, Under 10%	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Acetic Acid, Glacial	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Acetic Anhydride	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Limited Resistance	Limited Resistance	Limited Resistance	Limited Resistance	Not Recommended	Not Recommended
Acetone	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	&	&
Acetone Oil	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Acetyl Bromide	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Acetyl Chloride	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Acetylene Dichloride	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Acetyl Salicylic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Allyl Chloride	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Aluminum Bromide △	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Resistant	Resistant
Aluminum Chloride, Sulfate and Alums	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Aluminum Fluoride	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Not Recommended	Resistant	Not Recommended	Resistant	Not Recommended	Resistant
Ammonium Bromide △	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Ammonium Carbonate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Ammonium Chloride, Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Ammonium Fluoride	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Not Recommended	Resistant	Not Recommended	Resistant	Not Recommended	Resistant
Ammonium Hydroxide	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Ammonium Nitrate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Ammonium Persulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Ammonium Phosphates	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Ammonium Sulfide	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended

(continued)

TABLE 3.13: VARIOUS MORTARS– PENNWALT (continued)

KEY
- R = Resistant
- NR = Not Recommended
- LR = Limited Resistance
- C = Conditional, Test Required
- Not Tested

TYPE MORTAR	SILICA & SILICATE					RESIN** FURAN			RESIN** MODIFIED PHENOLIC		RESIN** PHENOLIC		SULFUR	
PENNWALT NAME	K14*	PENCHLOR*	CORLOK* B	HB*	H.E.S.*	FURALAC* Standard	FURALAC* Green Panel	FN*	ASPLIT* CV	ASPLIT* CN	Silica Filled Regular	Carbon Filled Regular	Sulfur	Carbon Sulfur
MAXIMUM SERVICE TEMP.	2500°F***	1650°F*†	1650°F†	1650°F	1650°F*	350°F	350°F	428°F	300°F	360°F	375°F	375°F	200°F	200°F
Ammonium Tungstate	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Amyl Acetate, Alcohol	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Aniline	R	R	R	R	R	NR	NR	C	LR	LR	NR	NR	NR	NR
Aniline Hydrochloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Antimony Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Antimony Oxychloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Antimony Potassium Tartrate	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Aqua Regia	R	R	R	R	R	NR	NR	NR	NR	NR	NR	NR	&	&
Arsenic Compounds (Neutral or Acid)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Barium Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Barium Hydroxide	NR	NR	NR	NR	NR	R	R	R	R	R	C	C	NR	NR
Barium Sulfide	R	R	R	R	R	R	R	R	R	R	NR	NR	NR	NR
Benzaldehyde (Neutral or Acid)	R	R	R	R	R	R	R	R	LR	R	NR	NR	R	R
Benzene (Benzol)	R	R	R	R	R	R	R	R	R	R	R	R	&	&
Benzene Sulfonic Acid (or Chloride)	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Benzoic Acid	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Benzyl Acetate	R	R	R	R	R	R	R	R	R	R	NR	R	R	R
Benzyl Alcohol	R	R	R	R	R	R	R	R	R	R	NR	NR	R	R
Benzyl Chloride	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Boric Acid 5%	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Bromine	R	R	R	R	R	NR	NR	NR	NR	NR	NR	NR	R	R
Bromine Water (Saturated)	R	R	R	R	R	R	R	R	R	R	♦	♦	R	R
Butanol	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Butyl Acetate	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Butyl Carbitol	R	R	R	R	R	R	R	R	R	R	NR	NR	NR	NR
Butyric Acid	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Calcium Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Calcium Hydroxide	NR	NR	NR	LR	LR	R	R	R	R	R	NR	NR	NR	NR
Calcium Hypochlorite	R	R	R	R	R	NR	NR	NR	NR	NR	NR	NR	NR	NR
Calcium Nitrate	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Calcium Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Carbon Bisulfide	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Carbon Dioxide	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Carbon Oxychloride (Phosgene)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Carbon Tetrachloride	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Chloroacetic Acid 10%	R	R	R	R	R	R	R	R	R	R	R	R	&	&
Chloral (Trichloroacetaldehyde)	R	R	R	R	R	R	R	R	NR	NR	NR	NR	NR	NR

(continued)

TABLE 3.13: VARIOUS MORTARS– PENNWALT (continued)

KEY
- Resistant
- Not Recommended
- Limited Resistance
- Conditional. Test Required
- Not Tested

TYPE MORTAR	SILICA & SILICATE					RESIN**							SULFUR	
						FURAN			MODIFIED PHENOLIC		PHENOLIC			
PENNWALT NAME	K14*	PENCHLOR*	CORLOK* B	HB*	H.E.S.*	FURALAC* Standard	FURALAC* Green Panel	FN*	ASPLIT* CV	ASPLIT* CN	Silica Filled Regular	Carbon Filled Regular	Sulfur	Carbon Sulfur
MAXIMUM SERVICE TEMP.	2500°F***	1650°F*†	1650°F†	1650°F	1650°F*	350°F	350°F	428°F	300°F	360°F	375°F	375°F	200°F	200°F
Chlorobenzene	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Chlorine Dioxide (Water Solution)	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended □	Not Recommended □
Chlorine (Liquid)	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Chlorine (Gas)	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant $	Resistant $	Resistant $	Resistant $	Resistant $	Resistant $	Resistant $	Not Recommended	Not Recommended
Chlorine Water (Saturated)	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant ♦	Resistant ♦	Resistant ♦	Resistant ♦	Resistant ♦	Resistant ♦	Resistant ♦	Not Recommended &	Not Recommended &
Chloroform	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended &	Not Recommended &
Chloronaphthalene	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Chlorosulfonic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Not Recommended	Not Recommended	Resistant	Resistant
Chromic Acid 10%	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended &	Not Recommended &
Chromic Chloride	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Chromium Potassium Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Citric Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Copper Acetate (Chlorides and Sulfates)	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Copper Nitrate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Cresol	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Limited Resistance	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Ethyl Acetate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Ethyl Alcohol	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Limited Resistance	Resistant	Resistant
Ethyl Amine 40%	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Resistant	Resistant
Ethyl Bromide	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Ethyl Chloride/Ethylene Dichloride	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Ethylene Disulfonic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Ethylene Oxide	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Ethyl Ether	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Ethyl Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Ethyl Sulfuric Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Fatty Acids	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Ferric Chloride, Nitrate, Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Ferri-and Ferrocyanides	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Fluoboric Acid	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Not Recommended	Resistant	Not Recommended	Resistant	Not Recommended	Resistant
Fluorine Gas, Anhydrous	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Tested	Not Tested
Fluorine Gas, in presence of water	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Fluosilicic Acid	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Not Recommended	Resistant	Not Recommended	Resistant	Not Recommended	Resistant
Formaldehyde	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Formic Acids and Compounds	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended &	Not Recommended &
Gallic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Glycol Monoacetate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Hydrazine Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended

(continued)

TABLE 3.13: VARIOUS MORTARS– PENNWALT (continued)

KEY
- Resistant
- Not Recommended
- Limited Resistance
- Conditional, Test Required
- Not Tested

TYPE MORTAR	SILICA & SILICATE					RESIN** FURAN			RESIN** MODIFIED PHENOLIC		RESIN** PHENOLIC		SULFUR	
PENNWALT NAME	K14*	PENCHLOR*	CORLOK* B	HB*	H.E.S.*	FURALAC* Standard	FURALAC* Green Panel	FN*	ASPLIT* CV	ASPLIT* CN	Silica Filled Regular	Carbon Filled Regular	Sulfur	Carbon Sulfur
MAXIMUM SERVICE TEMP.	2500°F***	1650°F*†	1650°F†	1650°F	1650°F*	350°F	350°F	428°F	300°F	360°F	375°F	375°F	200°F	200°F
Hydriodic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended ‡	Not Recommended ‡
Hydrobromic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance C	Resistant	Not Recommended	Not Recommended	Resistant	Resistant
Hydrobromic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Hydrochloric Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Hydrofluoric Acid 50%	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Not Recommended	Resistant	Not Recommended	Resistant
Hydrogen Peroxide 1% ■	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended &	Not Recommended &
Hydrogen Peroxide 10% ■	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Hydrogen Sulfide	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Hypochlorous Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Iodine	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended &	Not Recommended &
Iodoform	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Resistant	Resistant
Lactic Acids and Compounds	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Lead Chloride	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Lead Nitrate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Magnesium Chloride, Nitrate, Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Maleic Acid and Compounds	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Manganese Chloride, Oxides, Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Mercuric Chloride	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Methanol (Methyl Alcohol)	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Resistant	Limited Resistance	Limited Resistance	Resistant	Resistant
Methyl Acetate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Methylbutyleneglycol Acetate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Methyl Cyclohexanol	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Methylene Chloride	Resistant	Resistant	Resistant	Resistant	Resistant	Conditional, Test Required	Conditional, Test Required	Conditional, Test Required	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Methyl Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant To 80°F (27°C)	Resistant To 80°F (27°C)
Methyl Sulfonic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Molybdenum Acids and Oxides	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Naphthalene (Sulfonated)	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Naphthalenesulfonic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Naphtholsulfonic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Nickel Chloride and Sufate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Nitric Acid 1%	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Resistant	Resistant ♦	Resistant ♦	Resistant @	Resistant @
Nitric Acid 5%1	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Resistant ♦	Resistant ♦	Resistant @	Resistant @
Nitric Acid 50%	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Tested	Not Tested
Nitro Benzene	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Nitrogen Oxides	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant
Nitroglycerine	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Nitrophenol	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Limited Resistance	Not Recommended	Not Recommended	Resistant	Resistant

(continued)

TABLE 3.13: VARIOUS MORTARS– PENNWALT (continued)

KEY
- Resistant
- Not Recommended
- Limited Resistance
- Conditional. Test Required
- Not Tested

(In the table below: R = Resistant, NR = Not Recommended, L = Limited Resistance.)

TYPE MORTAR	SILICA & SILICATE					RESIN** FURAN			RESIN** MODIFIED PHENOLIC		RESIN** PHENOLIC		SULFUR	
PENNWALT NAME	K14*	PENCHLOR*	CORLOK* B	HB*	H.E.S.*	FURALAC* Standard	FURALAC* Green Panel	FN*	ASPLIT* CV	ASPLIT* CN	Silica Filled Regular	Carbon Filled Regular	Sulfur	Carbon Sulfur
MAXIMUM SERVICE TEMP.	2500°F***	1650°F*†	1650°F†	1650°F	1650°F*	350°F	350°F	428°F	300°F	360°F	375°F	375°F	200°F	200°F
Nitrotoluene	R	R	R	R	R	NR	NR	NR	NR	R	NR	NR	NR	NR
Oils-Vegetable, Mineral, Animal	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Oleic Acids and Compounds (Esters)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Oxalic Acids and Compounds	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Paradimethylamino Benzophenone	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Paraffin Wax	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR
Perchloric Acid 25%	R	R	R	R	R	NR	NR	NR	NR	NR	NR	NR	NR	NR
Phenol (20% Solution)	R	R	R	R	R	R	R	R	R	R	L	L	NR &	NR &
Phenol Sulfonic Acid	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Phosphoric Acid	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Phosphorous Bromide	R	R	R	R	R	NR	NR	NR	NR	NR	NR	NR	R	R
Phosphorous Chloride and Oxychloride	R	R	R	R	R	R	R	R	R	R	L	L	R	R
Phthalic Acid	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Picric Acid, 50% in water	R	R	R	R	R	R	R	R	R	R	R	R	R &	R &
Potassium Bichromate	R	R	R	R	R	R	R	R	R	R	R	R	R ‡	R ‡
Potassium Bromide 40% △	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Potassium Carbonate 50%	NR	NR	NR	NR	NR	R	R	R	R □	R	R ♦	R ♦	NR □	NR □
Potassium Chlorate 6.5%	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Potassium Chloride, Nitrate, Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Potassium Cyanide	NR	NR	NR	NR	NR	R	R	R	R	R	R	R	R	R
Potassium Ferri and Ferro Cyanide	R	R	R	R	R	R	R	R	R	R	R ♦	R ♦	R	R
Potassium Hydroxide 50%	NR	NR	NR	NR	NR	R	R	R	R	R	NR	NR	NR	NR
Potassium Oxalate	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Potassium Permagnate 10%	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Potassium Persulfate and Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Potassium Peroxide 5%	NR	NR	NR	NR	NR	NR	NR	R	NR	NR	NR	NR	NR	NR
Pyridine	R	R	R	R	R	L	L	R	R	R	L	L	NR	NR
Salicylic Acid	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Selenium Compounds (Acid or Neutral)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Silicon Tetrachloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Acetate	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Bicarbonate	NR	NR	NR	NR	NR	R	R	R	R	R	R	R	R	R
Sodium Bichromate 50%	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Bisulfate, Bisulfite	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Carbonate 18%	NR	NR	NR	NR	NR	R	R	R	R	R	L	L	NR	NR
Sodium Chloride, Nitrate	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sodium Chromate	R	R	R	R	R	R	R	R	R	R	R	R	R	R

(continued)

TABLE 3.13: VARIOUS MORTARS– PENNWALT (continued)

KEY

- Resistant
- Not Recommended
- Limited Resistance
- Conditional, Test Required
- Not Tested

TYPE MORTAR	SILICA & SILICATE					RESIN** FURAN			RESIN** MODIFIED PHENOLIC		RESIN** PHENOLIC		SULFUR	
PENNWALT NAME	K14*	PENCHLOR*	CORLOK* B	HB*	H.E.S.*	FURALAC* Standard	FURALAC* Green Panel	FN*	ASPLIT* CV	ASPLIT* CN	Silica Filled Regular	Carbon Filled Regular	Sulfur	Carbon Sulfur
MAXIMUM SERVICE TEMP.	2500°F***	1650°F*†	1650°F†	1650°F	1650°F*	350°F	350°F	428°F	300°F	360°F	375°F	375°F	200°F	200°F
Sodium Chlorosulfonate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sodium Hydroxide 25%	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Resistant	Not Recommended	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Sodium Hypochlorite	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended #	Not Recommended #	Not Recommended #	Not Recommended #	Not Recommended #	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Sodium Oxalate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sodium Peroxide 5%	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Limited Resistance	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Sodium Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sodium Sulfide	Not Recommended	Not Recommended	Not Recommended	Not Recommended +	Not Recommended +	Resistant	Resistant	Resistant	Not Recommended	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Sodium Tartrate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sodium Thiosulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Stearic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant ♦	Resistant ♦
Sulfuric Acid 20%	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sulfuric Acid 50%	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sulfuric Acid 70% at 100° C (212°F)	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sulfuric Acid 98% at 100° C (212°F)	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended
Sulfur Chloride	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sulfur Molten	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Sulfurous Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sulfur Dioxide	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sulfuryl Chloride (Sulfur Oxychloride)	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant
Tartaric Acid and Compounds	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Tetrachloroethane	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Tin Chlorides	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Tin Sulfates	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Titanium Chlorides, Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Toluene (Toluol)	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant ♦	Resistant ♦	Not Recommended	Not Recommended
Toluenesulfonic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Trichloroacetic Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended	Not Recommended ‡	Not Recommended ‡
Trichloroethylene	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended	Not Recommended
Trisodium Phosphate	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Not Recommended	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Limited Resistance	Not Recommended	Not Recommended
Urea	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Tested	Resistant	Resistant	Resistant	Resistant	Resistant
Uric Acid	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Xylene (Xylol)	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Recommended ‡	Not Recommended ‡
Zinc Chloride, Nitrate, Sulfate	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant

(continued)

TABLE 3.13: VARIOUS MORTARS– PENNWALT (continued)

- * Same chemical resistance with reduced physical strength above 750°F. (399°C)
- ** See Table 3.3 for epoxy mortars
- *** Pennwalt K14® Mortar has similar chemical resistances to CORLOK® B Mortar and HB® Mortar with some exceptions. Check with your Pennwalt representative for specific chemical resistances.
- † PENCHLOR® and CORLOK B Mortars should be tested for resistance in 1% range. All Mortars resistant in 10% and 25% range.
- @ Resistant up to 40% at 160°F (71°C). Test higher concentrations and temperatures.
- $ Up to 2% concentration.
- ¢ Limited resistance at 48% concentration.
- ◆ Resistant to 100°F (38°C). Test for higher temperatures.
- △ Strong oxidizers must not be added because elemental bromine would be freed that would make the rating of all resin mortars Not Resistant.
- ■ Polyester Mortar probably resistant to boiling point in all three concentrations. Epoxy toppings may be considered up to 10% but verify by test.
- + H.E.S.® and HB® Mortars will resist some concentrations. See Addenda.
- # Attack is slow at 1% or less.
- ‡ Resistant to 20% at 100°F. (38°C)
- & Resistant intermittent to 100°F. (38°C)
- □ Resistant intermittent to 160°F. (71°C)
- ≈ Up to 302°F. (150°C)

ADDENDA

H.E.S. and HB Mortars differ from other siliceous, silicate, or silica mortars in resisting exposures between pH 0.0 and pH 8.0 with the exception of acid fluorides and HF acid. In addition, they can be used in glycol acetate, potassium sulfate or persulfate, sodium sulfide and trisodium phosphate, all of which will damage other siliceous mortars.

"Use this reference information as a guide only. The information given in the resistance chart is believed to be reliable, but no guarantee is made nor can we assume liability in connection with their use. Please contact the Corrosion Engineering Department for specific recommendations."

TABLE 3.14: VARIOUS MORTARS—STERNSON

IN O BOND C is a high-purity quartz colloidal silicate mortar for use with all sizes of acid brick and is especially suited for stack or chimney linings as in sewage treatment operations and other, and as a mortar for process linings.

IN O BOND P is a potassium silicate based inorganic brick mortar formulated for use with all sizes of acid brick and is especially suited for chimney, stack or vessel linings where an easy to use mortar will facilitate quick installation.

IN O BOND S is a sodium silicate based mortar designed for use with all sizes of acid brick.

FURABOND and FURASET are furan based cements that resist a wide range of strong corrosive solutions and severe mechanical abuse. They are formulated to be used with all sizes of acid brick for protection of concrete and steel surfaces such as trenches, floors, piers, pump bases, supporting foundations, sumps, batching and pickling tanks, process vessels. They are especially suited for alternating alkali/acid conditions.

STERNCHEM Polyester Mortar is formulated to provide superior service for acid brick constructions in the chemical process, pulp and paper, plating, textile, fertilizer, and metal refining industries. They are especially suited for chlorine dioxide towers, bleaching vats, trenches, sumps, pits, bleaching solutions of sodium hypochlorite, oxidizing solutions of nitric and chromic acids to 20% concentrations, hydrobromic acid, potassium and sodium dichromates, bromine water, salt solutions to pH 11.

STERNCHEM Phenolic Mortar is formulated to provide superior service for acid brick constructions requiring the chemical resistance of carbon/resinous phenolic systems.

STERNCHEM CHEMICAL RESISTANCE GUIDE

R - Resistant
NR - Not Resistant
U - Untested
27°C - Maximum Temperature Tested
30% - Resistant To All Concentrations Up To 30%
- In O Bond Series Not Recommended For Frequent Or Continual Concentrations Below 10%
- Talychem Epoxy Mortar - Refer To Talychem Chemical Resistance Guide (Table 3.4)

EXPOSURE	IN O BOND SERIES	STERNCHEM SERIES		
	C - 1100°C P - 900°C S - 400°C	FURABOND FURASET 175°C	POLYESTER 120°C	PHENOLIC 175°C
Acetaldehyde	R	R	NR	NR
Acetic Acid, under 10%	R	R	30°C	R
Acetic Acid, Glacial	R	R	NR	R
Acetic Anhydride	R	NR	R	R
Acetone	R	30°C	NR	NR
Acetone Oil	NR	R	NR	NR
Acetyl-Bromide	R	NR	U	NR
Acetyl-Chloride	R	R	NR	NR
Acetylene-Dichloride	R	R	NR	NR
Acetyl Salicylic Acid	R	R	U	R
Aluminum Bromide	R	NR	U	NR
Aluminum Chloride, Sulphate & Alums	R	R	R	R

(continued)

TABLE 3.14: VARIOUS MORTARS—STERNSON (continued)

EXPOSURE	IN O BOND SERIES		STERNCHEM SERIES	
	C - 1100°C P - 900°C S - 400°C	FURABOND FURASET 175°C	POLYESTER 120°C	PHENOLIC 175°C
Aluminum Fluoride	NR	R	U	NR
Alum	R	R	R	R
Ammonium Bromide	R	NR	U	NR
Ammonium Carbonate	R	R	R	R
Ammonium Chloride, Sulphate	R	R	R	R
Ammonium Fluoride	NR	R	U	R
Ammonium Hydroxide	NR	R	35°C	NR
Ammonium Nitrate (Neutral Solutions)	R	R	R	R
Ammonium Persulphate	R	R	U	R
Ammonium Phosphates	R	R	U	U
Ammonium Sulphide	R	R	R	R
Ammonium Tungstate	R	R	U	U
Amyl Acetate, Alcohol	R	R		
Aniline	R	NR	NR	NR
Aniline Hydrochloride	R	R	NR	NR
Antimony Chloride	R	R	R	R
Antimony Oxychloride	R	R	U	R
Antimony Potassium Tartrate	R	R	U	R
Aqua Regia	R	NR	NR	NR
Arsenic Compounds, Neutral or Acid	R	R	U	R
Barium Chloride	R	R	R	R
Barium Hydroxide	NR	R	R	R
Barium Nitrate	R	R	R	R
Barium Sulphide	NR	R	30°C	NR
Benzaldehyde - Neutral or Acid	R	R	NR	NR
Benzene (Bensol)	R	R	NR	NR
Benzene Sulphonic Acid (or Chloride)	R	R	NR	U
Benzoic Acid	R	R	R	R
Benzyl Acetate	R	NR	U	U
Benzyl Alcohol	R	NR	U	NR
Benzyl Chloride	R	R	NR	R
Boric Acid	R	R	R	R
Bromine	R	NR	R	NR
Bromine Water, Saturated	R	NR	R	30°C
Butanol	R	R	U	NR
Butyl Acetate	R	R	NR	NR
Butyl Carbitol	R	R	U	NR
Butyric Acid	R	R	30°C	R
Cadmium Chloride	R	R	R	R
Cadmium Nitrate	R	R	70°C	R
Calcium Chloride	R	R	R	R
Calcium Hydroxide	NR	R	30°C	NR
Calcium Hypochlorite	R	R	R	U
Calcium Nitrate (Neutral Solutions)	R	R	R	R
Calcium Sulphate	R	R	R	R
Carbon Bisulphide	R	R	R	R

(continued)

TABLE 3.14: VARIOUS MORTARS–STERNSON (continued)

EXPOSURE	IN O BOND SERIES	STERNCHEM SERIES		
	C - 1100°C P - 900°C S - 400°C	FURABOND FURASET 175°C	POLYESTER 120°C	PHENOLIC 175°C
Carbon Dioxide	R	R	U	U
Carbon Oxychloride (Phosgene)	R	R	U	U
Carbon Tetrachloride	R	R	30°C	
Caustic Soda & Potash	NR	R	U	NR
Chloroacetic Acid	R	R	N	R
Chloral (Trichloroacetic aldehyde)	R	R	NR	NR
Chlorbenzene	R	R	N	30°C
Chlorine Dioxide, Water Solution	R	NR	80°C	NR
Chlorine, Liquid	R	NR	35°C	NR
Chlorine, Gas	R	NR	35°C	NR
Chlorine Water, Saturated	R	R	20°C	30°C
Chloroform	R	R	N	30°C
Chloronaphthalene	R	R	U	NR
Chlorosulphonic Acid	R	NR	U	NR
Chromic Acid 10%	R	NR	60°C	U
Chromic Acid	R	NR	NR	NR
Chromic Chloride	R	R	U	U
Chromium Potassium Sulphate	R	R	U	R
Citric Acid	R	R	R	R
Copper Acetate, Chlorides & Sulphate	R	R	R	R
Copper Nitrate (Neutral Solutions)	R	R	R	R
Cresol	R	R	U	NR
Ether	R	R	U	R
Ethyl Acetate	R	R	N	30°C
Ethyl Alcohol	R	R	80°C	30°C
Ethylamine	R	NR	U	NR
Ethyl Bromide	R	NR	NR	NR
Ethyl Chloride & Ethylene Dichloride	R	R	NR	30°C
Ethylene Disulphonic Acid	R	R	U	U
Ethylene Oxide	R	R	U	R
Ethyl Ether	R	R	25°C	30°C
Ethyl Sulphate	R	R	30°C	30°C
Ethyl Sulphuric Acid	R	R	R	R
Fatty Acids	R	R	U	30°C
Ferric Chloride, Nitrate, Sulphate	R	R	U	R
Ferri- & Ferrocyanides	R	R	U	R
Fluoboric Acid	NR	R	NR	NR
Fluorine Gas	NR	NR	NR	NR
Fluosilicic Acid	NR	R	30°C	R
Formaldehyde	R	R	R	R
Formic Acid & Compounds, not all	R	R	R	R
Furfural	U	25°C	NR	NR

(continued)

TABLE 3.14: VARIOUS MORTARS—STERNSON (continued)

EXPOSURE	IN O BOND SERIES C - 1100°C P - 900°C S - 400°C	FURABOND FURASET 175°C	STERNCHEM SERIES POLYESTER 120°C	PHENOLIC 175°C
Gallic Acid	R	R	U	R
Gasoline	R	R	25°C	R
Glycerine	R	R	70°C	R
Glycol Monoacetate	NR	R	U	NR
Hydrazine Sulphate	R	R	U	NR
Hydriodic Acid	R	NR	NR	NR
Hydrobromic Acid	R	NR	30°C	NR
Hexane	R	R	25°C	R
Hydrochloric Acid	R	R	R	R
Hydrocyanic Acid	R	R	R	R
Hydrofluoric Acid	NR	R	NR	R
Hydrogen Peroxide 1%	R	NR	30°C	NR
Hydrogen Peroxide 10%	R	NR	30°C	NR
Hydrogen Peroxide 25%	R	NR	30°C	NR
Hydrofluosilicic Acid	NR	R	NR	R
Hydrogen Peroxide 30%	NR	NR	25°C	NR
Hydrogen Sulphide	R	R	R	R
Hypochlorous Acid	R	NR	U	NR
Iodine	R	NR	NR	NR
Iron Chlorides	R	R	R	R
Iron Nitrates	R	NR	70°C	R
Iron Sulphates	R	R	R	R
Isopropyl Ether	R	R	25°C	U
Iodoform	R	R	NR	NR
Kerosene	R	R	25°C	R
Lactic Acid & Compounds	R	R	R	R
Lead Chloride	R	R	R	R
Lead Nitrate (Neutral Solutions)	R	R	R	R
Magnesium Chloride, Nitrate, Sulphate	R	R	R	R
Maleic Acid & Compounds	R	R	U	R
Manganese Chloride, Oxides & Sulphates	R	R	R	R
Mercuric Chloride	R	R	R	R
Methanol (Methyl Alcohol)	R	R	30°C	30°C
Methyl Acetate	R	R	R	R
Methylbutyleneglycol Acetate	R	R	U	NR
Methyl Cyclohexanol	R	R	U	U
Methylene Chloride	R	R	U	R
Methyl Sulphate	R	R	N	R
Methyl Sulphonic Acid	R	R	U	U
Mineral Oil	R	R	R	R
Molybdenum Acids & Oxides	R	R	U	U
Naphthalene (Sulphonated)	R	R	U	U
Naphthalenesulphonic Acid	R	R	U	U
Naphtholsulphonic Acid	R	R	U	U
Nickel Chloride & Sulphate	R	R	R	R

(continued)

TABLE 3.14: VARIOUS MORTARS–STERNSON (continued)

EXPOSURE	IN O BOND SERIES	STERNCHEM SERIES		
	C - 1100°C P - 900°C S - 400°C	FURABOND FURASET 175°C	POLYESTER 120°C	PHENOLIC 175°C
Nitric Acid 5%	NR	NR	70°C	U
Nitric Acid 20%	R	NR	25°C	NR
Nitric Acid 40%	R	NR	NR	NR
Nitrobenzene	R	R	NR	30°C
Nitrogen Oxides	R	NR	NR	NR
Nitroglycerine	R	NR	NR	NR
Nitrophenol	R	NR	U	NR
Nitrotoluene	R	NR	U	NR
Oils - Vegetable, Mineral, Animal	R	R	R	R
Oleic Acids & Compounds (Esters)	R	R	R	R
Oxalic Acids & Compounds	R	R	R	R
Paradimethylaminobenzophenone	R	R	U	U
Paraffin Wax	R	R	R	R
Perchloric Acid	R	NR	NR	NR
Phenol (20% Solution)	R	R	NR	NR
Phenol Sulfoacids	R	R	U	U
Phosphoric Acid	R	R	R	R
Phosphorous Bromide	R	NR	NR	NR
Phosphorous Chloride & Oxychloride	R	R	U	U
Phthalic Acid	R	R	R	R
Picric Acid	R	NR	NR	NR
Potassium Bichromate	R	R	R	R
Potassium Bromide	R	NR	U	NR
Potassium Carbonate	NR	R	U	30°C
Potassium Chlorate	R	R	R	R
Potassium Chloride, Nitrate, Sulphate	R	R	R	R
Potassium Cyanide	NR	R	U	30°C
Potassium Ferri & Ferro Cyanide	R	R	30°C	30°C
Potassium Hydroxide	NR	R	U	NR
Potassium Oxalate	R	R	U	U
Potassium Permanganate	R	80°C	80°C	R
Potassium Persulphate & Sulphate	R	R	60°C	R
Potassium Peroxide	NR	NR	R	NR
Pyridine	R	80°C	NR	NR
Salicylic Acid	R	R	R	R
Selenium Compounds - Acid or Neutral	R	R	U	U
Silicon Tetrachloride	R	R	U	U
Silver Nitrate	R	U	70°C	R
Sodium Acetate	R	R	R	R
Sodium Bicarbonate	NR	R	R	R
Sodium Bichromate	R	R	R	R
Sodium Bisulphate, Bisulphite	R	R	R	R
Sodium Carbonate	NR	R	U	30°C
Sodium Chloride, Nitrate	R	R	R	R
Sodium Chromate	R	R	R	R
Sodium Chlorosulphonate	R	R	U	U
Sodium Cyanide	NR	R	U	25°C

(continued)

TABLE 3.14: VARIOUS MORTARS—STERNSON (continued)

EXPOSURE	IN O BOND SERIES	STERNCHEM SERIES		
	C - 1100°C P - 900°C S - 400°C	FURABOND FURASET 175°C	POLYESTER 120°C	PHENOLIC 175°C
Sodium Hydroxide	NR	R	NR	NR
Sodium Hypochlorite	NR	NR	R	NR
Sodium Oxalate	R	R	U	U
Sodium Peroxide	NR	NR	U	NR
Sodium Sulphate	R	R	R	R
Sodium Sulphide	NR	R	30°C	NR
Sodium Sulphite	R	R	R	R
Sodium Tartrate	R	R	R	R
Sodium Thiosulphate, Thiosulphite	R	R	R	R
Soya Oil	R	R	U	R
Stearic Acid	R	R	R	R
Sulphuric Acid 5%	NR	R	R	R
Sulphuric Acid 50%	R	R	R	R
Sulphuric Acid 80%	R	NR	NR	25°C
Sulphuric Acid 93%	R	NR	NR	25°C
Sulphur Chloride	R	NR	U	U
Sulphur Molten	R	R	R	R
Sulphurous Acid	R	R	R	R
Sulphur Oxides	R	R	R	R
Sulphur Dioxide (Wet or Dry)	R	R	R	R
Sulphuric Acid, Fuming	R	NR	NR	NR
Sulphur Trioxide (Wet)	R	NR	NR	25°C
Sulfuryl Chloride (Sulphur Oxychloride)	R	NR	NR	NR
Tannic Acid	R	R	R	R
Tartaric Acid & Compounds	R	R	R	R
Tetrachloroethane	R	R	U	U
Tin Chlorides	R	R	R	R
Tin Sulphates	R	R	R	R
Titanium Chlorides, Sulphate	R	R	R	R
Toluene (Toluol)	R	R	80°C	NR
Toluenesulphonic Acid	R	R	U	U
Trichloroacetic Acid	R	R	NR	U
Trichloroethylene	R	R	U	U
Trisodium Phosphate	NR	R	30°C	NR
Tung Oil	R	R	R	R
Urea	R	R	30°C	R
Uric Acid	R	R	U	U
Xylene (Xylol)	R	R	30°C	U
Zinc Chloride, Nitrate, Sulphate	R	R	R	R
Zinc Nitrate	R	125°C	R	R

Ferrous Alloys

TABLE 4.1: AUSTENITIC ALLOY–ALLEGHENY LUDLUM

AL-6X is an austenitic chromium, nickel, molybdenum-containing alloy developed for service in chloride and other pitting or crevice corrosion environments such as sea water. The 20% chromium and 6% molybdenum contained in the alloy produces outstanding resistance to pitting and crevice attack in chloride-containing solutions. The high nickel (24%) and molybdenum provide good resistance to stress corrosion cracking. The alloy content of the material produces excellent general corrosion resistance in a number of media.

The alloy is readily welded by the inert gas processes. AL-6X possesses good ductility and high impact strength.

AL-6X is available as welded tubing, sheet and strip.

Typical Analysis

Carbon	.025
Manganese	1.50
Phosphorus	.025
Sulfur	.010
Silicon	.50
Chromium	20.25
Nickel	24.50
Molybdenum	6.25

Typical Weight Changes and Sample Conditions Resulting From 10 Percent Ferric Chloride Exposure Tests—72 Hours 70° F (21° C)

Alloy	Crevices On Samples	No Crevices On Samples
304	0.45 Gram Weight Loss Severe Crevice Attack	0.45 Gram Weight Loss Severe Pitting
316	0.40 Gram Weight Loss Severe Crevice Attack	0.03 Gram Weight Loss Some Pitting, especially on sample edges
AL-6X	No Weight change to 0.000 Grams No Attack	No Weight change to 0.000 Grams No Attack

Samples initially weighed about 10 g.

The following table illustrates the corrosion resistance of AL-6X in various solutions in comparison to AISI stainless steel grades. Tests were performed in boiling acid (concentrations in weight percent) for five 48-hour periods. The listed values are corrosion rates in IPM (inches per month):

Solution	Type 446	Type 304	Type 316	AL-6X
45% Formic Acid	.81	.143	.043	.0005
20% Acetic Acid	.0000	.025	.0002	.0001
10% Oxalic Acid	–	.047	.008	.0009
10% Sodium Bisulfate	–	.230	.014	.0011
10% Sulfuric Acid	12.0	1.36	.071	.010
65% Nitric Acid (ASTM A-262 Practice C)	.0007	.0007	.0009	.0026

Data, including the boiling acid tests above, show that AL-6X is generally more corrosion resistant than Type 316. In environments such as sulfuric acid, concentrations and temperatures have a marked influence on corrosion rate, and specific conditions should be carefully determined. The following data determined for 2-hour coupon tests are illustrative:

Temperatures / Concentrations of H_2SO_4 Weight %		Corrosion Rate, IPM 150°F	175°F	200°F
5	AL-6X	.004	.004	.005
	316	.003	.007	.012
10	AL-6X	.006	.004	.007
	316	.007	.013	.018
20	AL-6X	.009	.005	.013
	316	.016	.070	.148
40	AL-6X	.007	.010	.019
	316	.536	1.546	3.023
95	AL-6X	.031	.043	.056
	316	.005	.007	.028

TABLE 4.2: AUSTENITIC STAINLESS STEELS—JESSOP STEEL

Jessop Steel's corrosion resistant engineering alloys, JS700 and JS777, are high-alloy, fully austenitic, super stainless steels. These alloys are proven problem-solvers in many applications where corrosive conditions are too severe for the standard grades of stainless steel. They have also provided cost-effective alternatives to more expensive nickel-base and titanium-base alloys. JS700 and JS777 are much more highly alloyed than the standard stainless steels. These grades contain nominally 25% nickel, 20% chromium and 4.5% molybdenum. The combination of the three major alloying elements gives JS700 and JS777 a high degree of resistance to stress corrosion cracking. Neither alloy is completely immune to this type of corrosion failure, as can be shown by such severe tests as stressed exposure to boiling magnesium chloride solutions.

Corrosion Data (48 Hr. Laboratory Tests—All concentrations are by weight %).

Environment	Temperature °F	Corrosion Rate IPY			
		JS700	JS777	317L Plus	317L
20% Phosphoric Acid	Boiling Point	<0.002	<0.002		<0.002
54% Phosphoric Acid	250	0.0024			
60% Phosphoric Acid	Boiling Point	0.059	0.012		
85% Phosphoric Acid	Boiling Point	0.122	0.067	0.294	0.196
Sensitized Material	Boiling Point	0.124	0.080		
25% Phosphoric 2% HF	167	0.008			
60% Acetic Acid	Boiling Point	<0.002			<0.002
1:1 Acetic Acid/Anhydride	Boiling Point	0.001			
5% Nitric Acid + 3% HF	155	<0.002			
25% Nitric Acid	Boiling Point	<0.002			<0.002
65% Nitric Acid (Huey)	Boiling Point	<0.020			
5% Hydrochloric Acid	Boiling Point	1.491	0.962	1.454	1.691
10% Hydrochloric Acid	Room Temp.	0.018			
10% Hydrochloric Acid	140	0.150			
10% Hydrochloric Acid	Boiling Point	4.51	2.37		
10% HCl in EDA (1)	Boiling Point	<0.001			
30% Sulfuric Acid	Boiling Point	0.150	0.036		
Sensitized Material	Boiling Point	0.160	0.031		
50% Sulfuric Acid	Boiling Point	0.247	0.102	(4)	(4)
50% Sulfuric Acid + ½% HCl	Boiling Point	0.880	0.298	0.962	0.540
70% Sulfuric Acid	Boiling Point	57.6	27.6		
Butyl Acetate Mixture (2)	Boiling Point	0.264			
Streicher Test (3)	Boiling Point	0.096			

(1) 1 Volume conc. HCl in 9 volumes Ethylene Diamine.
(2) 75% Ester—11% Butanol—10% Acetic Acid—4% Water—0.3% H_2SO_4.
(3) 50% Sulfuric Acid + 0.6% Fe^{+3} as ferric sulfate inhibitor.
(4) Dissolved completely in 48 hours.

Chemical Composition (nominal analysis)

	JS700	JS777
Nickel	24.0-26.0%	24.0-26.0%
Chromium	19.0-23.0	19.0-23.0
Molybdenum	4.3- 5.0	4.3- 5.0
Columbium	8 x carbon min-0.40 max	8 x carbon min-0.40 max
Carbon, max	.04	.04
Silicon, max	1.00	1.00
Manganese, max	2.00	2.00
Phosphorus, max	.04	.04
Sulfur, max	.03	.03
Copper	.50 max	1.90-2.50

The copper added to JS777 markedly improves resistance to general corrosion in strongly acid environments. As shown in the tabulated corrosion test results, copper improves performance not only in oxidizing acids (e.g. sulfuric) but in media generally considered reducing (hydrochloric) as well. However, in more nearly neutral media, where failure is by localized corrosion, copper seems to be actually detrimental to performance.

Field exposure tests (e.g. the TAPPI program in pulp bleach washers) and electrochemical current decay tests show pits to propagate more rapidly in JS777. JS700 is therefore the recommended alloy where pitting or crevice corrosion is the primary concern.

TABLE 4.3: FERRITIC STAINLESS STEELS—ALLEGHENY LUDLUM

AL 29-4C is a ferritic stainless steel developed specifically for power plant surface condenser tubing. AL 29-4C has excellent resistance to brackish, polluted or high chloride waters, e.g., seawater. Consistent with its composition, AL 29-4C performs similar to austenitic stainless steels in a variety of other environments. Of particular importance is the excellent resistance of AL 29-4C to condenser environments where ammonia, other noncondensables and sulfides attack copper base alloys.

AL 29-4C Alloy Analysis

Element	Weight Percent
Chromium	29.00
Molybdenum	4.00
Nickel	0.30
Manganese	0.50
Phosphorus	0.03
Sulfur	0.01
Silicon	0.35
Cobalt	0.03
Carbon	0.02
Nitrogen	0.02
Titanium	0.50

Corrosion Results of AL 29-4C

Environment	Temperature °F	Corrosion Rate MPY
20% NaOH	250	0.6
40% NaOH	250	0.1
60% NaOH	250	0.3
60% NaOH	315	1.6
70% NaOH	250	0.2
70% NaOH	350	1.9
10% HNO_3	300	0.1
20% HNO_3	300	2.2
30% HNO_3	300	4.1

Corrosion Tests in Brines*

Environment	Alloy	Observed Corrosion
Boiling Saturated NaCl + 10% Na_2CO_3 pH 11 (230°F)	AL 29-4C	No Attack
	Ti-50A	No Attack
	Alloy 400	Crevice Attack
25% NaCl 0.38% Na_2SO_4 0.15% CaCl 0.03% $MgCl_2$ pH 6.7-7.2 (226°F)	AL 29-4C	No Attack
	Ti-50A	Crevice Attack
	Alloy 400	Crevice Attack
	T-316	Crevice Attack

*72-hour tests per ASTM G-48.

Stress Corrosion Cracking
The ferritic structure and the low level of copper and nickel make AL 29-4C highly resistant to chloride stress corrosion cracking. Laboratory tests of annealed strip have shown no evidence of stress corrosion cracking in U-bent samples after 500 hours in boiling 26% sodium chloride.

Intergranular Corrosion Resistance
AL 29-4C contains a deliberate titanium addition to stabilize the carbon and nitrogen. AL 29-4C is resistant to intergranular corrosion as determined by the copper-copper sulfate-sulfuric acid tests detailed in ASTM Specification A 763, Practices Y and Z.

AL 29-4-2 alloy is a high-purity ferritic stainless steel. The resistance of the AL 29-4-2 alloy to corrosion is generally far better than that of standard ferritic or austenitic stainless steels. In fact, the corrosion resistance properties of the AL 29-4-2 alloy are often comparable to those of titanium, high-nickel or nickel-base alloys. The Al 29-4-2 alloy provides exceptional resistance to stress corrosion cracking, pitting and/or crevice corrosion in addition to outstanding resistance to general corrosion in a broad spectrum of specific environments. For instance, the AL 29-4-2 alloy is highly resistant to caustic, nitric acic', dilute hydrochloric and sulfuric acids, amines and organic acids in addition to handling other environments in cc mmon with other stainless steels.

AL 29-4-2 Alloy Analysis

Element	Analysis (Weight Percent) Typical	UNS S44800
Chromium	29.0	28.0-30.0
Molybdenum	4.00	3.5- 4.2
Nickel	2.10	2.0- 2.5
Copper	0.06	0.15 max.
Manganese	0.05	0.30 max.
Phosphorus	0.02	0.025 max.
Sulfur	0.01	0.020 max.
Silicon	0.10	0.20 max.
Carbon	0.003	0.010 max.
Nitrogen	0.015	0.020 max.
C + N	0.018	0.025 max.

Pitting and Crevice Corrosion Tests

	Pitting Corrosion $KMnO_4$-NaCl(1)		Crevice Corrosion $FeCl_3$(2)	
Alloy	21C (70F)	90C (195F)	21C (70F)	50C (120F)
AL 29-4-2	R(3)	R	R	R
Titanium	R	R	R	R
Alloy C276	R	R	R	R
Alloy 625	R	R	R	F
E-BRITE Alloy	R	F	F	—
Alloy 825	R	F	F	—
Alloy 600	R	F	F	—
Alloy 20Cb3	F	—	F	—
Type 316	F	—	F	—
Type 304	F	—	F	—
Type 430	F	—	F	—

(1) 2% $KMnO_4$—2% NaCl, no crevices, pH = 7.5
(2) 10% $FeCl_3$—$6H_2O$, with crevices, pH = 1.6
(3) R = No Pitting or Crevice Corrosion
F = Fail by Pitting or Crevice Corrosion

Source: M. A. Streicher, "Stainless Steels: Past, Present and Future", *Stainless Steel '77*, Ed. by R. Q. Barr, Climax Molybdenum Co., pp. 1-34 (1978).

(continued)

TABLE 4.3: FERRITIC STAINLESS STEELS—ALLEGHENY LUDLUM (continued)

AL 29-4-2 Alloy (cont'd)

Critical Pitting Potentials in Saturated Sodium Chloride Brine at 38C (100F)

	Millivolts Vs. Saturated Calomel Electrode		
Alloy	pH 10	pH 6	pH 2
AL 29-4-2	+990	+990	+860
E-BRITE	+400	+420	+430
Type 316	+120	+ 10	- 20
Type 304	+ 40	- 50	- 50

Stress Corrosion Cracking in Various NaCl Tests

Alloy	NaCl Wick Test(1) 100 C (212F)	Aerated 26% NaCl 102 C (215F)	Autoclave Tests in 26% NaCl 155C (310F)	Autoclave Tests in 26% NaCl 200C (390F)
AL 29-4-2	NC(2) (3360h.)	NC (2528h.)	NC (487h.)	NC (655h.)
Alloy 20Cb3	NC (864 h.)	NC (2544h.)		NC (655h.)
Type 304	C(2) (72 h.)	C (72h.)	C (250h.)	C (48-72h.)

(1) 1500 ppm Cl as NaCl (Procedure described in ASTM A692).
(2) NC = No Cracks; C = Cracks.
Numbers in parantheses indicate the test duration.

Crevice Corrosion Test(1) in Synthetic Brine(2)

	Weight Loss, mg/cm²		
Alloy	22C (72F)	60C (140F)	107C (224F)
AL 29-4-2	.00 N(3)	.00 N	.00 N
Titanium	.00 N	.00 N	.00 C
Monel 400	.00 N	.08 C	.29 C
E-BRITE	.00 N	.12 C	.06 C
316L	.00 N	.01 C	.02 C

(1) pH 7.0, 72-hour test, crevices with rubber band and teflon spacers.
(2) Brine composition (wt. %): 25% NaCl; .38% Na_2SO_4; .15% $CaCl_2$; .03% $MgCl_2$.
(3) Visual appearance rating: N = No Corrosion; C = Crevice Corrosion.

Crevice Corrosion Tests in Boiling Brine with Sodium Carbonate(1)

Alloy	Weight Loss, mg/cm²	Visual Appearance
Al 29-4-2	0.00	No Corrosion
E-BRITE	0.00	No Corrosion
Titanium	0.00	No Corrosion
Monel 400	1.05	Crevice Corrosion

(1) Saturated NaCl brine containing 10% Na_2CO_3, pH 11, 72-hour test, boiling at atmospheric pressure, crevices with rubber bands and teflon spacers.

Corrosion of AL 29-4-2 and Other Alloys in Hot Geothermal Fluid(1)

Alloy	Uniform Corrosion (MPY)	Pitting(2) (MPY)	Crevice Corrosion(2) (MPY)
AISI 1018	1.8	43.5	33.6
AISI Type 410	0.22	39.5	41.0
AISI Type 340	0.02	30.3	P(3)
AISI Type 316	0.11	8.7	P
Ni-Fe-Cr Alloy G	0.0035	P	N(3)
AL 29-4-2	0.0035	N	N
Ni-Cr-Mo Alloy 625	N	N	N
Titanium (Gr. 2)	0.0063	N	N

(1) 133C (271F) Cl^- 776 ppm
pH 7.23 HCO_3^- 64 ppm
Nonaerated $SO_4^=$ 60 ppm
109 Day Exposure H_2S 0.1 ppm
(2) Penetration rate calculated from maximum pit or crevice depth.
(3) P—Present but not measured
N—Not observed

Source: D. W. DeBerry, P. F. Ellis and C. C. Thomas, "Materials Selection Guidelines for Geothermal Power Systems", First Ed., Radian Corp., for U. S. Dept. of Energy, Contract No. EG-77-C-04-3904, September, 1978.

Data from one year field corrosion tests at nine pulp and paper mill bleach plants are shown below. In this program, nine different pulp mills exposed corrosion test spools for one year. The AL 29-4-2 alloy was among those demonstrating the highest degree of corrosion resistance.

TAPPI (D Stage)(1) Corrosion Results(2)

	Mill								
Alloy	1	2	3	4	5	6	7	8	9
AL 29-4-2	I	I	I	I	I	I	I	I	I
Titanium	I	I	I	I	I	I	I	I	I
Alloy C-276	I	I	I	I	I	I	II	II	I
Alloy G	I	I	I	I	I	I	I	I	II
Alloy 825	I	I	III	III	II	II	III	III	III
Type 317	I	I	III	III	II	III	III	III	III
Type 316	I	I	III	III	II	III	III	III	III

(1) One Year Exposure
Chlorides: Up to 4100 ppm
pH : As low as 1.2
Temperature: Up to 74C (165F)
(2) Corrosion Classification:
I 0-5 mil pit depth and<1 mpy general corrosion rate
II 6-20 mil pit depth or>1 to 10 mpy general corrosion rate
III > 20 mil pit depth or>10 mpy general corrosion rate

Source: A. H. Tuthill, J. D. Rushton, J. J. Geisler, R. H. Heasley and L. L. Edwards, "Corrosion Resistance of Alloys to Bleach Plant Environments", TAPPI, Nov. 1979, Vol. 62, No. 11, pp. 49-51.

Performance of AL 29-4-2 and Other Alloys in Boiling 65% Nitric Acid(1)

Alloy	Corrosion Rate, mm/a (MPY)
AL 29-4-2	.05-.08 (2-3)
E-BRITE	.10-.13 (4-5)
Type 304	.20-.61 (8-24)
Type 347	.25-.41 (10-16)
Type 316	.28-.89 (11-35)
Type 430	.51-.91 (20-36)

(1) ASTM A 262, Practice C. Five 48-hour periods.

Corrosion of AL 29-4-2 and Other Alloys in 50% Nitric Acid Containing Chlorides and Fluorides at 79C (175F)

Impurities(1)		Corrosion Rate(2), mm/a (MPY)			
PPM Cl^-	PPM F^-	AL 29-4-2	E-BRITE	Type 304	Titanium
—	—	.003 (0.1)	.005 (0.2)	.015 (0.6)	.091 (3.6)
300	—	.005 (0.2)	.010 (0.4)	.025 (1.0)	.117 (4.6)
—	20	.018 (0.7)	.025 (1.0)	.079 (3.1)	.305 (12.0)
300	20	.028 (1.1)	.041 (1.6)	.102 (4.0)	.914 (36.0)
1000	100	.063 (2.5)	.089 (3.5)	.241 (9.5)	1.115 (43.9)

(1) Chlorides added as HCl, fluoride as HF.
(2) Corrosion rate is the average of two 48-hour periods.

(continued)

TABLE 4.3: FERRITIC STAINLESS STEELS—ALLEGHENY LUDLUM (continued)

AL 29-4-2 Alloy (cont'd)

Corrosion of AL 29-4-2 and Other Alloys in Boiling Organic Acids

Alloy	Corrosion Rate(1), mm/a (MPY)				
	45% Formic	88% Formic	10% Oxalic	20% Acetic	99% Acetic
AL 29-4-2	0.02 (0.7)	<0.01 < (0.1)	0.02 (0.7)	<0.01 (0.1)	<0.01 (0.1)
E-BRITE	0.1 (3)	<0.01 < (0.1)*	0.1 (3)	0.03 (1)	0.01 (0.4)*
Type 316	0.3 (11)	0.2 (9)*	1.0 (40)	0.01 (0.1)	0.05 (2)*
Type 304	1.2 (48)	2.4 (96)*	1.3 (50)	0.03 (1)	0.5 (18)*
Alloy 625	0.1 (5)	0.2 (9)*	0.2 (6)	0.03 (1.1)	0.01 (0.4)*

(1) Average of five 48-hour periods

*Source: A. I. Asphahani, P. E. Manning, W. L. Silence, F. G. Hodge, "Highly Alloyed Stainless Materials for Seawater Applications", Presented at NACE, CORROSION/80, Chicago, Illinois, March 3-7, 1980.

Corrosion of AL 29-4-2 and Other Alloys in Boiling Dilute Sulfuric Acid Solutions

Alloy	Test Condition	Corrosion Rate(1)-mm/a (MPY)		
		1% H_2SO_4	5% H_2SO_4	10% H_2SO_4
AL 29-4-2	NA(2)	.005 (0.2)	.03 (1.3)	.02 (0.8)
	A(2)	.07 (2.6)	.27 (10.7)	.46 (18.2)
Alloy 625	NA	.07 (2.8)	.32 (12.7)	.52 (20.6)
	A	.06 (2.2)	.23 (8.9)	.64 (25.3)
E-BRITE	NA	.02 (0.7)	.36 (14)	900 (35,000)(3)
	A	13.7 (541)	77 (3020)(3)	2600 (100,000+)(3)
Type 316	NA	.55 (21.7)	2.49 (98.2)	8.61 (339)
	A	.66 (25.8)	2.71 (107)	8.73 (344)

(1) Average of five 48-hour periods
(2) NA Samples not activated at start of test
A = Samples activated at start of each test period
(3) One period or less due to high corrosion rate

Intergranular Corrosion Tests on AL 29-4-2 Alloy

Test	Corrosion Rate, mm/a (MPY)		
	Plain Sample	Sample Containing Weld	Grain Dropping
Ferric Sulfate—50% H_2SO_4 ASTM A763, Practice X	.14 (5.6)	.13 (5.0)	None
Boiling 65% HNO_3 ASTM A262, Practice C	.06 (2.2)	.07 (2.6)	None
Copper Sulfate—50% H_2SO_4 ASTM A763, Practice Y	.12 (4.8)	.12 (4.8)	None

Crevice Corrosion of AL 29-4-2 Alloy and Other Metals In Simulated Flue Gas Desulfurization Environment(1)

Alloy	Test Duration	Weight Loss (mg/cm²)		
		24C (75F)	50C (122F)	70C (158F)
AL 29-4-2	24h	0.0 N(2)	0.0 N	0.2 N
AL 29-4-2	72h	—	0.0 N	—
Alloy 625	24h	0.0 N	0.1 N	4.2 C
Alloy 625	72h	—	0.1 C	—
Type 316	24h	0.2 N	8.1 C	20.6 C
Type 316	72h	—	19.5 C	—
Alloy G	72h	—	4.0 C	—
Alloy C-276	72h	—	0.1 N	—

(1) 7 Vol. % H_2SO_4; 3 Vol. % HCl; 1 Wt. % $CuCl_2$; 1 Wt. % $FeCl_3$
(2) Visual examination: N No Corrosion
C Crevice Corrosion

Corrosion of AL 29-4-2 Alloy in Laboratory Caustic Solutions

Composition, Wt. %			Temperature C (F)	Duration, Days	Corrosion Rate mm/a (MPY)
NaOH	NaCl	Other			
50	—	—	Boiling	5	0.00 (0.1)*
60	—	—	Boiling	4	0.02 (0.8)
70	—	—	Boiling	4	0.10 (3.8)
45	5	—	Boiling	4	0.00 (0.0)
45	5	—	149 (300)	4	0.04 (1.5)
45	5	—	177 (350)	4	0.19 (7.4)
26	9	—	Boiling	4	0.00 (0.0)
16	14	—	Boiling	4	0.00 (0.0)
45	23	1 Na_2CO_3 .15 $NaClO_3$ .01 Na_2SO_4	177 (350)	4	0.14 (5.6)

*Plain and welded U-bent samples showed no sign of stress corrosion cracking in 264 hour tests.

(continued)

TABLE 4.3: FERRITIC STAINLESS STEELS—ALLEGHENY LUDLUM (continued)

The E-BRITE alloy is a high-purity specialty ferritic stainless steel which combines excellent resistance to corrosion with good fabrication characteristics. It offers outstanding resistance to stress corrosion cracking along with superior pitting and crevice corrosion resistance, compared to conventional ferritic and austenitic stainless steels. General corrosion resistance is usually better than that provided by these standard materials and, in some cases, is even better than that of some nickel-base alloys. The E-BRITE alloy also is designed to provide excellent resistance to intergranular corrosion. Added to all this corrosion resistance are unique ductility characteristics, particularly when compared to other ferritic stainless steels.

E-BRITE Alloy Analysis

Element	Analysis (Weight Percent) Typical	ASTM XM-27
Chromium	26.0	25.0 -27.5
Molybdenum	1.0	0.75 - 1.50
Nickel	.15	.50 max
Copper	.02	.20 max
Manganese	.05	.40 max
Phosphorus	.01	.02 max
Sulfur	.01	.02 max
Silicon	.20	.40 max
Carbon	.002	.010 max
Nitrogen	.010	.015 max
Columbium	.10	0.05 - 0.20

Chloride Stress Corrosion Resistance Annealed Sheet

Boiling Solution	Time to Failure (Hours)[1] T304	T316	E-BRITE
42% $MgCl_2$	F (8)	F (24)	NF (200)
33% LiCl	F (22)	F (22)	NF (500)
26% NaCl	F (473)	F (221)	NF (1000)

(1) F — Stress Corrosion Failure
NF — No Failure

Critical Pitting Potentials in Saturated NaCl Brine at 38C (100F)

Alloy	Millivolts Versus Standard Calomel Electrode pH 10	pH 6	pH 2
E-BRITE	+400	+420	+430
Type 316	+120	+ 10	- 20
Type 304	+ 40	- 50	- 50

$KMnO_4$-NaCl Pitting Tests[1]

Alloy	Pitting Corrosion[2] RT	50C (120F)	75C (165F)	90C (195F)
Type 430	F	—	—	—
Type 304	F	—	—	—
Type 316L	F	—	—	—
Alloy 20Cb3	F	—	—	—
Alloy 600	R	F	—	—
Alloy 825	R	R	F	—
E-BRITE	R	R	F	—
Alloy "C"	—	R	R	R
Alloy 625	R	R	R	R
Titanium	R	R	R	R
A-L 29-4-2	R	R	R	R

(1) 2% $KMnO_4$-2% NaCl, no crevices (pH 7.5)
(2) F — Failure by pitting
R — Resistant, no corrosion

Source: M. A. Streicher, "Stainless Steels: Past, Present and Future", *Stainless Steel '77*, Ed. by R. Q. Barr, Climax Molybdenum Co., p. 1 (1978).

Crevice Corrosion Tests 10% Ferric Chloride

Alloy	Weight Loss, mg/cm²[1] RT	38C (100F)
E-BRITE	0.3	7.6
T317L	5.0	27.0
T316	11.5	32.2
Alloy 20Cb3	27.3	38.3

(1) 72 hour exposure, ASTM G-48 Procedures

Crevice Corrosion Tests[1] 5.25% Sodium Hypochlorite at 71C (160F)

Alloy	Weight Loss, mg/cm²	Sample Appearance
E-BRITE	.05	No Corrosion
Type 316	.95	Crevice Attack
Type 304	1.20	Crevice Attack

(1) 96-hour exposure

Crevice Corrosion Tests in Boiling Brine with Sodium Carbonate[1]

Alloy	Weight Loss, mg/cm²	Visual Appearance
E-BRITE	0.00	No Corrosion
Titanium	0.00	No Corrosion
Monel	1.05	Crevice Corrosion

(1) Saturate NaCl brine containing 10% $NaCO_3$, pH 11, 72-hour test, boiling at atmospheric pressure

Corrosion of E-BRITE Alloy in Boiling Caustic Solutions

% NaOH	Boiling Temperature C	(F)	Duration Days	Corrosion Rate mm/y	(MPY)
7.5	102	(215)	5	0.000	(0.01)
15	104	(220)	5	0.001	(0.04)
25	110	(230)	7	0.000	(0.01)
30	116	(240)	5	0.001	(0.05)
50	143	(290)	5	0.003	(0.11)
60	157	(315)	4	0.084	(3.3)
70	177	(350)	4	0.152-0.381	(6-15)

Resistance of E-BRITE Alloy to Caustic Solutions Containing NaCl and $NaClO_3$

% NaOH	% NaCl	% $NaClO_3$	Temperature C	(F)	Corrosion Rate mm/y	(MPY)
20	10	—	104	(220)	0.015	(0.6)
45	5	—	143	(290)	0.041	(1.6)
50	—	—	143	(290)	0.003	(0.1)
50	5	—	152	(305)	0.076	(3.0)
50	5	0.1	152	(305)	0.069	(2.7)
50	5	0.2	152	(305)	0.028	(1.1)
50	5	0.4	152	(305)	0.028	(1.1)

(continued)

TABLE 4.3: FERRITIC STAINLESS STEELS—ALLEGHENY LUDLUM (continued)

E-BRITE Alloy (cont'd)

Corrosion of E-BRITE and Austenitic Alloys In Pulp Liquors[1]

	Corrosion Rate, mm/y (MPY)[1]					
	White Liquor[1]		2 Parts White Liquor to 1 Part Black Liquor (by Vol.)[1]			
Alloy	170C	(338F)	130C	(266F)	170C	(338F)
E-BRITE	0.02	(0.8)	0.02	(0.8)	0.02	(0.8)
Type 316 Ti	0.10	(3.9)	0.10	(3.9)	0.03	(1.2)
Type 317L	0.10	(3.9)	0.10	(3.9)	0.03	(1.2)

(1) Liquor Composition		White Liquor	Black Liquor
NaOH	g/1	133.5	6.2
Na_2S	g/1	15.0	0.9
Sulfidity	%	11.2	—
$Na_2S_2O_3$	g/1	11.9	9.2
Na_2CO_3	g/1	37.5	36.3
NaCl	g/1	1.6	0.9

Source: J. P. Audouard, A. Desestret, G. Vallier, J. Chevassut and J. P. Mader, "Study and Development of Special Austenitic-Ferritic Stainless Steel Linings for Kraft Pulp Batch Digesters", Paper presented at *Third International Symposium on Pulp and Paper Industry Corrosion Problems*. Sponsored by Tech. Sec. of Can. P&P Assoc., TAPPI and NACE, Atlanta, Georgia, May 5-8, 1980.

Corrosion of E-BRITE and Austenitic Alloys In White Liquor Under Conditions of Heat Flux

	Corrosion Rate in White Liquor, mm/y (MPY)			
Alloy	Heat Flux[1]		Jet Impingement[2]	
E-BRITE	.005-.005	(0.2)	.06	(2.4)
Type 316 Ti	.10 -.20	(3.9-7.9)	.35	(13.8)
Type 317L	.05 -.10	(2.0-3.9)	.20	(7.9)

(1) Sample kept at 160C (320F) immersed in white liquor at 80C (176F).
(2) Sample temperature 160C (320F), white liquor jet at 80C (176F) projected against sample.

Source: J. P. Audouard, A. Desestret, G. Vallier, J. Chevassut and J. P. Mader, "Study and Development of Special Austenitic-Ferritic Stainless Steel Linings for Kraft Pulp Batch Digesters", Paper presented at *Third International Symposium on Pulp and Paper Industry Corrosion Problems*. Sponsored by Tech. Sec. of Can. P&P Assoc., TAPPI and NACE, Atlanta, Georgia, May 5-8, 1980.

In-Plant Corrosion Tests of E-BRITE and Other Alloys in White Liquor[1]

	Corrosion Rate	
Alloy	mm/y	(MPY)
E-BRITE	0.000	(0.0)
Ni-Cr Alloy 600	0.005	(0.2)
Type 329 Stainless Steel	0.008	(0.3)
Type 310 Stainless Steel	0.010	(0.4)
Ni-Fe-Cr Alloy 800	0.020	(0.8)
Ni-Cu Alloy 400	0.023	(0.9)
Ni-Fe-Cr Alloy 825	0.041	(1.6)
Type 304 Stainless Steel	0.168	(6.6), SCC[2]
Ni-Cr Alloy 625	0.173	(6.8)
Type 316 Stainless Steel	0.516	(20.3), SCC[2]
Carbon Steel	0.886	(34.9)

(1) White Liquor: 28% (NaOH+Na_2S), 7.8% NaCl, 1.5% Na_2CO_3, 3% Na_2SO_4
Temperature: 127C (261F)
Duration: 154 Days
(2) SCC — Stress Corrosion Cracking Observed

Source: G. E. Moller, "Use and Misuse of Stainless Steel", Paper presented at CPPA 1980 Maintenance Conference, Vancouver, British Columbia, September 1980.

Performance of E-BRITE Alloy and Other Stainless Steels in Huey Test[1]

Alloy	Corrosion Rate, mm/y (MPY)	
E-BRITE	0.10-0.13	(4-5)
Type 304	0.20-0.61	(8-24)
Type 347	0.25-0.41	(10-16)
Type 316	0.28-0.89	(11-35)
Type 430	0.51-0.91	(20-36)

(1) ASTM A262, Practice C, Boiling 65% HNO_3, Five 48-hour periods

Influence of Chloride And/Or Fluoride On Corrosion In 50% Nitric Acid at 79C (175F)

Solution[2]			Corrosion Rate, mm/y (MPY)[1]					
HNO_3	PPM Cl	PPM F	E-BRITE		Type 304		Titanium	
50%	—	—	0.005	(0.2)	0.015	(0.6)	0.091	(3.6)
50%	300	—	0.010	(0.4)	0.025	(1.0)	0.117	(4.6)
50%	—	20	0.025	(1.0)	0.079	(3.1)	0.305	(12.0)
50%	300	20	0.041	(1.6)	0.102	(4.0)	0.914	(36.0)
50%	1000	100	0.089	(3.5)	0.241	(9.5)	1.115	(43.9)

(1) Corrosion rate is average of two 48-hour periods.
(2) Chloride added as HCl, fluoride as HF.

Corrosion in Boiling, Dilute Sulfuric Acid Solutions

	Corrosion Rate, mm/y (MPY)[1]							
	1% H_2SO_4				5% H_2SO_4			
Alloy	Non-Activated		Activated[2]		Non-Activated		Activated[2]	
E-BRITE	0.018	(0.7)	13.741	(541)	0.356	(14)	76.7	(3020)[3]
Type 316	0.551	(21.7)	0.660	(26)	2.489	(98)	2.718	(107)
A-L 29-4-2	0.005	(0.2)	0.076	(3)	0.025	(1)	0.279	(11)

(1) Average of five 48-hour test periods.
(2) Sample activated at start of each test period.
(3) One period or less

Corrosion by Boiling Organic Acids

	Corrosion Rate, mm/y (MPY)					
Alloy	45% Formic		10% Oxalic		20% Acetic	
E-BRITE	0.076	(3)	0.076	(3)	0.025	(1)
Type 304	1.219	(48)	1.219	(48)	0.051	(2)
Type 316	0.305	(12)	1.016	(40)	0.025	(1)

Comparison of E-BRITE and Other Alloys in Boiling 88% Formic and 99% Acetic Acids

	Corrosion Rate, mm/y (MPY)			
Alloys	88% Formic		99% Acetic	
E-BRITE	<0.01	(<0.1)	0.01	(0.5)
Ni-Cr-Mo Alloy 276	0.05	(1.8)	0.01	(0.4)
Ni-Fe-Cr Alloy G	0.10	(4.0)	0.04	(1.6)
Ni-Fe-Cr Alloy 825	0.08	(3.0)	0.05	(2.0)
Ni-Cr Alloy 625	0.23	(9.0)	0.01	(0.4)
Ni Alloy 200	0.33	(13.0)	0.10	(4.0)
Ni-Cr Alloy 600	0.38	(15.0)	0.20	(8.0)
Type 304 Stainless	2.44	(96.0)	0.46	(18.0)
Type 316 Stainless	0.23	(9.0)	0.05	(2.0)

Source: A. I. Asphahani, P. E. Manning, W. L. Silence, F. G. Hodge, "Highly Alloyed Stainless Materials for Seawater Applications", Presented at NACE, CORROSION/80, Chicago, Illinois, March 3-7, 1980.

TABLE 4.3: FERRITIC STAINLESS STEELS—ALLEGHENY LUDLUM (continued)

Allegheny Ludlum Stainless Steel Type 439, a titanium stabilized, 18% chromium alloy, also known as ASTM XM-8 and by the UNS designation S43035, is a ferritic stainless steel designed to resist corrosion in a variety of oxidizing environments from fresh water to boiling acids. It may be used either annealed, cold formed or as welded in many applications where other stainless steel alloys such as Type 304, Type 410, Type 409 and Type 430 are used. Type 439 may also be used in many oxidizing environments where Type 304 is considered adequate in terms of general corrosion resistance but is considered subject to chloride stress corrosion cracking.

Typical General Corrosion Data

Corrosion Rates in Inches Per Month and Millimeters Per Annum ( )		
Medium	Type 304	Type 439
20% Acetic Acid Boiling	.00001 (.003)	.0003 (.09)
65% Nitric Acid Boiling	.0007 (.22)	.002 (.61)
20% Phosphoric Acid Boiling	.00002 (.006)	.00002 (.006)
10% Sodium Bisulfate Boiling	.005 (1.53)	.00001 (.003)
10% Sulfamic Acid Boiling	.013 (4.0)	.00008 (.025)
10% Oxalic Acid Boiling	.004 (1.22)	.18 (55)

TYPICAL ANALYSIS

Element	Standard Grade	MSR Grade
Carbon	.025	.018
Manganese	.40	.40
Phosphorous	.025	.025
Sulfur	.003	.003
Silicon	.50	.50
Chromium	18.00	18.00
Nickel	.30	.30
Titanium	.60	.50
Nitrogen	.025	.014

Corrosion Resistance

Type 439 is resistant to attack by potable water and many mildly or moderately corrosive chemical environments which are oxidizing in nature. In various chloride solutions, study has shown pitting resistance of Type 439 superior to that of Type 304. In addition, Type 439 is not subject to stress corrosion cracking which may cause premature failure of austenitic steels in chloride bearing environments such as hot waters used in heat exchangers.

Stress Corrosion Cracking

One of the most important corrosion properties of Type 439 is resistance to chloride stress corrosion cracking beyond the capabilities of conventional austenitic grades. This resistance is provided by the ferritic structure and low nickel content of Type 439. Results are equivalent for annealed, U-bent and autogenously welded Type 439.

MF-1 is the designation for a corrosion resisting steel developed by Allegheny Ludlum originally for automotive exhaust system applications. An 11% chromium alloy, MF-1 is a functional corrosion resistant material that has served outstandingly in strong acid condensates that form in automobile mufflers and tailpipes. The functional uses of MF-1 as a corrosion resistant material for many other special applications can be equally attractive; such as replacement for carbon steels, to avoid painting or other maintenance, or for galvanized steels under severe corrosive conditions.

Corrosion Resistance of MF-1

Medium	Rates in Inches Penetration/Month		
	Carbon Steel	MF-1	Type 304
25% Boiling Nitric Acid	50.0	.0150	.0002
20% Boiling Phosphoric Acid	30.0	.048	—
60% Boiling Acetic Acid	20.0	.159	.0002
50% Potassium Hydroxide at 240°F	.0050	.00055*	.00055
75% Potassium Hydroxide at 410°F	.221	.085*	

*Welded samples show no preferential corrosion.

TYPICAL ANALYSIS

C	Cr	Ti	Fe
.045	11.0	.50	Bal.

TABLE 4.4: FERRITIC-AUSTENITIC STAINLESS STEEL—CABOT WROUGHT PRODUCTS

FERRALIUM alloy 255 is a patented, ferritic-austenitic stainless steel containing approximately 26% chromium, 5% nickel, 2% copper and 3.3% molybdenum. It combines high mechanical strength, ductility and hardness with resistance to corrosion and erosion.

Comparative Aqueous Corrosion Data

Media	Concentration, percent by weight	Test Temp., °F (°C)	Average Corrosion Rate, mils (mm) per year FERRALIUM alloy 255	Type 317L Stainless Steel
Acetic Acid	10	Boiling	0.2 (<0.01)	0.2 (<0.01)
	50	Boiling	Nil	0.2 (<0.01)
	Glacial	Boiling	0.1 (<0.01)	2.9 (0.07)
Citric Acid	50	Boiling	Nil	0.2 (<0.01)
Formic Acid	20	Boiling	0.4 (0.01)	8.5 (0.22)
	40	Boiling	0.4 (0.01)	17 (0.43)
	60	Boiling	0.1 (<0.01)	22 (0.56)
	88	Boiling	18 (0.46)	9.2 (0.23)
Hydrochloric Acid	1	Room	Nil	Nil
	2.5	Room	Nil	11 (0.28)
Nitric Acid	10	Boiling	1.9 (0.48)	—
	65	Boiling	8.0 (0.20)	—
Phosphoric Acid	10	150 (66)	Nil	Nil
	10	Boiling	Nil	Nil
	30	150 (66)	0.1 (<0.01)	Nil
	30	Boiling	0.2 (<0.01)	6.7 (0.17)
	55	150 (66)	Nil	0.1 (<0.01)
	55	Boiling	0.1 (<0.01)	1.2 (0.03)
	85	150 (66)	0.1 (<0.01)	0.2 (<0.01)
Sodium Chloride	3	Boiling	0.4 (0.01)	—
Sodium Chloride plus 200 ppm Cu	3	Room	0.4 (0.01)	—
Sodium Chloride plus 0.5% Acetic Acid	0.8	Boiling	0.2 (<0.01)	0.3 (<0.01)
Sodium Chloride plus 0.5% Citric Acid	0.8	Boiling	1.2 (0.03)	31 (0.79)
Sodium Chloride plus 0.5% Oxalic Acid	0.8	Boiling	0.5 (<0.02)	22 (0.56)
Sodium Chloride plus 0.5 % Ammonium Chloride	0.8	Boiling	Nil	Nil
Sodium Chloride plus 0.5% Phosphoric Acid	0.8	Boiling	Nil	0.1 (<0.01)
Sodium Chloride plus 0.1 N Sulfuric Acid	5	Boiling	1.0 (<0.03)	148 (3.8)
Sodium Hydroxide	50	Boiling	1.8 (0.05)	29 (0.74)
Sulfuric Acid	5	150 (66)	Nil	Nil
	5	Boiling	12 (0.30)	200 (5.1)
	10	150 (66)	Nil	8.9 (0.23)
	10	Boiling	40 (1.0)	490 (12)
	20	150 (66)	Nil	50 (1.3)

—not tested

(continued)

TABLE 4.4: FERRITIC-AUSTENITIC STAINLESS STEEL–CABOT WROUGHT PRODUCTS (continued)

Average Corrosion Data in Mixed Acids and Salts

Media	Test Temp., °F (°C)	Average Corrosion Rate, per year mils	mm
5% Citric Acid plus 8% NaCl	286 (141)	0.1	<0.01
Palmitic Acid plus 1% H_2SO_4	212 (100)	8.4	0.21
Palmitic Acid plus 3% NaCl	212 (100)	0.3	<0.01
Palmitic Acid plus 1% H_2SO_4 and 3% NaCl	212 (100)	0.2	<0.01
Stearic Acid plus 3% NaCl	212 (100)	0.3	<0.01
Stearic Acid plus 1% H_2SO_4	212 (100)	8.3	0.21
Stearic Acid plus 1% H_2SO_4 and 3% NaCl	212 (100)	0.4	0.01
44% Sulfuric Acid plus 6% HNO_3	86 (30)	0.2	<0.01

Corrosion Data in Seawater

Media	Test Temp. °F	°C	Average Corrosion Rate, mils (mm) per year
ASTM Synthetic Seawater*	68	20	Nil
	95	35	Nil
	122	50	0.1 (<0.01)
	149	65	0.1 (<0.01)
	176	80	Nil
	194	90	Nil
ASTM Synthetic Seawater Saturated with Chlorine Gas*	68	20	2 (0.05)
	95	35	0.8 (0.02)
	149	65	7 (0.18)**
ASTM Synthetic Seawater Saturated with SO_2 Gas	150	66	Nil

*Average of duplicate, smooth specimens. 96-hr. exposure. **Initiation of pits

Crevice-Corrosion Data in Natural Seawater

Alloy	Test Duration, Days	Test Temp., °F	°C	Percent Crevices Initiated*	Maximum Depth of Attack, mm
FERRALIUM alloy 255	29	57	14	0	<0.01
Type 316 Stainless Steel	29	57	14	81	1.2
FERRALIUM alloy 255	30	86	30	1.6	<0.08
Type 316 Stainless Steel	30	86	30	28	1.9
Type 317 Stainless Steel	30	86	30	76	1.9
Type 317LM Stainless Steel	30	86	30	97	1.1
20 Cb-3**Alloy	30	86	30	41	3.1
FERRALIUM alloy 255	30	126	52	0.8	<0.01
Type 316 Stainless Steel	30	126	52	28	0.10

$* \frac{\text{Number of Crevices Initiated}}{\text{Number of Crevices Possible (120)}}$

**Trademark of Carpenter Technology Corporation

(continued)

TABLE 4.4: FERRITIC-AUSTENITIC STAINLESS STEEL—CABOT WROUGHT PRODUCTS (continued)

Crevice-Corrosion Data in 10% Ferric Chloride at Room Temperature for 10 Days

Alloy	Number of Attacked Crevices*	Maximum Depth of Penetration, mils	mm
FERRALIUM alloy 255	0	0	0
Type 317LM Stainless Steel	20	12	0.30
Alloy No. 904L	23	19	0.48
Type 317L Stainless Steel	16	77	2.0
20 Cb-3 alloy	24	76	1.9
Type 316 Stainless Steel	24	76	1.9 (Perforated)

*Maximum possible number of crevices was 24.

Crevice-Corrosion Tests in Simulated SO_2 Scrubber Environment*

Alloy	Corrosion Rate per year, mils	mm	Number of Attacked Crevices**	Maximum Depth of Crevice Attack, mils	mm
FERRALIUM alloy 255	0.4	0.01	0	0	0
Alloy No. 904L	57	1.4	24	6	0.15
Type 317LM Stainless Steel	179	4.5	24	10	0.25
Alloy No. 825	216	5.5	24	10	0.25

*45,000 ppm Cl-***, 150°F (66°C), pH 2, SO_2/O_2 (1:1) bubbled through solution.
**Maximum possible number of crevices was 24.
***0.003% $FeCl_3$, 0.11% KCl, 0.5% $MgCl_2$, 1.1% $CaCl_2$, 5.6% NaCl, 0.02% CaF_2 and 200g/l $CaSO_4 \cdot 2H_2O$.

Comparative Localized Corrosion Temperature Data in Oxidizing NaCl-HCl Solution*

Alloy	Pitting Temperature, °C	°F	Crevice-Corrosion Temperature, °C	°F
FERRALIUM alloy 255	50	122	35	95
Alloy No. 904L	45	113	20	68
Type 317LM Stainless Steel	35	95	15	59
Type 317L Stainless Steel	25	77	10	54
CABOT alloy No. 825	25	77	≤ −5	≤23
20 Cb-3 alloy	20	68	≤ −5	≤23
Type 316 Stainless Steel	20	68	≤ −5	≤23

*4% NaCl + 0.01M HCl + 0.1% $Fe_2(SO_4)_3$.

Comparative Stress-Corrosion Cracking Data

Media	Test Temp., °F	°C	Time to Failure, hrs. FERRALIUM alloy 255	Type 316L Stainless Steel	Type 317L Stainless Steel
50% NaOH Saturated with NaCl	290	143	NC	NC	NC
70% NaOH Saturated with NaCl	350	177	NC	200,648	1031,1031

NC-No failure in 1000 hours. All tests were run on duplicate specimens.

(continued)

TABLE 4.4: FERRITIC-AUSTENITIC STAINLESS STEEL—CABOT WROUGHT PRODUCTS (continued)

Comparative Stress-Corrosion Cracking Data

Media	Test Temp., °F	°C	Type 316 Stainless Steel	FERRALIUM alloy 255
ASTM Synthetic Seawater	176	80	NC[a]	NC
0.8% NaCl + 0.5% Oxalic Acid*	286	141	NC	NC
0.8% NaCl + 0.5% Acetic Acid*	286	141	C	NC
0.8% NaCl + 0.5% Citric Acid*	286	141	C	NC
Modified Wick Test*[b]	212	100	C	NC
25% NaCl***	393	200	—	NC
30% NaCl**	Boiling		—	NC
0.8% NaCl + CO_2*	286	141	—	NC
4% NaCl + 1% H_3PO_4*	Boiling		—	NC
0.8% NaCl + 0.2% H_3PO_4*	286	141	C	C
45% Magnesium Chloride	Boiling		C	C

*U-bend specimen, 30-day exposure
**U-bend specimen, 100-day exposure
***U-bend specimen, 504-hr. exposure
NC-No Cracks
C-Cracked
—Not tested
[a]Localized attack
[b]1000 ppm Cl (as NaCl) and 500 ppm $FeCl_3$

Average Aqueous Corrosion Resistance of Weldments*

Media	Test Temp., °F (°C)	Average Corrosion Rate Per Year, mils (mm): Base Metal	½ in. (12.7mm) Plate, SMAW	⅛ in. (3.2mm) Plate, GTAW	½ in. (12.7mm) Plate, GTAW
75% Acetic Acid	Boiling	0.1 (<0.01)	Nil	0.2 (<0.01)	0.2 (<0.01)
2.5% Hydrochloric Acid	Room	0.1 (<0.01)	Nil	1.7 (<0.05)	Nil
10% Ferric Chloride	86°F (30°C)	0.2 (<0.01)	0.6 (<0.02)	0.7 (<0.02)	—
6% Ferric Chloride (With Crevice)	Room	Nil	Nil	Nil	Nil
65% Nitric Acid	Boiling	4.7 (0.12)	8.3 (0.21)	7.6 (0.19)	11 (0.28)
10% Nitric Acid + 3% Hydrofluoric Acid	Room	2.3 (0.06)	—	6.8 (0.17)	—
55% Phosphoric Acid	Boiling	1.4 (0.04)	1.6 (0.04)	4.1 (0.10)	1.3 (<0.04)
10% Sulfuric Acid	Boiling	37 (0.94)	73 (1.9)	49 (1.2)	66 (1.7)
50% Sulfuric Acid + 42 g/l of Ferric Sulfate	Boiling	13 (0.33)	19 (0.48)	18 (0.46)	23 (0.58)

FERRALIUM alloy 255 to itself.

Comparative Stress-Corrosion Cracking Data*

Alloy	Calcium Chloride** 250 °F / 121 °C	300 / 149	350 / 177	400 / 204	Sodium Chloride** 250 / 121	300 / 149	350 / 177	400 / 204
FERRALIUM alloy 255	NC	NC	NC	C	NC	NC	NC	C
Alloy No. 904L	NC	NC	C	C	NC	NC	C	C
20Cb-3 alloy	NC	NC	NC	C	NC	NC	C	C

*1-week exposure, C-shaped specimens, like alloy holder.
**Compositions were selected to provide the same chloride content as a 25% NaCl solution.
NC-No cracks
C-Cracked

TABLE 4.5: IRON ALLOY—CABOT WROUGHT PRODUCTS

MULTIMET alloy is an iron-base alloy for use in applications involving high stresses at temperatures up to 1500°F (816°C), and moderate stresses at up to 2000°F (1093°C). It has good oxidation resistance, ductility and is readily fabricated. Its high-temperature properties are inherent and are not dependent upon age hardening.

CORROSION RESISTANCE OF MULTIMET® ALLOY

All results are expressed in mils (mm) penetration per year. Acid strengths are given in percent by weight. In some instances, no measurable penetration could be observed. These instances are noted by the word, "Nil." All data are steady-state as calculated from a minimum of five 24-hr. test periods.

All data were obtained using corrosion specimens prepared from 12-gage, solution heat-treated sheet.

TYPICAL PENETRATION RATES IN CORROSIVE MEDIA, Mils (mm) Per Year

	ACETIC ACID			CHROMIC ACID			FORMIC ACID					
	10%	50%	99%	2%	10%	20%	10%	20%	30%	40%	60%	89%
Room	Nil	Nil	Nil	Nil	Nil	Nil	Nil	0.1 (<0.01)	—	0.1 (<0.01)	0.1 (<0.01)	Nil
150 deg. F (66 deg. C)	Nil	Nil	Nil	Nil	8.0 (0.20)	91 (2.31)	Nil	0.1 (<0.01)	—	Nil	0.1 (<0.01)	Nil
Boiling	0.1 (<0.01)	0.1 (<0.01)	0.1 (<0.01)	6.0 (0.15)	358* (9.09)	>1000 (>25.4)	4.0 (0.10)	6.0 (0.15)	—	8.0 (0.20)	6.0 (0.15)	3.0 (0.08)

*Rate is for the fifth (24-hour) test period, not steady state rate.

	CUPRIC CHLORIDE					FERRIC CHLORIDE			
	2%	2% + 5% NaCl	5% + 10% NaCl	10%	10% + 10% NaCl	2%	2% + 5% NaCl	5% + 10% NaCl	10%
Room	Nil	—	—	Nil	—	Nil	—	—	Nil
150 deg. F (66 deg. C)	—	160 (4.06)	Nil	—	Nil	—	193 (4.90)	>1000 (>25.4)	—
Boiling	—	919 (23.3)	>1000 (>25.4)	—	—	—	>1000 (>25.4)	—	—

	HYDROCHLORIC ACID								WET CHLORINE
	1%	2%	5%	10%	15%	20%	25%	37%	
Room	0.1 (<0.01)	0.1 (<0.01)	17 (0.43)	13 (0.33)	15 (0.38)	8.0 (0.20)	6.0 (0.15)	11 (0.28)	180 (4.57)
150 deg. F (66 deg. C)	Nil	Nil	343 (8.71)	572 (14.5)	431 (10.9)	424 (10.8)	687 (17.4)	>1000 (>25.4)	—
Boiling	370 (9.40)	934 (22.7)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	—	—	—

(continued)

TABLE 4.5: IRON ALLOY–CABOT WROUGHT PRODUCTS (continued)

	NITRIC ACID							
	10%	20%	30%	40%	50%	60%	65%	70%
Room	Nil	Nil	Nil	Nil	Nil	Nil	—	Nil
150 deg. F (66 deg. C)	Nil	Nil	Nil	0.1 (<0.01)	0.3 (<0.01)	0.4 (0.01)	—	0.8 (0.02)
Boiling	0.3 (<0.01)	0.8 (0.02)	2.0 (0.05)	4.0 (0.10)	6.0 (0.15)	10 (0.25)	12 (0.30)	14 (0.36)

	PHOSPHORIC ACID				HYDROFLUORIC ACID			SODIUM HYDROXIDE		
	10%	30%	50%	85%	5%	25%	45%	5%	25%	50%
Room	Nil	Nil	Nil	Nil	5.0 (0.13)	37 (0.94)	52 (1.32)	Nil	Nil	Nil
150 deg. F (66 deg. C)	Nil	0.1 (<0.01)	0.1 (<0.01)	0.1 (<0.01)	—	—	—	Nil	Nil	Nil
Boiling	0.1 (<0.01)	0.3 (<0.01)	3.0 (0.08)	303 (7.70)	—	—	—	Nil	—	—

TABLE 4.6: IRON ALLOYS–CABOT STELLITE DIVISION

The TRISTELLE alloys were designed to resist corrosion and all forms of wear. In particular, they were developed to withstand galling, the gross damage commonly encountered in metal-to-metal sliding systems. By virtue of their excellent resistance to cavitation erosion, they are particularly recommended for valve service.

Compositions

	Fe	Cr	Ni	Co	Si	C
TRISTELLE alloy TS-1	Bal	30	10	12	5	1
TRISTELLE alloy TS-2	Bal	35	10	12	5	2
TRISTELLE alloy TS-3	Bal	35	10	12	5	3

Resistance to Corrosion

The following immersion test results relate to multilayer undiluted gas tungsten arc deposits. N/L represents an initial corrosion rate of greater than 50 mpy (1.27 mm/year) and a steady state corrosion rate of less than 5 mpy (0.13 mm/year).

	30%CH_3COOH Boiling	50%H_3PO_4 66°C	65%HNO_3 66°C	5%H_2SO_4 66°C
TRISTELLE alloy TS-1	E	E	E	E
TRISTELLE alloy TS-2	U	E	G	N/L
TRISTELLE alloy TS-3	U	U	S	U
STELLITE alloy No. 1	G	E	S	E
STELLITE alloy No. 6	E	E	U	E

E = < 5 mpy (< 0.13 mm/year) S = 20-50 mpy (0.51 – 1.27 mm/year)
G = 5-20 mpy (0.13 – 0.51 mm/year) U = > 50 mpy (> 1.27 mm/year)

TABLE 4.7: IRON- AND NICKEL-BASE ALLOYS—STAINLESS FOUNDRY & ENGINEERING

Corrosion in Pulp and Paper Industry

Specialty Alloys

Alloy Designation	Description
CF8M	Cast 316 Alloy
Modified CN-7M (Alloy 20)	
ILLIUM P	Fe Base Cr-Ni-Cu Alloy
ILLIUM PD	Fe Base Cr-Ni-Co Alloy
ILLIUM 98	Ni Base Cr-Mo-Cu Alloy

Erosion-Corrosion in Causticized Liquor

Alloy	Specimen Weight (gms) Before	After	Metal Loss Due To Erosion-Corrosion (Rate Factor)
CF8M (316)	30.3667	30.3646	0.65
Modified CN-7M	32.1459	32.1437	0.57
ILLIUM P	29.7435	29.7420	0.41
CN-7M (S-20)	31.4510	31.4491	0.37
ILLIUM PD	29.8805	29.8793	0.31
ILLIUM 98	32.5120	32.5109	0.27

Hardwood Spent Sulfite Liquor from Digester
Typical Analysis

Specific Gravity (25°C)	1.048	
pH	2.3 - 3.0	
CaO	4.52%	on Solids
MgO	0.18%	" "
Total Sulfur (% S)	5.95%	" "
Acetic Acid	6.37%	" "
Formic Acid	1.26%	" "
OCH	8.74%	" "
Reducing Sugars	25.00%	" "
Sulfonic Sulfur (% S)	4.60%	" "

Erosion-Corrosion in Hardwood Spent Sulfite Liquors

Alloy	Specimen Weight (gms) Before	After	Metal Loss Due To Erosion-Corrosion (Rate Factor)
ILLIUM 98	32.2792	32.2789	0.51
ILLIUM PD	29.8990	29.8944	0.82
Modified CN-7M (Alloy 20)	32.1817	32.1722	1.73

Corrosion Resistance of ILLIUM PD

Boiling Nitric Acid Tests:

A 65% solution of boiling nitric acid test revealed that ILLIUM PD is up to 10 times more resistant to attack than 316 stainless steel Test results were:

ILLIUM PD	1 to 1.8 mills per year
CF-8M (316)	11.7 mills per year

Sea Water and Salt Spray:

ILLIUM PD passes the ASTM B117 salt spray test. Sea water corrosion tests conducted for the U. S. Navy at Portsmouth resulted in no evidence of corrosive attack on specimens stressed at 55,000 to 75,000 psi for a period of six months.

Food Acids:

Tests conducted in boiling vinegar and mayonnaise demonstrate that ILLIUM PD exhibits excellent resistance to attack from food products.

Fluosilicic Acid:

Food processors are becoming more aware of the severe corrosive nature of cleaning chemicals and disinfectants. Fluosilicic acid is typical of these corrosive agents. A 25% solution of fluosilicic acid at 125° F corrodes CF-8M at a rate of 500 mills per year. ILLIUM PD has a measured corrosion rate of 0.25 mills per year.

(continued)

TABLE 4.7: IRON- AND NICKEL-BASE ALLOYS—STAINLESS FOUNDRY & ENGINEERING (continued)

Corrosion in Phosphoric Acid Industry

Analysis of Discharge Product from
Phosphoric Acid Reactor

	Amount Present (percent by weight)	
MATERIAL	AVERAGE	RANGE
Phosphoric Acid	48%	47-49%
Fluorine Compounds	1%	1-2 %
Sulfuric Acid	1-2%	to 5%
Solids	--	to 40%

Measured Corrosion Rate of Alloys in
Reactor Product at 180°F

MATERIAL	CORROSION RATE MPY
ILLIUM 98	0.5
Inconel 625	1.2
ILLIUM P	1.9
ILLIUM W	2.9
Inconel 825	9.1
Carpenter 20	10.1
Durimet 20	53.7

Alloy Performance in Phosphoric Acid Evaporator
(71% Phosphoric Acid at 440°F)

MATERIAL	MEASURED CORROSION RATE IPY
ILLIUM 98	.0066
ILLIUM G	.0109
ILLIUM P	.028
316 (sensitized)	.067
317 (3.3 Mo)	.079
316 (2.6 Mo)	.131
316L (2.2 Mo)	.160

TABLE 4.8: STAINLESS STEEL–ARMCO STAINLESS STEEL PRODUCTS

Armco NITRONIC 50 Stainless Steel provides a combination of corrosion resistance and strength. This austenitic stainless steel has corrosion resistance greater than that provided by Types 316, 316L, 317 and even 317L, plus approximately twice the yield strength at room temperature. In addition, Armco NITRONIC 50 has very good mechanical properties at both elevated and sub-zero temperatures.

This is the material for equipment requiring excellent corrosion resistance–including that in which Types 316 and 316L stainless steels are marginal. NITRONIC 50 is an effective material for the petroleum, petrochemical, chemical, pulp and paper, textile, food processing and marine industries. Components using the combination of excellent corrosion resistance and high strength currently include pumps, valves and fittings; fasteners, cables, chains, screens and wire cloth; marine hardware, boat shafting, heat exchanger parts, springs and photographic equipment. A wide range of additional applications is made possible by high strength and toughness at sub-zero temperatures, low magnetic permeability even after severe cold working or exposure to sub-zero temperatures, and excellent mechanical properties at temperatures up to 1200 °F (649°C).

Composition

	%		%
Carbon	.06 max	Nickel	11.50/13.50
Manganese	4.00/6.00	Molybdenum	1.50/3.00
Phosphorus	0.040 max	Nitrogen	.20/.40
Sulfur	0.030 max	Columbium	.10/.30
Silicon	1.00 max	Vanadium	.10/.30
Chromium	20.50/23.50		

Corrosion Resistance

Corrosion Rates in Inches per Year (IPY) Unless Otherwise Indicated(1)

Test Medium	NITRONIC 50 Bar Annealed 1950 F (1066 C)	NITRONIC 50 Bar Annealed 2050 F (1121 C)	NITRONIC 50 High-Strength (HS) Bar	Types 316 & 316L Annealed Bar	Types 317 & 317L Annealed Bar
10% $FeCl_3$, 25 C–plain(2)	<.001 g/in²	<.001 g/in²	<.001 g/in²	.011 g/in²	–
10% $FeCl_3$, 25 C–creviced(2)	<.001 g/in²	<.001 g/in²	<.001 g/in²	.186 g/in²	–
1% H_2SO_4, 80 C	<.001	<.001	<.001	0.002	<.001
2% H_2SO_4, 80 C	<.001	<.001	<.001	0.011	<.001
5% H_2SO_4, 80 C	<.001	<.001	<.001	0.060	0.036
10% H_2SO_4, 80 C	–	0.028	–	0.10	0.049
20% H_2SO_4, 80 C	–	0.133	–	0.48	0.155
1% H_2SO_4, Boiling	–	0.027	–	–	0.013
2% H_2SO_4, Boiling	–	0.064	–	0.12	0.027
5% H_2SO_4, Boiling	.194	0.131	0.296	0.26	0.093
10% H_2SO_4, Boiling	–	0.356	–	0.73	0.465
20% H_2SO_4, Boiling	–	1.64	–	2.20	1.30
1% HCl, 35 C	<.001	<.001	<.001	0.012	0.002
2% HCl, 35 C	0.024	<.001	0.027	0.021	0.023
1% HCl, 80 C	–	<.001	0.239	–	0.148
2% HCl, 80 C	–	0.439	0.452	–	0.263
65% HNO_3, Boiling	0.010	0.007	–	0.012	0.012
70% H_3PO_4, Boiling	0.203	0.154	–	0.202	0.201
33% Acetic Acid, Boiling	<.001	<.001	<.001	<.001	<.001
20% Formic Acid, Boiling	–	<.001	–	0.027	–
40% Formic Acid, Boiling	–	0.032	–	0.034	–
10% HNO_3 + 1% HF, 35 C	–	0.007	–	0.064	–
10% HNO_3 + 1% HF, 80 C	–	0.069	–	0.442	–

(1)Immersion tests performed on ⅝" dia. x ⅝" (15.9 x 15.9 mm) long machined cylinders. Results are average of five 48-hour periods. Specimens tested at 35 C and 80 C were intentionally activated for third, fourth, and fifth periods. Where both active and passive conditions occurred, only active rates are shown.

(2)Exposure for 50 hours with rubber bands on some specimens to produce crevices.

TABLE 4.9: VARIOUS DUPLEX AND AUSTENITIC STAINLESS STEELS—CLIMAX MOLYBDENUM

Chemical Analyses of Stainless Steels Studied, wt %

Stainless Steel Type	C	N	Si	Mn	P	S	Cr	Ni	Mo	Cu	Others
S12	0.004	0.018	0.24	0.34	0.005	0.012	25.51	10.93	1.89	-	Ti=0.54
S13	0.004	0.011	0.30	0.35	0.005	0.014	25.18	10.35	2.91	1.04	Ti=0.48
DP-3	0.018	0.12*	0.43	0.88	0.015	0.012	25.02	6.91	3.07	0.64	W=0.11
SAF 2205	0.012	0.14	0.34	0.65	0.017	≦0.003	22.13	5.70	3.05	-	--
FERRALIUM® alloy 255	0.019*	0.20*	-	-	-	-	26.00*	5.52*	3.33*	1.73*	--
VEW A905	0.034*	0.36*	-	5.8	-	-	26	3.7	2.3	<0.1*	--
T304	0.068	-	0.52	1.07	0.007	0.014	18.29	9.25	0.24	0.16	--
T316	0.03	0.052	0.43	1.58	0.017	0.014	17.2	11.2	2.2	-	--
JS700	0.036	0.032	0.32	1.77	0.020	0.005	20.5	25.10	4.40	0.28	Nb=0.32

* Analyzed at Climax Research Laboratory

FERRALIUM is a registered trademark of Bonar Langley Alloys, Ltd.
VEW A905 is a trademark of Vereinigte Edelstahlwerke
SAF 2205 is a trademark of Sandvikens Jernverks Aktiebolag
DP-3 is a trademark of Sumitomo Metal Industries, Ltd.
JS700 is a trademark of Jessop Steel Company
S12 and S13 are trademarks of Nisshin Steel Co., Ltd.

Critical Crevice Corrosion Temperature for the Duplex and some Austenitic Stainless Steels in 10% $FeCl_3 \cdot 6H_2O$ (pH 1)*

Stainless Steel Type	Highest Temperature of No Crevice Corrosion °C	Lowest Temperature of Crevice Corrosion °C
S12	2.5, 2.5	7.5, 7.5
S13	0, 0, 2.5	2.5
DP-3	10, 10	12.5, 12.5
SAF 2205	17.5, 17.5	20, 20
VEW A905	17.5, 17.5	20, 20
FERRALIUM® alloy 255	22.5, 22.5	25, 25
T304	--	-2.5, -2.5
T316	--	-2.5, -2.5
JS700	10, 10	12.5, 12.5

*Based on one-day exposure tests.

(continued)

TABLE 4.9: VARIOUS DUPLEX AND AUSTENITIC STAINLESS STEELS—CLIMAX MOLYBDENUM (cont'd)

Corrosion Rates and Deepest Penetration in the Creviced Area for Duplex and Austenitic T304, T316 and JS700 Stainless Steels in Dilute Chloride (600 ppm Cl^-, 5 ppm Cu^{++}, O_2) Solution at 90°C (194°F), One Week Exposure

Stainless Steel Type	Corrosion Rate mg dm^{-2}/day	Deepest Penetration in Creviced Area, microns	Remarks
S12	0.0, 0.1	NA[a], 47	some etched spots
S13	4.1, 1.9	49, NMP[b]	pits, rust spots
DP-3	0.0, 0.0	NA, NA	—
SAF 2205	0.2, 0.3	28, 39	etched spots, small pits
VEW A905	0.8, 0.9	39, 32	small pits, discoloration
FERRALIUM® alloy 255	0.1, 0.1	NA, NA	--
T304	33, 28	206, 77	numerous pits, etched spots
T316	7.7, 0.9	175, NMP	pits, etched spots, rust spots
JS700	0.1, 0.1	NA, NA	—

[a]NA - no attack   [b]NMP - no measurable penetration

Pitting Potentials for the Duplex Stainless Steels and T316 and JS700 in M NaCl

Stainless Steel Type	Pitting Potential Volts 50°C	60°C
S12	0.100, 0.100	--
S13	0.120, 0.120	--
DP-3	0.320, 0.280, 0.240 Average 0.280	--
SAF 2205	0.360, 0.320 Average 0.340	--
VEW A905	0.400, 0.340 Average 0.370	--
FERRALIUM® alloy 255	No pitting	0.080, 0.140 Average 0.110
T316	0.060, 0.060	--
JS700	No pitting	0.420

EDX Analysis of Austenitic and Ferritic Phases of the Duplex Stainless Steels

Stainless Steel Type	Segregation Ratio % in Ferrite/% in Austenite Cr	Ni	Mo	Other
S12	1.41	0.56	1.03	--
S13	1.42	0.50	2.34	--
DP-3	1.29	0.43	2.39	--
SAF 2205	1.22	0.52	1.86	--
VEW A905	1.11	0.6	2.53	0.8 (Mn)
FERRALIUM® alloy 255	1.17	0.65	2.61	0.54 (Cu)

TABLE 4.10: VARIOUS STAINLESS STEELS—AMERICAN IRON AND STEEL INSTITUTE

Relative Corrosion Resistance of AISI Stainless Steels*

TYPE Number	UNS Number	Mild Atmospheric and Fresh Water	Atmospheric		Salt Water	Chemical		
			Industrial	Marine		Mild	Oxidizing	Reducing
201	(S20100)	x	x	x		x	x	
202	(S20200)	x	x	x		x	x	
205	(S20500)	x	x	x		x	x	
301	(S30100)	x	x	x		x	x	
302	(S30200)	x	x	x		x	x	
302B	(S30215)	x	x	x		x	x	
303	(S30300)	x	x			x		
303 Se	(S30323)	x	x			x		
304	(S30400)	x	x	x		x	x	
304L	(S30403)	x	x	x		x	x	
	(S30430)	x	x	x		x	x	
304N	(S30451)	x	x	x		x	x	
305	(S30500)	x	x	x		x	x	
308	(S30800)	x	x	x		x	x	
309	(S30900)	x	x	x		x	x	
309S	(S30908)	x	x	x		x	x	
310	(S31000)	x	x	x		x	x	
310S	(S31008)	x	x	x		x	x	
314	(S31400)	x	x	x		x	x	
316	(S31600)	x	x	x	x	x	x	x
316F	(S31620)	x	x	x	x	x	x	x
316L	(S31603)	x	x	x	x	x	x	x
316N	(S31651)	x	x	x	x	x	x	x
317	(S31700)	x	x	x	x	x	x	x
317L	(S31703)	x	x	x	x	x	x	
321	(S32100)	x	x	x		x	x	
329	(S32900)	x	x	x	x	x	x	x
330	(N08330)	x	x	x	x	x	x	x
347	(S34700)	x	x	x		x	x	
348	(S34800)	x	x	x		x	x	
384	(S38400)	x	x	x		x	x	
403	(S40300)	x				x		
405	(S40500)	x				x		
409	(S40900)	x				x		
410	(S41000)	x				x		
414	(S41400)	x				x		
416	(S41600)	x						
416 Se	(S41623)	x						
420	(S42000)	x						
420F	(S42020)	x						
422	(S42200)	x						
429	(S42900)	x	x			x	x	
430	(S43000)	x	x			x	x	
430F	(S43020)	x	x			x		
430F Se	(S43023)	x	x			x		
431	(S43100)	x	x	x		x		
434	(S43400)	x	x	x		x	x	
436	(S43600)	x	x	x		x	x	
440A	(S44002)	x				x		
440B	(S44003)	x						
440C	(S44004)	x						
442	(S44200)	x	x			x	x	
446	(S44600)	x	x	x		x	x	
	(S13800)	x	x			x	x	
	(S15500)	x	x	x		x	x	
	(S17400)	x	x	x		x	x	
	(S17700)	x	x	x		x	x	

The "X" notations indicate that a specific stainless steel type may be considered as resistant to the corrosive environment categories.

*Steel Products Manual "Stainless and Heat Resisting Steels," December 1974, American Iron and Steel Institute, Washington,D.C.

(continued)

TABLE 4.10: VARIOUS STAINLESS STEELS—AMERICAN IRON AND STEEL INSTITUTE (continued)

Relative Corrosion Resistance of AISI Stainless Steels Where Different Grades Are Used*

Environment	Grades
Acids	
Hydrochloric acid	Stainless generally is not recommended except when solutions are very dilute and at room temperature.
"Mixed acids"	There is usually no appreciable attack on Type 304 or 316 as long as sufficient nitric acid is present.
Nitric acid	Type 304L or 430 is used.
Phosphoric acid	Type 304 is satisfactory for storing cold phosphoric acid up to 85% and for handling concentrations up to 5% in some unit processes of manufacture. Type 316 is more resistant and is generally used for storing and manufacture if the fluorine content is not too high. Type 317 is somewhat more resistant than Type 316. At concentrations up to 85%, the metal temperature should not exceed 212 F (100 C) with Type 316 and slightly higher with Type 317. Oxidizing ions inhibit attack and other inhibitors such as arsenic may be added.
Sulfuric acid	Type 304 can be used at room temperature for concentrations over 80%. Type 316 can be used in contact with sulfuric acid up to 10% at temperatures up to 120 F (50 C) if the solutions are aerated; the attack is greater in airfree solutions. Type 317 may be used at temperatures as high as 150 F (65 C) with up to 5% concentration. The presence of other materials may markedly change the corrosion rate. As little as 500 to 2000 ppm of cupric ions make it possible to use Type 304 in hot solutions of moderate concentration. Other additives may have the opposite effect.
Sulfurous acid	Type 304 may be subject to pitting, particularly if some sulfuric acid is present. Type 316 is usable at moderate concentrations and temperatures.
Bases	
Ammonium hydroxide, sodium hydroxide, caustic solutions	Steels in the 300 series generally have good corrosion resistance at virtually all concentrations and temperatures in weak bases, such as ammonium hydroxide. In stronger bases, such as sodium hydroxide, there may be some attack, cracking or etching in more concentrated solutions and at higher temperatures. Commercial purity caustic solutions may contain chlorides, which will accentuate any attack and may cause pitting of Type 316 as well Type 304.
Organics	
Acetic acid	Acetic acid is seldom pure in chemical plants but generally includes numerous and varied minor constituents. Type 304 is used for a wide variety of equipment including stills, base heaters, holding tanks, heat exchangers, pipelines, valves and pumps for concentrations up to 99% at temperatures up to about 120 F (50 C). Type 304 is also satisfactory for contact with 100% acetic acid vapors, and—if small amounts of turbidity or color pickup can be tolerated—for room temperature storage of glacial acetic acid. Types 316 and 317 have the broadest range of usefulness, especially if formic acid is also present or if solutions are unaerated. Type 316 is used for fractionating equipment, for 30 to 99% concentrations where Type 304 cannot be used, for storage vessels, pumps and process equipment handling glacial acetic acid, which would be discolored by Type 304. Type 316 is likewise applicable for parts having temperatures above 120 F (50 C), for dilute vapors and high pressures. Type 317 has somewhat greater corrosion resistance than Type 316 under severely corrosive conditions. None of the stainless steels has adequate corrosion resistance to glacial acetic acid at the boiling temperature or at superheated vapor temperatures.
Aldehydes	Type 304 is generally satisfactory.
Amines	Type 316 is usually preferred to Type 304.
Cellulose acetate	Type 304 is satisfactory for low temperatures, but Type 316 or Type 317 is needed for high temperatures.
Citric, formic and tartaric acids	Type 304 is generally acceptable at moderate temperatures, but Type 316 is resistant to all concentrations at temperatures up to boiling.
Esters	From the corrosion standpoint, esters are comparable with organic acids.
Fatty acids	Up to about 300 F (150 C), Type 304 is resistant to fats and fatty acids, but Type 316 is needed at 300 to 500 F (150 to 260 C) and Type 317 at higher temperatures.
Paint vehicles	Type 316 may be needed if exact color and lack of contamination are important.
Phthalic anhydride	Type 316 is usually used for reactors, fractionating columns, traps, baffles, caps and piping.
Soaps	Type 304 is used for parts such as spray towers, but Type 316 may be preferred for spray nozzles and flake-drying belts to minimize offcolor product.
Synthetic detergents	Type 316 is used for preheat, piping, pumps and reactors in catalytic hydrogenation of fatty acids to give salts of sulfonated high molecular alcohols.
Tall oil (pulp and paper industry)	Type 304 has only limited usage in tall-oil distillation service. High-rosin-acid streams can be handled by Type 316L with a minimum molybdenum content of 2.75%. Type 316 can also be used in the more corrosive high-fatty-acid streams at temperatures up to 475 (245 C), but Type 317 will probably be required at higher temperatures.
Tar	Tar distillation equipment is almost all Type 316 because coal tar has a high chloride content; Type 304 does not have adequate resistance to pitting.
Urea	Type 316L is generally required.
Pharmaceuticals	Type 316 is usually selected for all parts in contact with the product because of its inherent corrosion resistance and greater assurance of product purity.

*"Stainless Steel and the Chemical Industry," Climax Molybdenum Company, 1966, Greenwich, CT.

CORROSION RATES OF STAINLESS STEELS IN FLUE GASES (EXPOSURE 3 MONTHS)**

Material AISI Type	Corrosion Rate					
	Coke Oven Gas (1500 F) (816 C)		Coke Oven Gas (1800 F) (982 C)		Natural Gas (1500 F) (816 C)	
	mpy	mmpy	mpy	mmpy	mpy	mmpy
430	91	2.31	236†	6.00	12	0.30
446(26 Cr)	30	0.76	40	1.02	4	0.10
446(28 Cr)	27	0.69	14	0.36	3	0.08
302B	104	2.64	225†	6.00	–	–
309S	37*	0.94	45	1.14	3	0.08
310S	38*	0.97	25	0.64	3	0.08
314	23*	0.58	94	2.39	3	0.08

*Pitted specimens—average pit depth. † Specimens destroyed.

**W.F. White, Materials Protection, 2 (1963), 47.

TABLE 4.11: VARIOUS STAINLESS STEELS—CARPENTER TECHNOLOGY

CORROSION RESISTANCE TABLE

This table shows the resistance of a number of materials to the more common chemicals. Many factors influence the resistance of materials to various solutions. Factors which must be given consideration for service in corrosive environments are: temperature, concentration, aeration, influence of inhibiting or accelerating contaminants, influence of recirculation, solids in suspension, velocity, frequency of use, and equipment design. The corrosion data for all grades except Carpenter 20Cb-3 are reprinted from Corrosion Data Survey, 1967 and 1974 Editions, published by the National Association of Corrosion Engineers. The corrosion rates for Carpenter 20Cb-3 stainless represent a composite of the NACE Corrosion Data Survey and more current data developed in Carpenter's Corrosion Laboratory.

The influence of contaminants is probably the most important from a commercial standpoint. Corrosive solutions are seldom found that will be free of all contaminants. However, the majority of these contaminants have no influence on corrosion, but the ones that do generally affect the conditions greatly.

When reviewing these corrosion tables, it is good to keep the following in mind:

Stainless Type 410 is resistant to mild atmospheres.

Stainless Type 430 is resistant to industrial atmospheres.

Stainless Type 304 is resistant to food processing and mild corrodents.

Stainless Type 316 is resistant to chemicals.

20Cb-3 stainless is resistant to severe corrodents.

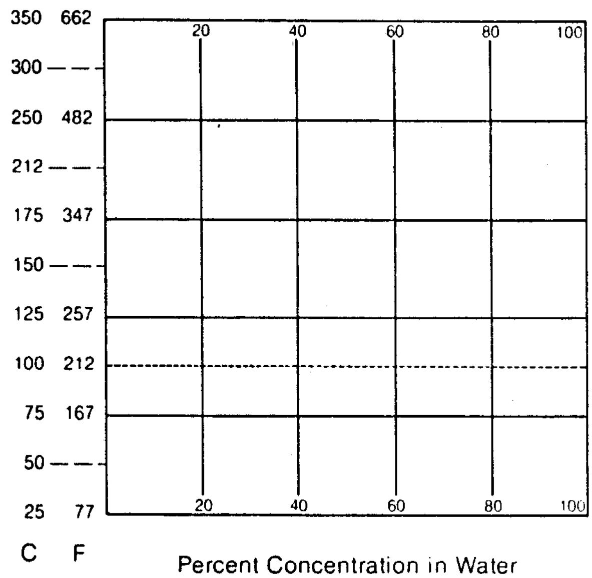
CODE

● Corrosion Rate less than 0.002" per year

○ Corrosion Rate less than 0.020" per year

□ Corrosion Rate from 0.020" to 0.050" per year

× Corrosion Rate greater than 0.050" per year



Footnotes for Corrosives

1 Poison
2 Toxic
3 Explosive
4 Flammable
5 Ingestion poison
6 Inhalant poison
7 Attacks skin
8 Irritant
9 Vapor harmful
10 Ignites organics
11 Fuming liquid
12 Hygroscopic
13 Liberates HCl in water
14 Narcotic
15 Volatile
16 Hazardous under pressure
17 Ignites combustibles
18 Fire hazard
19 Explosive over 70%
20 Ignites in moist air at 30°C
21 Exothermic in water
22 Dust explodes
23 Explosive dust
24 Exothermic with water

Footnotes for Data Squares

1 No water
2 No air, oxygen
3 Low air, oxygen
4 Pits
5 Stress cracks
6 Stress corrosion
7 Discolors
8 Crevice attack
9 Intergranular attack
10 No chlorides
11 May discolor
12 May catalyze
13 May pit
14 May stress crack
15 Transgranular attack
16 Vapor
17 Aerated
18 Catalyzes
19 Static
20 Agitated
21 ~7 pH
22 <7 pH
23 >7 pH
24 No HCl, H_2SO_4, NaCl
25 No ferric chloride
26 ~0.1% acetic acid
27 Also sludge
28 No iron salts
29 No sulfuric acid
30 Explosive
31 With H_2SO_4
32 With steam
33 No sulfur
34 No stress
35 No ammonia
36 300 psi
37 Stress relieved
38 No HCl, Cu, Ni ions
39 No Cu, Fe ions
40 Over 70% air
41 20-70% air, 530 psi
42 With sulfur, <340°C=x
43 <10 mg/1
44 No H_2SO_4
45 <60 psi
46 No sulfides
47 <20% zinc
48 Trace HCl
49 pH 2 to 3.5
50 Annealed, immersed
51 >2.25% Mo
52 Erratic
53 With NaCl
54 With NaCl, HCl, H_2O_2
55 No Fe, Cl
56 With +~0.05−1% H_3PO_4 or H_2SO_4
57 +SO_2 or HCOOH
58 <RC 22, 60,000
59 Annealed
60 No cold work
61 No H_2S
62 Permeable to H_2
63 Unsulfated
64 With or without
65 240 psi
66 Cold worked
67 >80% copper
68 >20% sulfuric, bal. nitric acid
69 No Mo; low C
70 Red fuming
71 Pits in chlorides
72 Over 400°C
73 Steam and air
74 75-100% concentration
75 Low NaCl
76 With HCl
77 <17% zinc
78 <0.23%, 200 psi
79 300 psi
80 No SO_3
81 No NaCl
82 High pressure
83 75-120 psi
84 No sodium sulfite
85 +ammonia
86 Avoid hydroxides
87 Saturated
88 Not wood
89 No free acid
90 Passivated
91 <0.03% water
92 Attacks stress zones near weld
93 pH >12
94 >15 psig
95 No SO_2
96 0.5-2.9 pH
97 >200 ppm water
98 Pits when wet
99 >3 pH

(continued)

TABLE 4.11: VARIOUS STAINLESS STEELS—CARPENTER TECHNOLOGY (continued)

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Acetic Acid Aerated 7, 12	4	24	24	24	
Acetic Acid No Air		8 9	9 24	24	
Acetic Acid Vapor		9			
Acetic Anhydride In Acetic Acid 4, 7, 9					
Acetone 4					
Aluminum Chloride 8, 13	4	4 5	5 1	4 1	4 1
Aluminum Potassium Sulfate	10			4	4
Aluminum Sulfate		7	9 14 17	4	4
Ammonium Carbonate					
Ammonium Chloride	4	4 5	4 5	4	5 4
Ammonium Nitrate 3, 4			9		5
Ammonium Sulfate			4 9 31	4	
Amyl Acetate 4			13	4	
Aniline 1, 7, 9					
Aniline Sulfite					
Arsenic Acid 1					

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Barium Carbonate 1					
Barium Chloride 1	13	4 5	4 5	4	4
Barium Hydroxide 1					
Barium Nitrate 1, 4	4	4	4		
Barium Sulfate					
Benzene 1, 2, 3, 4, 14	16		88		
Benzene Sulfonic Acid	2				
Benzoic Acid					
Boric Acid		4	4		
Butyl Acetate 4, 7, 9			4		
Butyric Acid			24	24	24
Cadmium Sulfate					
Calcium Bisulfite		36 37	9		
Calcium Carbonate					
Calcium Chlorate 4	10	10	10	10	10
Calcium Chloride		4 5	4 5	4	

(continued)

TABLE 4.11: VARIOUS STAINLESS STEELS—CARPENTER TECHNOLOGY (continued)

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Calcium Sulfate					
Camphor					
Carbonic Acid 6, 9	20	816C →	900C →		
Carbon Disulfide 1, 4, 9, 15					
Carbon Monoxide 1, 4	600C →	500C →	500C → 61		
Carbon Tetrachloride 1, 9	1	5 1 →	5 1 → 4 →	4	
Chlorine 1, 16		4 1 → 5	4 1 → 5		
Chloroform 1, 9		4 5 1 →	5 1 →		
Chlorosulfonic Acid 1, 7, 11		4	4	4	4
Chromic Acid 7, 10	44	8 44	4 8 31	4	
Chromic Sulfates					
Citric Acid		4 45	4 10	10	10
Copper Nitrate 1, 10					
Copper Sulfate 1		9 10	89 9		
Cupric Cyanide 1					
Ethanol					

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Ethyl Acetate 4			13		
Ethyl-Chloride 4		1 → 5 →	5 800C → 1 →	1 →	1 →
Ethylene Dibromide 1, 8, 9	4	4	4 1 →	1 →	1 →
Ethylene Dichloride 4, 9	48	21 1 →	21 1 → 4 8	1 →	1 →
Ferric Nitrate 4					
Ferric Sulfate			9		
Ferrous Sulfate		8	4 8	4	4
Fluorine Gas 1, 4, 17					
Fluosilicic Acid 1	4	4 8	4 8		
Formaldehyde 2, 4, 6, 8		20	20		
Formic Acid 3, 7, 9		4 51	4 9	24	24
Furfural 4					4
Gallic Acid					
Glutamic Acid		4 5 8	4 5	4	
Glycerol	4-53 8		13 5-76		
Hexamethylene Tetramine 4, 7					

(continued)

TABLE 4.11: VARIOUS STAINLESS STEELS—CARPENTER TECHNOLOGY (continued)

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Hydrochloric (Aerated) 1, 6, 7, 9	4				
Hydrochloric Acid (No Air)	4				
Hydrocyanic Acid + Hydrogen Cyanide 3, 4, 7, 9	14	6	5 9		
Hydrofluoric Acid (Aerated) 1, 7, 9			5 9		
Hydrogen 4	<1000C 58 59 60 61	<1000C 58 59 60 61	<1000C 58 59 60 61		
Hydrogen Chloride (Anhydrous) 7, 9	500C	500C	14 480C		
Hydrogen Fluoride (Anhydrous)		482C	480C		
Hydrogen Peroxide 3, 7		23	23 90	89	89
Hydrogen Sulfide - Dry 1, 4	538C	538C	538C		
Lactic Acid		4 16 8 9	4 8 9		
Lead Acetate 1, 6					
Lead Nitrate 1, 10					
Lithium Chloride 1		4 5	4 5		
Lithium Hydroxide					
Magnesium Chloride	5	5	4 5	4	5
Magnesium Chloride + Calcium Chloride	17 20	4 6	4 5 8		

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Magnesium Hydroxide Or Magnesium Oxide					
Magnesium Sulfate	10		10		
Maleic Acid 1, 7					
Malic Acid					
Manganese Chloride		5	5		
Mercuric Nitrate 1					
Mercury 1			550C 14		
Methane 3, 4					
Methanol 1, 4, 9					
Methyl Chloride 1, 4, 9		1	91 4 6	1	1
Methylene Chloride 6, 7		4 5	4 6 21	1	1
Mixed Acids H_2SO_4 + HNO_3		68			
Monoethanolamine					
Naphthalene 4					
Naphthenic Acid			4 5 9		
Nickel Chloride			4 5	4	4

(continued)

TABLE 4.11: VARIOUS STAINLESS STEELS—CARPENTER TECHNOLOGY (continued)

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Nickel Nitrate 4					5
Nickel Sulfate					
Nitric Acid 1, 6, 7, 18	70	9 69 37	92 69	81	0.5h
Nitric Acid - Red Fuming 7, 9, 18					
Nitric + Hydro-fluoric Acids					
Nitriding Gases					
Nitro-Benzene 1, 7, 9	22				
Nitro-glycerin 3					
Nitrous Acids					
Nitrous Oxide					
Oleic Acid	20		450PSI	4	4
Oxalic Acid 1, 7		9	9		
Per-chloric Acid 7, 18, 19		1→	1→	1→	
Per-chloro-ethylene 9		4	4		
Phenol 1, 7		365C	4		
Phosphoric Acid (Aerated) 7		9	5 9		

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Phosphorus 1, 4, 7, 20					
Phthalic Anhydride 7		16→	16→		
Phthalic Anhydride (Pure) + Maleic Anhydride					
Picric Acid 1, 3, 4					
Potassium Bromide	13	4	4 6	93	93
Potassium Carbonate					
Potassium Chlorate 1, 10			10		
Potassium Chloride	4	4 5 22	5 4	4	4
Potassium Chromate					
Potassium Cyanide 1, 6, 7					
Potassium Dichromate 1, 7			8 94		
Potassium Ferri-cyanide 1		71	4	4	4
Potassium Ferro-cyanide 1			13		
Potassium Hydroxide 1, 5, 7, 8, 21	2 380C 19	5	5 17		
Potassium Nitrate 4, 10			500C		
Potassium Oxalate					

(continued)

TABLE 4.11: VARIOUS STAINLESS STEELS—CARPENTER TECHNOLOGY (continued)

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Potassium Permanganate 4, 10					
Potassium Peroxide 3, 4, 10					
Potassium Sulfate					
Propionic Acid					
Pyridine 4, 9					
Pyrogallic Acid					
Pyroligneous Acid					
Rosin 4					
Salicylic Acid 22					
Silver Nitrate 1, 7			23	89	89
Sodium Acetate			4		
Sodium Aluminum Sulfate					
Sodium Bicarbonate					
Sodium Bichromate 5, 6					
Sodium Bisulfate		5, 9	4, 5, 9	4	
Sodium Bisulfite		5	5		
Sodium Bromide			13, 700C	4	4
Sodium Carbonate	900C	5-72, 900C	5, 72, 900C	900C	900C
Sodium Chlorate 4	10	10	10		
Sodium Chloride	2, 4, 8, 1	5, 8, 4-22, 1	4, 5, 700C, 1, 23	4	4
Sodium Chromate					
Sodium Citrate					
Sodium Cyanide 1	700C	4, 700C	4, 8, 700C		
Sodium Ferricyanide 1			4	4	4
Sodium Formaldehyde Sulfoxylate			4		
Sodium Hydrosulfide 1, 7, 9					
Sodium Hydroxide 1, 6	5, 300C	4, 5	4, 5	5	5
Sodium Metasilicates					
Sodium Nitrate 10		4, 34, 510C	4, 36, 510C		
Sodium Perborate	10	10			
Sodium Perchlorate 3, 4	75				
Sodium Phosphate		10, 14	4, 14		5

(continued)

TABLE 4.11: VARIOUS STAINLESS STEELS—CARPENTER TECHNOLOGY (continued)

Corrodent	20Cb-3 stainless	Type 316 18-8 Mo	Type 304 18-8	Type 430 17% Cr.	Type 410 12% Cr.
Sodium Phosphate (Tribasic)		5, 17	5, 17		
Sodium Silicates	800-1100C	800-1100C	800-1100C		
Sodium Sulfate 3		840C	5		
Sodium Sulfide 9			4	4	4
Sodium Sulfite					
Stannous Chloride			4	4	
Stearic Acid					
Sulfate Black Liquor					
Sulfate Green Liquor				5	
Sulfite Liquor with 10% Sulfur Dioxide		4, 79			
Sulfur 4, 23	454C	13, 446C	13, 446C	845C	445C
Sulfur Chloride 9	1	4, 1	1	1	1
Sulfur Containing Oils			37		37
Sulfur Dioxide 6	81	4, 80	4, 650C, 9, 95	1	1
Sulfuric Acid Aerated 1, 7, 24			4, 9		
Sulfuric Acid Fuming 1, 6					840-1100C
Sulfuric Acid No Air-Static		9	9		
Sulfurous Acid 6, 9	83	5, 83	9, 45		
Sulfur Trioxide 3, 6, 7, 9, 21	370C	370C	370C, 649C, 1		1
Tall Oil					
Tannic Acid			84		
Tetraphosphoric Acid					
Titanium Tetrachloride 9, 21			1	1	1
Toluene 4, 9					
Trichloroethylene 9		4	4, 96, 97	98	98
Trichloromonofluoroethane					
Trichloropropane					
Trichlorotrifluoroethane					
Triphenyl Phosphite					
Uric Acid 1					
Vinyl Chloride 4	500C	475C	5, 475C, 99		
Zinc Carbonate					
Zinc Chloride		4, 5, 8	4, 5, 8	3	
Zinc Sulfate		4, 8, 16	4, 8, 16		

TABLE 4.12: VARIOUS STAINLESS STEELS—CYCLOPS

UNILOY Type 410: hardenable martensitic stainless steel
UNILOY Type 430: nonhardenable ferritic stainless steel
UNILOY Type 304 and 316: austenitic stainless steel

CORROSION DATA

MEDIA	CONCENTRATION	°F.	TYPE 410	TYPE 430	TYPE 304	TYPE 316
Acetic Acid	5% Aerated	70	II	I	I	I
	10% Aerated	70	IV	II	I	I
	10%	Boiling	IV	II	I	I
	60%	60	IV	III	I	I
	60%	Boiling	IV	III	II	II
	100%	70	IV	III	I	I
	100%	Boiling	IV	III	II	II
Acetic Anhydride	90% Anhydride	70	III	III	II	II
	90%	Boiling	IV	IV	IV	II
Acetylene		70	I	I	I	I
Alcohol	Ethyl	70	II	II	II	I
	Methyl	70	II	II	II	I
Aluminum Acetate	20%	70	II	II	II	II
	20%	Boiling	II	II	II	II
Aluminum Chloride	5%	70	IV	IV	IV	III
	25%	70	IV	IV	IV	III
Aluminum Fluoride	5%	70	IV	IV	IV	IV
Aluminum Potassium Sulphate (Alum)	10%	70	III	III	II	II
	10%	Boiling	IV	IV	II	II
Aluminum Sulphate	10%	70	IV	IV	I	I
Ammonia		70	I	I	I	I
Ammonium Carbonate	1%	70	II	II		
	5%	70	II	II		
Ammonium Chloride	10%	Boiling	IV	IV	IV	II
Ammonium Hydroxide		70	I	I	I	I
Ammonium Nitrate	All concentrations	70	II	I	I	I
Ammonium Perchlorate	10%	70	II	II	II	II
	10%	Boiling	IV	IV	II	II
Ammonium Sulphate	10%	70	III	III	II	II
	10%	Boiling	IV	IV	II	II
Ammonium Sulphite		70	IV	IV	III	II
Aniline	Concentrated	70	II	II	II	II
Barium Chloride	10%	70	III	II	II	II
Beer		70	III	III	I	I
Benzoic Acid	10%	70	II	II	II	II
Blood		70	I	I	I	I
Boric Acid	10%	70	II	II	I	I
	Saturated	Boiling	III	III	II	II
Buttermilk		70	I	I	I	I

I—Very Good II—Good III—Fair IV—Poor

(continued)

TABLE 4.12: VARIOUS STAINLESS STEELS—CYCLOPS (continued)

MEDIA	CONCENTRATION	°F.	TYPE 410	TYPE 430	TYPE 304	TYPE 316
Butyric Acid	10%	70	III	III	II	II
	10%	Boiling	III	III	II	II
Calcium Carbonate	10%	70	II	I	I	I
Calcium Chloride	10%	70	II	III	II	II
Cane Juice	Sugar Cane	70	II	II	I	I
Carbolic Acid	C.P.	70	II	II	II	II
Carbon Dioxide (Dry)		70	I	I	I	I
Carbonic Acid		70	II	II	II	II
Chloracetic Acid	All concentrations	70	IV	IV	IV	IV
Chromic Acid	10% C.P.	70	III	II	II	II
	50% C.P.	70	IV	IV	II	II
Citric Acid	10%	70	II	II	II	II
	10%	Boiling	IV	III	II	II
	50%	70	III	II	II	II
	50%	Boiling	IV	IV	IV	II
Copper Chloride (Cupric Chloride)	10%	70	IV	IV	IV	IV
Copper Nitrate (Cupric Nitrate)	10%	70	II	II	I	I
Copper Sulphate (Cupric Sulphate)	10%	70	II	II	I	I
	10%	Boiling	III	II	I	I
Cottonseed Oil		70	I	I	I	I
Epsom Salt (Magnesium Sulphate)	10%	70	IV	I	I	I
Ethylene Glycol	All concentrations	70	I	I	I	I
Fatty Acids	100%	70	II	II	II	I
Ferric Chloride	10%	70	IV	IV	IV	IV
Ferric Nitrate	10%	70	II	II	II	II
	50%	70	II	II	II	II
Ferric Sulphate	10%	70	II	II	II	II
	50%	70	II	II	II	II
Fluorine (Gas)	100%		IV	I	I	I
Formaldehyde	40%	70	II	II	I	I
Formic Acid	10%	70	II	III	II	I
	50%	70	IV	IV	II	I
Gasoline	Containing H_2S	70	III	III	I	I
	Refined	70	I	I	I	I
Glue	Dry	70	I	I	I	I
Hydrobromic Acid	All concentrations	70	IV	IV	IV	IV
Hydrochloric Acid	All concentrations	70	IV	IV	IV	IV

I—Very Good II—Good III—Fair IV—Poor

(continued)

TABLE 4.12: VARIOUS STAINLESS STEELS–CYCLOPS (continued)

MEDIA	CONCENTRATION	°F.	TYPE 410	TYPE 430	TYPE 304	TYPE 316
Hydrogen Peroxide	10%	70	II	II	I	I
Lactic Acid	10%	70	IV	IV	II	II
Magnesium Carbonate	10%	70	II	II	II	II
Magnesium Chloride	10%	70	III	II	III	II
Magnesium Sulphate	10%	70	IV	I	I	I
	10%	70	II	II		
	10%	Boiling	IV	IV	I	I
Molasses		70	II	II	I	I
Nitric Acid	10%	70	II	II	I	I
	10%	Boiling	IV	II	I	I
	20%	70	II	II	I	I
	20%	Boiling	IV	II	II	II
	40%	70	II	II	I	I
	40%	Boiling	IV	II	II	II
	90%	70	IV	II	I	I
	100%	70	IV	III	I	I
	100%	Boiling	IV	IV	IV	IV
Oxalic Acid	10%	70	IV	II	II	II
Phosphoric Acid	10% Aerated	70	II	II	II	I
	10% Air Free	70	IV	IV	II	II
Picric Acid	All concentrations	70	II	II	II	II
Potassium Bichromate	10%	70	II	II	II	II
Potassium Chloride	10%	70	II	II	II	I
Potassium Dichromate	10%	70	II	II	I	I
Potassium Permanganate	10%	70	I	II	II	II
	10%	Boiling	IV	IV	II	II
Propane	100%		I	I	I	I
Silver Nitrate	10%	70	II	II	II	I
	10%	Boiling	II	II	II	II
Sodium Bisulphate	10%	70	I	I	I	I
Sodium Hydroxide	10%	70	I	I	I	I
Sodium Nitrite	10%	70	II	II	II	II
Sodium Phosphate	10%	70	II	II	II	II
Sodium Sulphate	10%	70	III	II	II	I
Tannic Acid	10%	70	II	II	II	II
Tartaric Acid	10%	70	II	II	I	II
Turpentine		70	I	I	I	I
Uric Acid	100%	70	II	II	II	II
Vegetable Oils		70	I	I	I	I

I—Very Good II—Good III—Fair IV—Poor

TABLE 4.12: VARIOUS STAINLESS STEELS—CYCLOPS (continued)

UNILOY TYPE NO.	410	430	304	316
COMPOSITION Wt. per cent	C .15 max. Cr 11.50/13.50 Mn 1.00 max. Si 1.00 max. P .040 max. S .030 max.	C .12 max. Cr 14.00/18.00 Mn 1.00 max. Si 1.00 max. P .040 max. S .030 max.	C .08 max. Cr 18.00/20.00 Ni 8.00/10.00 Mn 2.00 max. Si 1.00 max. P .045 max. S .030 max.	C .08 max. Cr 16.00/18.00 Ni 10.00/14.00 Mn 2.00 max. Si 1.00 max. P .045 max. S .030 max. Mo 2.00/3.00

UNILOY 13-8 Martensitic Stainless Steel

UNILOY 13-8, a precipitation hardening, martensitic stainless steel, has high strength, ductility and toughness in large cross sections in both longitudinal and transverse directions.

TYPICAL ANALYSIS (in weight percent)

Carbon	0.05 Max.
Manganese	0.10 Max.
Silicon	0.10 Max.
Sulfur	0.008 Max.
Phosphorus	0.010 Max.
Chromium	12.25-13.25
Nickel	7.50- 8.50
Molybdenum	2.00- 2.50
Aluminum	0.90- 1.35

The general corrosion resistance of Uniloy 13-8 is superior to the standard martensitic stainless grades. Much like Uniloy® 17-4 and Uniloy® 15-5, this alloy's corrosion resistance approaches that of Type 304 stainless steel. The general corrosion resistance is greatest in the fully hardened condition (H 950) and decreases slightly as the aging temperature increases.

Uniloy 13-8, the most resistant to stress corrosion cracking of any of the precipitation hardening stainless steels, attains highest resistance at the higher aging temperatures.

UNILOY 15-5 Martensitic Stainless Steel

UNILOY® 15-5, a precipitation hardening stainless steel, offers a broad range of mechanical properties for a variety of applications, particularly those that require high transverse strength and toughness.

TYPICAL ANALYSIS (in weight percent)

Carbon	0.07 Max.
Manganese	1.00 Max.
Silicon	1.00 Max.
Sulfur	0.03 Max.
Phosphorus	0.04 Max.
Chromium	14.00-15.50
Nickel	3.50 - 5.50
Copper	2.50 - 4.50
Columbium plus Tantalum	0.15 - 0.45

Uniloy 15-5 exhibits lower corrosion resistance but higher stress-corrosion cracking resistance. When hardened at H 1025 condition and tested in boiling 65% nitric acid, the corrosion rate is 0.127 inches per year (3.2 mm/year); in 1% hydrochloric acid at 100°F (38°C) the rate is 0.083 inches per year (2.1 mm/year); exposure in 5% salt fog at 95°F (35°C) for 10 days results in 0 to 5% rust.

UNILOY 17-4 Martensitic Stainless Steel

UNILOY 17-4 is a unique stainless steel. It is martensitic and magnetic, capable of precipitation or age hardening to various levels of hardness and strength. It is normally purchased in the annealed condition and because of its great stability, it can be machined very near finished dimensions prior to heat treatment (900° to 1150°).

Uniloy 17-4 has a high resistance to corrosion. It stands up to corrosive attack better than any of the hardenable stainless steels (martensitic) and is comparable to Type 304. It is used regularly in such industries as chemical processing, dairy, petroleum, food processing, paper and marine.

TYPE ANALYSIS

Carbon	0.07 Max.
Manganese	1.00 Max.
Silicon	1.00 Max.
Sulphur	0.03 Max.
Phosphorus	0.04 Max.
Chrome	15.00-17.50
Nickel	3.00- 5.00
Columbium Plus Tantalum	0.15- 0.45
Copper	3.00- 5.00

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM

Stress Corrosion Cracking of Stainless Steels "U" Bends in Boiling 42% $MgCl_2$

Alloy	Time to Failure, hrs	Ref
Type 304	8	2
Type 316	48	2
Type 430	624 NF	2
Type 434	1800 NF	3
18Cr-2Mo	1704 NF	4
26Cr-1Mo	1200 NF	5
26Cr-1Mo-Ti	516 NF(2)	6
21Cr-3Mo-Ti(1)	2000 NF	7
28Cr-4Mo	2400 NF(2)	8

(1) Specimen was a stressed bolt
(2) Nominal 45% $MgCl_2$
NF = No Failure

Crevice Corrosion in Oxygen Saturated Chloride Solutions, 90 C*

Solution	Weight Loss, (mg/dm²/day) 434	304	316	18Cr-2Mo
200 ppm Cl^-, 1 ppm Cu^{++}	41.0	15.0	2.6	0.2
600 ppm Cl^-, 1 ppm Cu^{++}	241.0	11.8	3.5	0.8

* Steigerwald, R. F. TAPPI, Vol. 56, p. 129 (1973).

Corrosion Rates for Stainless Steels* (24-hour Exposure) No Activation

Corrosive Medium	Temp.	Corrosion Rate (mpy) T304	T316	18Cr-2Mo
20% Acetic Acid	Boiling	30	0.3	0.2
80% Acetic Acid	Boiling	–	–	0.2
20% Citric Acid	Boiling	0.4	0.5	0.3
30% Formic Acid	Boiling	81	29	34
45% Formic Acid	Boiling	–	–	212
20% Lactic Acid	Boiling	73	0.1	0.2
40% Nitric Acid	Boiling	2.4	2.2	2.3
1% Oxalic Acid	Boiling	–	–	20
3% Oxalic Acid	Boiling	110	57	57(1)
10% Oxalic Acid	Boiling	74	47	2340
50% Phosphoric Acid	Boiling	785	7.5	4.4
2% Sulfuric Acid	30 C	1.3	0	400
25% Sodium Hydroxide	100 C	1.1	1.9	7.6
35% Sodium Hydroxide	100 C	2.2	1.6	20
50% Sodium Hydroxide	100 C	3.0	2.7	24

* Lizlovs, E. A. Climax Molybdenum Co. of Michigan, personal communication (1973).

(1) Active/passive behavior

Pitting of Stainless Steels in Oxygen-Saturated NaCl Solutions—90 C During 30-Day Exposure*

Solution	Weight Loss (mg/dm²/day) 430	434	304	316	18Cr-2Mo
3% NaCl (18,200 ppm Cl^-)	46	0.4	0	–	0
0.1% NaCl (609 ppm Cl^-, partial immersion)	48	0	0	–	0
1200 ppm Cl^-, 400 ppm Cu^{++}	900	400	187	–	183
180 ppm Cl^-, 60 ppm Cu^{++}	40	14	5	–	0.9
600 ppm Cl^-, 1 ppm Cu^{++}, 5 ppm Zn^{++}	–	4.7	6.1	–	0.4
600 ppm Cl^-, 5 ppm Cu^{++}	–	24.3	14	1.4	3.3
600 ppm Cl^-, 20 ppm Cu^{++}	–	82.5	84.4	9.0	6.0

* Steigerwald, R. F. TAPPI, Vol. 56, p. 129 (1973).

Pitting Corrosion in 10% $FeCl_3 \cdot 6H_2O$ at Room Temperature*

Alloy	Weight-loss (mg/dm²/day)
18Cr-2Mo-Ti	1250
Type 304	485
Type 316	97
22Cr-2Mo	0
26Cr-1Mo	0
26Cr-1Mo-Ti	0
28Cr-4Mo	0

*Bond, A. P., Marshall, J. D., Dundas, H. J. STP No. 425 ASTM, Philadelphia, p. 116 (1948).

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Crevice Corrosion in 10% $FeCl_3 \cdot 6H_2O$*

Alloy	Result Room Temp.	50 C
Type 304	C	–
Type 316	C	–
Carpenter 20Cb3	C	–
Inconel 600	C	–
Inconel 625	R	C
Hastelloy Alloy C	R	R
26Cr-1Mo	–	C
28Cr-4Mo	R	R
28Cr-4Mo-2Ni	R	R
Titanium	R	R

* Streicher, M. A. Corrosion, Vol. 30, p. 77 (1974).

C = Crevice Corrosion R = Resists Crevice Corrosion

Pitting Potentials 1M NaCl–25 C*

Alloy	Pitting Potential, V vs SCE
Type 304	-0.030
Type 316	0.315
Type 216	NP
Armco 22-13-5	NP
JS700	NP
Alloy 6X	NP

* Lizlovs, E. A. Climax Molybdenum Co. of Michigan, personal communication (1973).

NP = No Pitting

Crevice Corrosion in 10% $FeCl_3 \cdot 6H_2O$ Solution (pH=1) at 25 C*

Material	Corrosion Rate mg/dm^2/day	Remarks
Alloy 6X	0	
JS-700	0	
Armco 22-13-5	1.4	Some crevice corrosion
Type 216	50.8	Crevice corrosion
Type 316	207	Severe crevice corrosion, some pitting
Type 304	376	Severe crevice corrosion, some pitting

* Lizlovs, E. A. Climax Molybdenum Co. of Michigan, personal communication (1973).

Comparison of Corrosion Behavior of Ferralium Alloy and Type 316 Stainless Steel*

Solution	Temperature	Corrosion Rate (mpy) Type 316	Ferralium Alloy
10% Acetic Acid	Boiling	0.1	0.4
20% Formic Acid	Boiling	3.1	6.5
10% Oxalic Acid	Boiling	39	235
1N Sulfuric Acid	Boiling	2600	46
10% $FeCl_3$	Room	640	25
3% NaCl	Boiling	0.2	0.4
3% NaCl + 20 ppm Cu**	Room	1.0	0.4

* "Ferralium Alloy, Preliminary Data Sheet", Stellite Division, Cabot Corporation, Kokomo, Indiana.

Service Performance of an Austenitic-Ferritic Stainless Steel*

Application	Conditions	Material Failed	3RE60 Performance
Desalting Crude Oil	800-900 ppm Cl^- pH = 6-7, 75-195 C	Type 304 Failed by stress-corrosion	5 years, no attack
Air Cooler Desulfurization	5 ppm Cl^-, 1000 ppm H_2S, 10 ppm NH_3 60-140 C	Type 316Ti stress-corrosion 6 mo.	4 years, no corrosion
Waste Water Treatment	5000 ppm H_2S, 15 ppm Cl^- pH=8, 30-80 C 90 ppm mercaptan	Type 316 Failed by stress-corrosion, 6 mo.	3.5 years no corrosion
Heat Exchanger, Town Gas	380-400 C 570 psi	Type 321 stress-corrosion 6-12 mo.	18 mo., no attack
Heat Exchanger Chemical Industry	River water 300-500 ppm Cl^-	Type 321 stress-corrosion 6 mo.	1 year, no attack
Cooling Coils	River water 300-500 ppm Cl^-	Type 316Ti stress-corrosion 6-12 mo.	1 year, no attack

* Carlen, J. C., Helmer, C. NACE CORROSION/73, paper No. 13.

Comparative Corrosion Rates for High Alloys*

Solution	Temperature	Corrosion Rate (mpy) MP35N	Hastelloy Alloy C	Inconel Alloy 625
65% HNO_3	Boiling	37	440	23
50% H_2SO_4 + 41.2g/l $Fe_2(SO_4)_3H_2O$	Boiling	14	190	20
10% H_2SO_4	Boiling	38	21	7.9
5% HCl	Boiling	610	120	790
1.08% HCl	Boiling	185	22	140
10% Oxalic Acid	Boiling	9.8	8.5	8.8
10% $FeCl_3 \cdot 6H_2O$ + 0.1N HCl	90 C	0	0	–

* Bond, A. P. Climax Molybdenum Co. of Michigan, Private communication (1970).

[The tables above have been reprinted from *Materials Performance,* Vol. 13, No. 9, pp. 9-16 (1974) September.]

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

KEY to special symbols used in the following table to denote type of test, aeration and agitation during test, specific details of material samples tested and modes of corrosion.

Type of Test	F	field or pilot plant test
	L	laboratory test
Temperature	R.T.	room temperature
	B.P.	boiling
Aeration	—	none
	x	slight to moderate
	xx	strong
Agitation	—	none
	x	slight to moderate
	xx	rapid
Type 304		* Type 302 or Type 304 with carbon over the standard maximum
"20"		Wrought material is Carpenter 20; castings correspond to ACI CN-7M

Corrosion Rates Capital letters in front of corrosion-rate figures refer to condition of the material tested	S	sensitized
	L	low carbon grade (0.03% C max)
	C	cast
	W	welded
Lower-case letters after corrosion-rate figures refer to observed mode of corrosion where the attack was not uniform	a	slight pitting (maximum depth of pits from incipient to 0.005 in.)
	b	moderate pitting (maximum depth of pits from 0.005 to 0.010 in.)
	c	severe pitting (maximum depth of pits over 0.010 in.)
	d	crevice attack (tendency to concentration-cell corrosion)
	r	stress corrosion cracking

Alloy 825 Huntington Alloy Products Division, The International Nickel Company, Inc.

Note: The compositions of corrosion media reported are those given by the cooperating companies and do not always total 100%.

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
ACETALDEHYDE											
100%	Rayon	F	142	414	—	xx	0.0001	0.0001	...	...	...
98-97%, water remainder	Rayon	F	150	294	—	x	...	nil	<0.0001	...	...
ACETALDEHYDE MIXTURES											
99%, water 1%, acidity as acetic acid 0.014%, phosphates trace, pH 2.3	Chemical	F	150	609	—	x	nil	nil	...	...	...
99%, ethylene oxide 1%	Rayon	F	133	1645	—	xx	<0.0001	...	...	...	...
99%, ethylene oxide 0.85%, methyl formate 0.15%	Chemical	F	144	897	—	xx	nil	...	...	...	...
98.01%, ethylene oxide 1.92%, carbon dioxide 0.07%, crotonaldehyde 0.0%	Chemical	F	150	147	—	xx	nil	nil	...	...	...
98%, low boilers 2% (secondary oxidation)	Chemical (distillation)	F	135	129	—	x	<0.0001*	<0.0001	<0.0001	...	...
98%, methyl formate 2%	Chemical	F	135	623	x	xx	...	<0.0001	...	...	...
95%, methyl formate 3%, methyl acetate 2%	Chemical	F	140	805	x	x	...	nil	nil	...	...
85%, low boilers 12%, acetic acid 3%	Chemical	F	170	75	x	xx	...	0.0001	...	...	...
83%, carbon dioxide 6%, dimethyl ether 5%, methyl formate 4%, butane 2%	Rayon	F	142	1158	—	xx	<0.0001	<0.0001	<0.0001	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetaldehyde mixtures											
80%, acetic acid 8%, formic acid 0.3%, water remainder	Chemical	F	220	357	x	xx	...	<0.0001	<0.0001	...	...
75%, vinyl acetate 20%, acetic acid 5%	Rayon	F	239	664	—	xx	0.0006	0.0002	0.0002	...	...
75%, methyl formate 14%, methyl acetate 10.5%, water 0.3%, acetic acid 0.2%	Chemical	F	158	805	x	x	...	nil	nil	...	...
70%, acetic acid 14.5%, water 15%, formic acid 0.5%	Chemical	F	210-215	84.5	x	xx	...	0.0001	...	...	...
70%, acetic acid 14.3%, formic acid 0.3%, water remainder	Chemical	F	245	169	x	xx	...	0.0046a	0.0007	...	...
70%, acetic acid 8%, low boilers 3%, water remainder	Chemical	F	220	100	—	x	...	nil	0.0001	...	...
70%, acetone 10%, methyl formate 8%, methyl acetate 7%, vinyl acetate 5%	Chemical	F	158	133	x	x	<0.0001	<0.0001	...	...	...
70%, methyl formate 10%, methyl acetate 8%, acetone 7%, vinyl acetate 5%	Chemical	F	190	610	—	x	nil	nil	...	...	...
70%, acetone, methanol, higher alcohols and oxides, water 2%	Chemical	F	160	349	—	xx	nil	...	...	...	...
50%, acetic acid 12%, low boilers 3%, water remainder	Chemical	F	198	246	—	x	...	nil	nil	...	...
50%, acetic acid 10%, low boilers 3%, water remainder	Chemical	F	198	81	—	x	...	<0.0001	nil	...	...
50%, combined organics 45% (acetone, methanol, trimethylene oxide, etc), sodium acetate 1000 ppm approximately, formaldehyde 500 ppm approximately, some resinous matter, water 5%	Chemical	F	195-200	265	x	xx	<0.0001	<0.0001	...	...	...
45%, acetaldol 40%, water 10-15%, high boilers 4-5%	Chemical	F	80	1025	—	x	nil	nil	...	...	...
42%, water 30%, indirect acidity 23%, formic acid 4%, acetic acid 0.5%	Chemical	F	216	510	—	—	...	<0.0001	<0.0001	...	...
40%, acetone, methanol, water and ethyl alcohol together 60%	Chemical	..	176	456	—	..	<0.0001	nil	...	...	...
40%, acetone, methanol and glycol together 50-60%, formaldehyde 2000 ppm max	Research	L	176	542	—	x	nil a	nil	...	...	...
40%, combined organics 40% (acetone, methanol, oxides, etc), formaldehyde 2000 ppm approximately, sodium acetate 1000 ppm approximately, pH 5.5-6.0	Chemical	F	230	265	x	xx	<0.0001	<0.0001	...	...	...
37%, acetone, water, methanol and ethyl alcohol together 60%	Chemical	..	176	456	—	..	<0.0001	<0.0001	...	...	...
36.92%, water 62%, formic acid 1.07%, propylene oxide 0.01%, pH 2.3	Chemical	F	195	11.6	—	xx	0.28	0.011	...	...	...
35%, water 40%, acetic acid 6%, low boilers 5% (methyl formate 20-60%, methanol, methyl acetate and acetone), formic acid 1%	Rayon	F	117	335	—	xx	...	...	0.00011	<0.0001	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetaldehyde mixtures											
35%, water 38%, crotonaldehyde and aldol 24%, phosphoric acid, sodium phosphate	Chemical	F	225	183	—	xx	nil	nil	...	...	...
35%, water 38%, crotonaldehyde 24%, phosphoric acid, sodium phosphate and unidentified 3%	Chemical	..	410	147	—	x	nil	nil	...	...	...
30% approximately, water 67%, formic acid 1.11%, methyl formate and propylene oxide	Chemical	F	210	11.6	—	—	0.13	0.003	...	...	...
29.5%, water 45.4%, crotonaldehyde 21.9%, hexadiene aldehyde 1.3%, butyl butyrate <1.3%, butyric acid <0.6%	Chemical	F	220	449	—	xx	<0.0001	<0.0001	...	...	...
20%, acetone 22%, *t*-butanol 20%, ethanol 15%, isopropanol 10%, water 6%, acetals 3%, acidity 0.5%, *n*-proponal 0.3%, carbonyls 0.2%	Chemical	F	150-230	508	—	xx	0.0013c	0.0001a	...	...	...
20%, low boilers 3% (methyl acetate, methyl formate, etc), water remainder	Chemical	F	140-142	174	—	xx	...	0.0001	...	0.0001	...
5%, *t*-butanol 29%, ethanol 21.9%, isopropanol 17.1%, water 12.6%, carbonyls 4.1%, acetone 3.94%, methanol 3.7%, *n*-propanol 1.3%, acetals 1%, acidity 0.36%, formic and acetic acids traces	Chemical	F	126-140	508	xx	xx	<0.0001a	<0.0001	...	...	...
ACETIC ACID											
100%	Rayon	F	245	756	—	x	...	0.00016d	<0.0001	...	...
100-80%	Chemical (solvents)	F	B.P.	3.5	..	..	0.012*	<0.0001	...	...	...
100-80% (half immersed)	Chemical (solvents)	F	B.P.	3.5	..	..	0.0048*	<0.0001	...	...	...
100-80% (vapors)	Chemical (solvents)	F	B.P.	3.5	..	..	0.0076*	0.00015	...	...	...
99.98%, water 0.017%	Chemical	..	224	71	..	x	...	0.0042	0.00018	...	...
99.98%, water 0.017%	Chemical	..	224	71	..	x	...	0.0024	<0.0001	...	...
99.9%, C.P. glacial acetic acid	Research	L	B.P.	5-6	—	—	...	0.0009	...	...	...
99.9%, water <1%	Chemical	F	222	40	—	xx	...	0.0004	0.0003	0.0003	0.0002
glacial acetic acid	Research	L	B.P.	7	..	..	0.027	...	...	C0.0001	...
glacial acetic acid (column)	Chemical (distillation)	F	B.P.	11	..	..	0.012 0.023*	0.00084	...	...	...
glacial acetic acid	Research	L	B.P.	4	..	..	C0.0064*	C0.00036	...	...	...
glacial acetic acid	Research	L	B.P.	6	..	..	0.0027*	L nil	...	...	...
glacial acetic acid (vapors)	Synthetic Rubber	L	932	1	—	xx	0.002	nil	...	...	...
99.7%	**Research**	F	**249**	**261**	—	xx	...	0.032	...	...	...
99.7%	**Chemical**	L	**244**	...	..	..	L0.0009	L0.00075	...	...	...
99.7%	Chemical	L	**293**	...	..	..	L0.0556	0.270 L0.0142	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic acid											
99.5% approximately (column)	Chemical (distillation)	F	266	51	—	x	. . .	0.003	0.004	0.0005	. . .
99.43%, water 0.2%	Chemical	F	222	28	—	x	. . .	0.0009a	0.00046	. . .	. . .
99.43%, water 0.03%	Chemical	F	222	23	—	x	. . .	0.0012	0.00021	. . .	. . .
99%, water 1%	Rayon	F	235	266	. .	xx	. . .	0.0004	0.0004	0.0004	. . .
99% (vapors)	Chemical (solvents)	F	212-249	82	. .	. .	0.066c	0.0025	. . .	. . .	. . .
99-98%	Chemical	F	244	625	. .	xx	0.018a	0.0003	0.0003	. . .	. . .
98%, water 2%	Plastic	F	73-112	157	x	—	<0.0001* <0.006*	nil	<0.0001	. . .	. . .
98%	Chemical	F	128	51	—	x	0.0074	0.002 S0.004	0.0012	0.002	. . .
97% approximately (column)	Chemical (distillation)	F	250	51	—	x	0.042	0.016	0.001	0.008	. . .
95%	Chemical	F	240	216	—	xx	. . .	0.055	0.012	. . .	. . .
83% approximately (column)	Chemical (distillation)	F	240	51	—	x	0.066	0.009	0.004	0.005	. . .
80%, commercially pure acetic acid (bottom of storage tank)	Chemical (solvents)	F	R.T.	13.8	. .	. .	<0.0001 <0.0001*	. . .	0.0001	. . .	. . .
75%	Research	L	B.P.	7	. .	. .	0.033	. . .	. . .	C<0.0001	. . .
75%	Research	L	285	. . .	. .	. .	C0.006	. . .	. . .	. . .	. . .
75%	Research	L	340	. . .	. .	. .	. . .	C0.001	. . .	. . .	. . .
75%	Research	L	355	. . .	. .	. .	C0.860	. . .	. . .	. . .	. . .
75%	Research	L	395	. . .	. .	. .	. . .	C0.007	. . .	. . .	. . .
70%	Research	L	B.P.	. . .	—	—	0.17	. . .	. . .	. . .	. . .
67%, water 33%	Rayon	F	212	377	—	xx	. . .	0.002	. . .	0.001	0.0015
50%	Jewelry	L	223	2	. .	. .	. . .	0.0011	. . .	. . .	. . .
50%	Research	L	B.P.	0.25	—	x	0.210	. . .	. . .	. . .	. . .
50%	Research	L	B.P.	. . .	—	—	0.20	nil	. . .	. . .	. . .
50%	Research	L	B.P.	7	. .	. .	0.0004	. . .	. . .	C0.0002	. . .
35%	Chemical	L	190	. . .	. .	. .	0.0001	0.0001	. . .	. . .	. . .
30%	Chemical	F	330	36.5	. .	. .	. . .	nil	. . .	C0.0018	. . .
30%	Research	L	230	. . .	. .	. .	C<0.001	C0.001	. . .	. . .	. . .

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic acid											
30%	Research	L	330	...	..	..	C0.010	C0.003	...	...	...
30%	Research	L	350	...	..	..	C0.140	C0.020	...	...	...
30%	Research	L	370	...	..	..	C0.160	C0.210	...	...	...
20%	Chemical	L	213	...	..	..	L0.0018 S0.0001	L0.0035 S0.0002	...	...	...
10%	Chemical	L	B.P.	7	..	..	0.0699*	...	...	...	...
10%	Research	L	B.P.	15	xx	x	nil*	...	...	...	...
10%	Research	L	B.P.	7	..	..	0.0002	...	...	C0.0001	...
10%	Research	L	B.P.	2	—	—	0.049*	...	...	...	...
10%	Research	L	B.P.	2	—	—	L0.053	...	...	...	...
10% (column)	Chemical (distillation)	F	232	51	—	x	...	0.0002 S0.00036	0.0003	0.004	...
5%	Chemical	L	213	...	..	..	L0.0016	L0.0009	...	...	...
ACETIC-ACID MIXTURES see also ACETIC-ACID MIXTURES WITH FORMIC ACID and ACETIC-ANHYDRIDE MIXTURES WITH ACETIC ACID											
99.98%, water 0.017%, sulfur trioxide trace	Chemical	F	224	25	x	xx	...	0.0033	0.0013	...	...
99.9%, dichromate added over one 24-hour period, water <0.1%	Chemical	F	222	18	—	x	...	0.0039a	0.0024a	...	...
99.9%, dichromate added over one 24-hour period, water <0.1%	Chemical	F	222	13	—	xx	...	0.0013	0.001	...	...
99.9%, dichromate and permanganate added	Chemical	F	251	31	..	xx	0.5a	0.02	..	...	...
99.8%, propionic acid and water traces	Chemical	F	245	36	..	..	0.06r	0.008r	0.004	...	...
99.8%, propionic acid and water traces	Chemical	F	245	50	..	..	...	0.03	0.025	...	...
99.8%, propionic acid and water traces	Chemical	F	245	93	..	..	0.082	0.03r	...	...	...
99.7%, water 2%, manganese acetate 0.1%	Chemical	F	253	29	..	xx	...	0.001	...	0.0026	0.0008
99.7%, water 2%, manganese acetate 0.1%	Chemical	F	248	40	..	xx	...	0.0008	...	0.0002	0.0007
99.7%, propionic acid, isobutyric and *n*-butyric acids traces (column)	Chemical	F	255	21	—	xx	0.0058	0.0005	0.0005	...	...
99.6%, water 0.3-0.4%, acetaldehyde 0.02%, some chromate added	Chemical	F	216	406	—	xx	...	0.00032	0.0001	...	...
99.5%, water 0.45%, salicylates 0.05% (column, vapors)	Pharmaceutical	F	234	42.5	x	xx	0.005*	0.0041	0.003	0.0022	...
99.49%, water 0.04%, mineral acid trace, no sulfur trioxide	Chemical	..	211	25	x	xx	...	0.0055b	0.0011a	...	...
99.49%, water 0.04%, mineral acid trace, no sulfur trioxide, chromate added	Chemical	..	215	71	..	..	...	0.0036b	0.0006a	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures											
99.49%, water 0.04%, mineral acid trace, no sulfur trioxide	Chemical	..	211	71	—	..	...	0.0043b	0.00052a	...	...
99.43%, water 0.04%, mineral acid trace	Chemical	..	215	25	x	xx	...	0.0038	0.0023	...	...
99.43%, water 0.04%, mineral acid trace	Chemical	..	215	71	—	..	...	0.00079a	0.00036	...	...
99.43%, water 0.04%, mineral acid trace, chromate added	Chemical	..	220	71	xx	..	...	0.0003	<0.0001	...	...
99.43%, water 0.04%, mineral acid trace, chromate 35 lb/day	Chemical	..	230	88	..	x	...	0.00067	0.00043	...	...
99.43%, water 0.04%, mineral acid trace, sulfur trioxide trace	Chemical	..	215	25	x	xx	...	0.0038a	0.0023	...	...
99%, high boilers 1-2%, water 0.05%	Chemical	F	228	28	—	xx	...	0.0024a	0.00041a	...	...
99%, high boilers, 0.5%, water 0.5%, carbon deposit on all specimens, pressure 40 psig	Chemical	F	311	171	—	x	...	0.0027d L0.00108d	0.00108d	...	...
99%, acetic anhydride 1%, pressure 2 psig	Chemical	F	250	638	—	x	...	0.00071	0.00062a	...	...
99%, heavy ends remainder	Chemical	F	248	833	..	..	0.04c	0.016a	...	...	...
99%, water 1%, acetic anhydride trace	Rayon	F	235	728	—	xx	...	0.0016	...	0.0012	0.0011a
99-98%, high boilers 1-2%, water 0.017%	Chemical	F	228	23	—	x	...	0.00084	0.00053	...	...
99-98%, high boilers 1-2%, water 0.017%, dichromate 35 lb/day	Chemical	F	235	88	..	x	...	0.0019a	0.00092	...	...
99-98%, high boilers 1-2%, water <0.1%	Chemical	F	228	40	—	xx	...	0.0004	0.0002	0.0002	0.0002
99-98%, high boilers 1-2%, water <0.1%, dichromate 50 lb/day	Chemical	F	228	75	—	x	...	0.0007	0.0006	...	...
99-98%, high boilers 1-2%, water <0.1%, dichromate 100 lb/day	Chemical	F	228	13	—	xx	...	0.0017	0.0026	...	...
98%, acetic anhydride 2%	Chemical	F	250	638	—	x	...	0.0073b	0.0065b	...	...
98%, high boilers, water trace	Chemical	F	253	473	—	xx	...	<0.0001	0.0001	...	...
98%, high boilers (esters) 2%	Chemical	F	250	72	—	xx	...	0.0048a	0.0021a	...	...
98%, esters, high and low boilers, propionic acid trace	Chemical	F	240	72	—	xx	...	0.002a	0.002a	...	...
98%, glycol diacetate 1.9%, water 0.1%, dichromate trace	Chemical	F	252	43	—	xx	...	0.0001	0.0004	...	...
98%, salicylates 1.5%, water 0.5% (evaporator vapors)	Pharmaceutical (evaporation)	F	265	2	x	xx	0.017*	0.0011	0.0009	0.0024	...
98%, light ends, esters, etc together 2%	Chemical	F	235	73	..	xx	...	0.002	0.0009	...	...
96.4%, propionic acid 3.1%, acetic anhydride 0.5%	Chemical	F	248	50	..	..	...	0.008	0.0006	0.004	...
96%, propionic acid 3.1%, butyric acid 1%, nitric acid 1%	Chemical	..	170-284	54	..	xx	...	0.0002	...	0.0004	0.0004

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures											
95%, propionic acid 5%	Chemical	F	176-284	125	..	xx	0.05	0.004	0.001	...	...
95%, propionic acid 5%	Chemical	F	252	36	..	..	0.02r	0.002r	0.0016	...	...
95%, propionic acid 5%	Chemical	F	252	50	..	..	...	0.0025	0.002	...	...
95%, propionic acid 5%	Chemical	F	252	93	..	..	0.033	0.01	...	...	...
95-85% (bottom of column)	Chemical (distillation)	F	250	30	x	..	...	0.006	...	...	0.002
94%, acetic anhydride 6%	Chemical	F	265	638	—	xx	...	0.0007	0.0005	...	...
91.86%, water 6.69%, salicylic acid 0.95%, naphtha 0.5% (vapors)	Pharmaceutical	F	246	58	x	xx	0.021	0.014	0.005	0.005	...
91.68%, water 7.46%, salicylic acid (vapors)	Pharmaceutical	F	250	37	x	xx	0.009*	0.0012	0.0011	0.001	..
91%, propionic acid 6.5%, acetic anhydride 1.5%, water 1%	Chemical	F	248	36	..	..	0.065r	0.007r	0.001	...	...
91-86%, salicylic acid 8.4% (nozzle between exit of calandria and base section of still column)	Pharmaceutical	F	260	37	x	xx	0.137	0.034	0.011	0.103	...
90%, propionic acid 10% (variable)	Chemical	F	275	137	..	..	...	0.01a	0.006r	C0.002a	...
90%, manganese acetate 10%, water 0.5%, manganese dioxide 0.15%, permanganate added	Rayon	F	259	96	—	xx	...	0.0004	0.0002	0.0003	...
90%, manganese acetate 10%, water 0.5%, manganese dioxide 0.15%, permanganate added	Rayon	F	259	75	—	xx	0.0006	0.0003	...	...	...
90%, manganese acetate 10%, water 0.5%, manganese dioxide 0.15%, permanganate added	Rayon	F	...	72	—	xx	...	0.0024	0.0016	0.0015	...
90%, manganese acetate 10%, water 0.5%, manganese dioxide 0.15%, permanganate added	Rayon	F	259	72	—	xx	...	0.0003 0.001	0.0002 0.0007	0.0004	...
90%, water remainder, high boilers trace	Chemical	F	300-310	23	—	xx	...	0.0047	...	C0.002	...
87%, acetic anhydride 13%, pressure 4 psig	Chemical	F	270	638	—	x	...	0.00073a	0.00036	...	...
85%, acetaldehyde 2%, diacetyl 1%, glycol diacetate, oxygen trace	Chemical	F	240	12	x	xx	...	0.0006	0.0002	...	...
85%, acetaldehyde 2%, diacetyl 1%, glycol diacetate, oxygen trace	Chemical	F	240	12	x	xx	...	0.0002	0.0004	...	...
85%, acetaldehyde 2%, diacetyl 1%, glycol diacetate 1%, dichromate 0.1%, water remainder, pH 1.4-1.6	Chemical	F	235	2	—	xx	...	0.0005	0.0011	...	...
85%, acetaldehyde 2%, diacetyl 1%, glycol diacetate 1%, dichromate 0.1%, water remainder, pH 1.4-1.6	Chemical	F	235	7	—	xx	...	0.0033	0.0003	...	...
85%, acetaldehyde 2%, glycol diacetate 1%, diacetyl 1%, unknown reducing agent trace (possibly sulfur dioxide), water remainder, pH 1.2	Chemical	F	240	35	—	xx	corr	0.312	0.117	...	...
85%, acetic anhydride 10%, water 5%, acetone, acetonitrile, amines, etc (vapor line, column)	Chemical	F	239	875	—	xx	0.0036	0.0008	0.0007	0.0004	0.0003

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy) Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures											
85%, water 5%, acetaldehyde 1-2% (bottom of oxidizer)	Chemical	F	194	35	xx	x	0.0013 0.0014	0.0003 0.0018	0.0003	0.0002	0.0019
75%, glycol diacetate 16%, water 9%, acetaldehyde 1.6%, diacetyl 0.8%, sodium sulfate and acetate 0.6%, unknown reducing agent trace	Chemical	F	300	15	x	xx	0.386	0.0358	...	...	...
75%, glycol diacetate 16%, water 9%, acetaldehyde 1.6%, diacetyl 0.8%, sodium sulfate and acetate 0.6%, unknown reducing agent trace	Chemical	F	300	12	x	xx	...	0.0035a	0.0001	...	...
74.66%, water 24.97%, naphtha 1%, salicylic acid 0.27% (vapors)	Pharmaceutical (distillation)	F	226	57.5	x	x	>0.105	0.032	0.01	0.01	...
74.66%, water 24.97%, naphtha 1%, salicylic acid 0.27% (vapors)	Pharmaceutical (distillation)	F	226	45	x	x	corr	0.077	...	...	...
74.66%, water 24.97%, naphtha 1%, salicylic acid 0.27% (vapors)	Pharmaceutical (distillation)	F	226	28	x	xx	...	0.0004	0.0004	0.0004	...
72%, glycol diacetate 16%, water 9%, diacetyl 0.8%, sodium acetate and sulfate 0.6%, unknown reducing agent trace	Chemical	F	300	35	—	xx	corr	0.128a	0.0528a	...	...
72%, glycol diacetate 16%, water 9%, acetaldehyde 1.6%, diacetyl 1%, sodium acetate and sulfate 0.6%	Chemical	F	300	26	x	xx	...	0.0002d	<0.0001	...	...
67%, propionic acid 33%	Chemical	F	273	93	..	..	0.016a	0.0022a	...	...	...
65%, water 30%, light ends 5%	Chemical	F	225	32	—	x	corr	0.007	0.0025	...	...
64.6%, nitric acid 33.2%, water 1.6%, nitrogen tetroxide 0.6%	Chemical	F	179	32	—	—	0.0002 S0.0003 L0.0003	0.0003	...	0.0004	0.0005
64%, nitric acid 25%, water 11%	Metal (cleaning)	F	110	61	x	x	<0.0001 S0.0001	L<0.0001	...	<0.0001	0.001 S0.0002
60%, water 35%, propionic acid 4%, butyric acid 1%	Rayon	F	217	381	—	xx	...	0.0001	0.0001	0.0002	...
60%, acetic anhydride 40%	Chemical	F	257-275	718	—	xx	0.01	0.001	0.0009	...	...
60%, hydrocarbons 18%, esters 9%, carbon monoxide 8%, water 5%	Chemical	F	356	300	x	xx	...	0.009	0.004	...	...
58-10%, acetic anhydride 1-40%, sulfuric acid 0.25-4%	Chemical	F	5-122	75	x	xx	<0.0001	<0.0001	...	nil	...
57.5%, sulfuric acid 30.3%, water 12.3% (liquid line)	Plastic	F	104	74	x	—	<0.0001	<0.0001	<0.0001	...	...
55.5%, water 43.48%, naphtha 1%, salicylic acid 0.016%	Pharmaceutical	F	219	57.5	x	x	0.025	0.0016	0.0013	0.0017	...
55%, glycol diacetate 40%, sludge (manganese acetate and resin) 4.8%, steam injection, water 0.1-0.2%	Chemical	F	310	97	–	xx	...	0.005a	0.0017a	...	...
51%, propionic acid 29.5%, acetic anhydride 11.5%, propionic anhydride 7.5%	Chemical	F	275	97	..	..	0.032	0.014r	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures											
51%, propionic acid 29.5%, acetic anhydride 11.5%, propionic anhydride 7.5%	Chemical	F	275	50	..	..	...	0.01	0.007	C0.007	...
50%, water 20%, esters 12%, carbon monoxide 10%, hydrocarbons 5%	Chemical	F	356	258	xx	xx	...	0.002	0.001	...	...
50%, water 20%, esters 12%, carbon monoxide 10%, hydrocarbons 8%	Chemical	F	356	300	xx	xx	...	0.0004	0.0003	...	...
50%, vinyl acetate 50%	Chemical	F	266	133	—	x	0.002	0.001	...	...	...
50%, vinyl acetate 50%	Chemical	F	194	150	..	x	0.0003 0.0005	0.0002	...	...	...
50%, water 25%, ethyl acetate 7%, various esters, ketones and alcohols together 7%, methyl acetate 5%, methylethyl ketone 4%, acetone 2%	Chemical	F	131	360	—	x	<0.0001	<0.0001	...	...	...
50%, water 25%, carbonyls and esters 25%	Chemical	F	125	108	x	—	nil	nil	nil	...	...
50%, acetic anhydride 50%, some peracetic acid and ethylidene acetate (column, liquid header)	Chemical (fractionation)	F	228	140	—	xx	...	0.0005	<0.0001	...	...
45%, vinyl acetate 40%, acetaldehyde 12%, acetic anhydride 2%, light ends 1%, acetone trace	Chemical	F	220	609	..	x	nil	nil	...	...	...
45%, high boilers 55%	Chemical	F	310	300	—	x	...	0.0016	0.0057	...	...
40%, butane 20%, ethyl acetate 8%, propionic acid 6%, pentane 5%, methylethyl ketone 5%, other esters and ketones	Chemical	F	356	220	..	xx	0.03	0.007	...	...	...
40%, butane 20%, ethyl acetate 8%, propionic acid 6%, pentane 5%, methylethyl ketone 5%, other esters and ketones	Chemical	F	347	216	x	xx	...	0.003	...	0.002	0.002
40%, butane 20%, ethyl acetate 8%, propionic acid 6%, pentane 5%, methylethyl ketone 5%, other esters and ketones together 16%	Chemical	F	347	216	x	xx	0.014	0.0013	...	...	...
40%, vinyl acetate 40%, acetaldehyde 15%, acetic anhydride	Chemical	F	194	150	..	x	0.06	0.0015	...	...	...
40%, ethyl propionate 60% during 16 days, water 95% and mixed alcohols 5% during 36 days	Chemical	..	212	52	..	xx	0.0004a	0.0002a	...	...	...
40%, butane 25%, esters 15%, carbonyls 15%, water 5%	Chemical	F	345	108	x	x	0.0624c	0.0071b S0.0092c	...	...	...
35%, *sec*-butyl acetate 40%, *n*-propyl acetate 8%, *sec*-butanol 7%, *n*-propanol 7%, water 3%, toluene sulfonic acid 0.25%	Chemical	F	235-245	75	—	x	...	0.0207	0.0092	...	...
35%, *sec*-butyl acetate 40%, *n*-propyl acetate 8%, *sec*-butanol 7%, *n*-propanol 7%, water 3%, toluene sulfonic acid 0.25%	Chemical	F	235-245	92	—	x	0.0912c 0.0519c	0.0312c 0.0083c	0.0152c 0.0067a	... ...	... ...
30%, acetaldehyde 3%, water remainder	Chemical	F	110	129	x	x	<0.0001*	<0.0001	<0.0001	...	...
30%, acetaldehyde 0.5%, water remainder	Chemical	F	100	129	x	x	<0.0001*	<0.0001	<0.0001	...	...
30%, light ends 20%, water remainder	Chemical	F	185	321	xx	x	0.051	0.0009	0.0002	...	...
30%, *sec*-butyl acetate 42%, *n*-propanol 18%, *n*-propyl acetate 9%, *sec*-butanol 7%, water 4%, toluene sulfonic and sulfuric acid traces	Chemical	F	230	52	—	xx	0.1735c	0.0512c	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures											
27%, high boilers 70%, water 3%, sulfuric acid used in hydrolysis, dichromate 28 lb/day and soda 12 lb/day added	Chemical	F	280	28	x	x	...	0.025	0.00043	...	...
27%, high boilers 70%, water 3%, phosphoric acid used in hydrolysis, no dichromate or soda added	Chemical	F	280	12	x	x	...	0.0031a	0.00025	...	...
25%, organic esters 75%	Chemical	L	68-185	15	..	..	<0.0001	nil	...	...	...
24% approximately (column)	Chemical (distillation)	F	231	51	—	x	corr	0.0027	0.0027	0.004	...
24%, water 74%, formaldehyde trace	Plastic	F	95	115	x	—	<0.0001*	<0.0001	<0.0001	...	...
23.44%, water 75.56%, naphtha 1%, salicylic acid 0.011% (column, vapors)	Pharmaceutical	F	212	57.5	x	x	0.042	0.0007	0.0012	0.0002	...
20%, glycol diacetate 78%, sodium sulfate and acetate 1-2%, solids trace, dichromate trace	Chemical	F	320	42	—	xx	0.0477c	0.007a	0.006a	...	...
20%, water 78%, benzene 2%	Chemical	F	171-208	214	—	x	0.0008	<0.0001	...	...	...
20%, water 30%, acetaldehyde remainder	Chemical	F	210	112	—	x	0.0026	0.0007	0.0002	...	...
9.7%, high boilers 89.8%, water 0.5%	Chemical	..	335	72	x	xx	...	0.016	0.0032	...	...
5%, sulfuric acid 1%	Pulp and Paper	F	70-250	20	x	..	<0.0001a <0.0001a*	<0.0001	...	...	...
5%, butyric acid	Chemical	..	239-284	54	..	xx	...	0.0017	...	0.001	0.001
4%, butane 56%, other organics 27%, nitrogen 10%, water 2%, carbon dioxide 1%	Chemical	..	356	220	x	xx	0.001	0.0006	...	...	...
4%, butane 56%, other organics 27%, nitrogen 10%, water 2%, carbon dioxide 1%	Chemical	..	347	220	x	xx	0.0007c	0.0004c	...	...	...
2.5-1.75%, furfural 0.5-1% (vapors and condensate)	Chemical	F	208-220	132	—	..	0.0001	0.0001	0.0001	0.0001	0.0001
2.2%, methyl acetate 60%, water 18%, acetaldehyde 5%, methyl acetate 4-5%, methanol 4%, acetone 2.5%, ethyl acetate 1.5%	Chemical (distillation, secondary oxidation)	F	223	45	—	xx	0.031	0.0077	0.01	...	...
2-1%, ethylidene diacetate 25-50%, acetic acid 2-4%, vinyl acetate 1-2%, toluene sulfonic acid 0.2%	Chemical	F	<300	14	x	x	...	...	0.0003	0.0003	...
1%, water 98%, carbonyls 1%	Chemical	F	212	29	—	xx	0.0001	0.0002	...	...	...
1%, water 98.4%, sulfuric acid 0.8%	Chemical (distillation)	F	224	87	x	xx	...	0.0132	...	0.0032	0.0041
ACETIC-ACID MIXTURES WITH FORMIC ACID											
99.9%, water <0.1%, acetaldehyde 0.02%, formic acid <0.01%, dichromate added over one 24-hour period	Chemical	F	216	18.3	—	xx	...	0.0033a L0.0027a	0.0011a	0.0021b	...
99.9%, water <0.1%, acetaldehyde 0.02%, formic acid <0.01%, no dichromate added	Chemical	F	216	40	—	xx	...	0.0005	0.0004	0.0003	0.0002

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures with formic acid											
99.9%, formic acid <0.01%	Chemical	F	248	296	x	x	...	0.0007	0.0003	...	...
99.9%, formic acid <0.01%	Chemical	F	216	15	—	x	...	0.0035a	0.0021a	0.0027a	0.0017
99.87%, formic acid trace	Rayon	F	244	243	—	xx	...	0.00023 0.00019	0.00017 0.00015	0.00034	...
99.8%, water 1.6%, permanganate 0.3%, formic acid 0.3%	Chemical	..	248	40	..	xx	...	0.0018	...	0.0016	0.0018
99.8%, formic acid 0.02%, permanganate trace, no water	Rayon	F	255	75	—	xx	...	0.0025	0.0028	0.0022	...
99.8-90%, formic and propionic acids in water, azeotropic solution	Chemical	F	266	56	x	xx	0.0355	0.0124	...	...	0.0044
99.7%, formic acid 0.02%, permanganate 0.03%	Chemical (distillation, secondary oxidation)	F	248	152	—	x	0.005	0.0004 L0.0004	0.0005	...	...
99.7%, permanganate <0.02%, formic acid <0.01%	Chemical (fractionation, secondary oxidation)	F	244	244	—	x	...	0.0017	0.001	...	...
99.6%, formic acid 0.3%, water 0.1% (natural circulation evaporator)	Chemical (evaporation)	F	272	20	x	x	0.0058	0.0001	0.0001	0.0048	0.0002
99.6%, formic acid <0.01%	Chemical	F	216	23	—	x	...	0.0011	nil	...	...
99.6%, acetaldehyde 0.02%, formic acid <0.01%, dichromate added 40 lb/day	Chemical	F	216	28	—	xx	...	0.00076a	0.00015a	...	...
99.6%, glycol diacetate 0.1%, water <0.1%, formic acid, high boilers and aldehydes remainder	Chemical	F	290	436	—	xx	...	0.0015	0.0015	...	...
99%, formic acid 0.5%, water 0.5%	Chemical	F	255	116	x	x	0.03b	0.0023	0.0017	...	...
99%, water 0.6%, formic acid 0.2%, formaldehyde 0.1%, propionic acid 0.1%	Rayon	F	250	253	—	xx	0.028	0.013	...	...	...
98.7%, propionic acid 0.4%, formic acid 0.3%, high boilers, manganese dioxide, butyric acid trace	Rayon	F	243	243	—	xx	0.011 0.0046	0.00043 0.00031	...	...	...
98.5%, water 0.1%, formic acid 0.01%, high boilers remainder	Chemical	F	275	75	—	xx	...	0.0027 L0.0022	...	...	...
98.2%, propionic acid 0.6%, water 0.4%, high boilers 0.3%, formic acid 0.2%, butyric acid 0.1%, some manganese dioxide	Rayon	F	248	243	—	xx	...	0.0024 0.0021	0.002 0.0018	...	...
98%, formic acid 0.2%, remainder unknown	Chemical	F	212-252	6	..	xx	...	<0.0001 <0.0001	<0.0001 0.0002	0.0004 0.0001	...
98%, propionic acid 1%, water 0.7%, formic acid 0.2%, formaldehyde 0.1%	Rayon	F	257	253	—	xx	0.07	0.006	...	...	...
98-96.5%, formic acid 1.5%, water 1-1.5%	Rayon	..	255	262	x	x	...	0.015	...	0.01	0.006
97%, water 1%, formic acid 2%	Chemical	F	240-284	291	..	xx	0.0053c	0.0003	0.0002	...	...
97%, water 1%, formic acid 2%	Chemical	F	226	54	..	xx	...	0.0023	...	0.0028	0.0021

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures with formic acid											
97%, formic acid 1.5%, water 1.5%	Chemical	F	348	892	—	x	...	0.0021	0.0026	...	...
97%, formic acid 1.3%, propionic acid 1%, heavy esters 0.5%, water 0.2%	Rayon	..	225	382	—	xx	...	0.0009	0.0004	0.0006	...
97%, formic acid 1%, heavy esters 0.5%, water 0.2%, methylethyl ketone, ethyl acetate and benzene traces	Rayon	..	248	382	—	xx	...	0.0035	0.0025	0.0015	...
97%, water 0.7%, formic acid 0.2%, formaldehyde 0.1%	Rayon	F	262	253	—	xx	0.03	0.0001	...	...	...
97-96%, water 3%, formic acid 0.5%	Rayon	F	342	76	—	xx	0.055	0.005	...	...	...
96.5%, formic acid 1.5%, esters 1%, carbonyls 1%	Chemical	F	250	337	..	x	0.04	0.009	0.006	...	...
96%, formic acid 1.5%	Rayon	F	336	315	—	xx	...	0.018 0.003	0.008 0.0029	0.013 0.0015	...
96%, water 4%, formic acid trace, propionic acid trace, permanganate injected at tray	Rayon	..	239	243	—	xx	0.0098	0.011	...	...	...
95.4%, water 1.5%, formic acid 0.69%, propionic acid 0.1%	....	F	235	266	..	xx	...	0.0002	0.0001	0.0001	...
95%, formic acid 1.5-3%, permanganate 0.5%, remainder unknown	Chemical	..	230-291	...	..	xx	...	0.0027	...	0.0024	0.0015
95%, water 4%, formic acid 1%, high boilers trace	Rayon	F	311	567	—	xx	...	0.0025 0.0032 0.012	0.0058	0.0019 0.0089	...
95%, water, formic acid trace, high boilers remainder	Chemical	F	290	43	x	x	...	0.0001	<0.0001	...	...
94%, water 3.4%, formic acid 2.3%, propionic acid trace	Rayon	F	226	243	—	xx	...	0.00049	<0.0001	...	...
94%, high boilers 5%, formic acid 1%	Rayon	F	257	465	—	xx	...	0.003 0.006	...	0.001 0.001	0.0007 0.0015
91.5%, water 6%, formic acid 2.5%	Chemical	..	230	54	..	xx	...	0.0028	...	0.0005	0.0031
90.1%, water 6%, formic acid 1.75%	Rayon	F	235	266	..	xx	...	0.0002	0.0001	<0.0001	...
90%, acetaldehyde 7%, water 3%, formic acid 1%	Chemical	..	211	511	..	xx	...	<0.0001d	<0.0001d	...	...
90%, water 8%, ethyl acetate 0.5%, unsaturates 0.5%, methylethyl ketone 0.4%, propionic acid, formic acid trace, biacetyl trace	Rayon	F	225	243	—	xx	0.031	L0.0026	...	...	...
89%, acetaldehyde 7%, water 3%, formic acid 1%	Chemical	..	250	511	—	—	0.006cd	0.0001	<0.0001	...	...
89%, formic acid 1%, propionic and butyric acids	Rayon	F	248	382	—	xx	0.0025	0.0004	...	...	...
88.1%, water 10%, ethyl acetate 0.5%, unsaturates 0.5%, methylethyl ketone 0.5%, biacetyls 0.1%, formic acid trace, propionic acid trace	Rayon	F	221	243	—	xx	...	0.0009 0.00078	0.00051 0.00031	0.00051	...
87%, acetaldehyde 7%, formic acid 1%, low and high boilers, water remainder	Rayon	F	252	756	—	xx	0.0027d	<0.0001d	<0.0001	...	...
86.5-85%, butyric and propionic acids together 9%, formic acid 3%, water 1.5-3%, pressure 3 psig	Chemical	F	244	166	—	x	0.0068c	0.00074	0.001	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures with formic acid											
85%, acetaldehyde 8%, low boilers 2%, formic acid 0.75%, high boilers 0.1%, water remainder	Chemical	F	260	135	—	xx	. . .	0.0004	0.0002	. . .	. . .
85%, acetaldehyde 8%, low boilers 2%, formic acid 0.75%, high boilers 0.1%, water remainder	Chemical	F	235	300	—	x	. . .	0.0003	0.0002	. . .	. . .
85%, acetaldehyde 8%, low boilers 2%, formic acid 0.75%, high boilers 0.1%, water remainder	Chemical	F	250	300	—	x	. . .	0.0011	0.0006	. . .	. . .
85%, acetaldehyde 8%, low boilers 2%, formic acid 0.75%, high boilers 0.1%, water remainder	Chemical	F	545	300	—	x	. . .	nil	0.0001	. . .	. . .
85%, acetaldehyde 7%, water 5%, methyl acetate and formate 2%, formic acid 0.5%	Rayon	F	221	756	—	xx	. . .	0.00011 0.00013	<0.0001	. . .	. . .
71.28%, acetaldehyde 7.37%, formic acid 1.96%, water and low boilers remainder	Chemical	F	240	135	—	xx	>0.12	0.0268	0.0009	. . .	. . .
65%, acetaldehyde 15%, formic acid 3%, low boilers 1%, water remainder	Chemical	F	245	558	x	xx	. . .	0.0001	0.0001	0.0001	. . .
65-60%, formic acid 2-2.5%, water remainder	Chemical	F	230	113	—	x	. . .	0.0004a L0.0046a	0.004a	. . .	. . .
62%, acetaldehyde 18%, formic acid 3%, low boilers 1%, water remainder	Chemical	F	235	179	x	xx	. . .	0.0085	0.0001	0.018 0.002	. . .
62%, acetaldehyde 18%, formic acid 1.5%, low boilers and water remainder	Chemical	F	235	300	—	xx	. . .	0.0018	0.0003	. . .	. . .
60%, acetaldehyde 20%, water 12%, methyl formate and acetate 6%, formic acid 2%	Rayon	F	221	756	—	xx	. . .	<0.001	<0.001	. . .	. . .
60%, water 38%, formic acid 2%	Chemical	F	221	315	. .	x	. . .	0.008	0.004	. . .	. . .
60%, water 35%, propionic acid 4%, formic acid 1%, butyric acid 1%	Rayon	F	226	536	—	xx	. . .	0.0007	0.0005	0.0003	. . .
60-55%, formic acid 1-1.6%, methyl acetate 0.5%, water remainder	Chemical	F	220-240	57	—	xx	. . .	0.085 L0.076	. . .	C0.05b	. . .
60-50%, water 25-30%, acetaldehyde 10-15%, indirect acidity 3-4%, formic acid 3%	Chemical	F	217	511	x	—	. . .	0.0002d	<0.0001	. . .	. . .
55-50%, formic acid 0.5%, esters, ketones, alcohols, aldehydes, butane, pentane, nitrogen, carbon monoxide and carbon dioxide remainder	Rayon	F	365-383	359	x	x	0.006	0.0008	. . .	. . .	. . .
55-50%, formic acid 0.5%, esters, ketones, alcohols, aldehydes, butane, pentane, nitrogen, carbon monoxide and carbon dioxide remainder	Rayon	F	356-378	360	—	xx	0.01c	0.0035	. . .	. . .	. . .
50.9%, water 43.2%, propionic acid 1.7%, formic acid 1.7%, butyric acid 0.5%, high boilers	Chemical	. .	221	452	. .	xx	. . .	0.009 L0.0108	. . .	. . .	. . .
50%, water 28%, ethyl acetate 4%, methylethyl ketone 4%, propionic acid 3%, alcohols 3%, dimethyl ketone 1%, acetaldehyde 1%, methyl formate 1%, formic acid 0.5%	Rayon	F	208	525	—	xx	<0.0001	<0.0001	. . .	. . .	. . .
50-30%, formic acid 2-10%, methyl formate 5%, acetaldehyde, methyl acetate, ethyl acetate, acetone, methanol, water remainder	Chemical	F	223	99	—	x	. . .	. . .	0.0089	0.015	. . .

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures with formic acid											
45%, high and low boilers 29.5%, water 24%, formic acid 1.5%	Chemical	..	200	380	..	xx	...	0.0003 L0.0008	0.0001	...	...
40%, water 50%, acetaldehyde 8%, formic acid 2%	Chemical	..	230	511	—	x	...	0.0009	<0.0001	...	...
40%, formic acid 1.5-2%, acetaldehyde 1%, low boilers trace, water remainder	Chemical	F	110	81	xx	—	...	<0.0001	0.0001	...	...
40%, formic acid 1-1.3%, water remainder	Chemical	F	242	277	x	xx	...	0.023c	0.0088b	...	...
40%, formic acid 0.9-1.2%, water remainder	Chemical	F	256	247	—	xx	...	<0.0001	nil	...	...
40%, butane 20%, esters and ketones 16%, ethyl acetate 8%, pentane 5%, methylethyl ketone 5%, formic acid 0.5%	Rayon	F	338-374	358	x	xx	0.031	0.011	...	...	...
40%, butane 20%, esters and ketones 16%, ethyl acetate 8%, pentane 5%, methylethyl ketone 5%, formic acid 0.5%	Rayon	F	338-374	359	—	xx	0.006	0.002	...	...	...
40-35%, formic acid 5.2%	Chemical	F	230	131	—	x	0.018*	0.0006	0.0006	...	...
40-30%, formic acid 4-10%, methyl acetate 0.5-1%, water remainder	Chemical	F	220	112	—	x	...	0.0046	...	0.013	...
40-30%, formic acid 1-1.5%	Chemical (distillation, secondary oxidation)	F	220	106	—	xx	0.019	0.0001	0.0002	...	...
35%, acetaldehyde 3%, formic acid 1%	Chemical	F	100	81	x	xx	...	<0.0001	<0.0001	...	...
35%, formic acid 0.9-1.2%, water remainder	Chemical	F	256	300	—	xx	...	0.0089	0.0023	...	...
35%, formic acid 0.9-1.2%, water remainder	Chemical	F	256	150	—	xx	...	0.0001	0.0007	...	...
35%, formic acid 0.9-1.2%, water remainder	Chemical	F	256	81	—	xx	...	0.0079c	0.0038a	...	...
35-25%, formic acid 0.8-1.5%, water remainder	Rayon	F	262	433	—	—	...	0.026	0.0058	...	...
33%, formic acid 66%, water	Chemical	..	255	511	—	x	...	0.003d	0.002	...	...
33%, formic acid 1.5%, water	Chemical	F	270	246	x	xx	...	0.0001	0.0001	...	...
33%, formic acid 1.5%, water	Chemical	F	270	246	x	xx	...	0.0001d	...	C0.0001	...
30%, formic acid 8%, water remainder	Chemical (fractionation, secondary oxidation)	F	275	112	—	x	...	0.0045	0.0018	...	...
30%, acetaldehyde 5%, formic acid 4%, water remainder	Chemical	F	245	300	—	x	...	0.0001	0.0001	...	...
30%, formic acid 1.2-1.6%, water remainder	Chemical	F	265	172	x	xx	...	0.0202c	0.0065b	...	...
30%, formic acid 1%, acetaldehyde 1%, water remainder	Chemical	F	72	511	—	—	...	<0.0001	<0.0001	...	...
28%, water 70%, formic acid 1%, propionic acid 1%	Rayon	F	208	382	—	xx	0.003	<0.0001	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures with formic acid											
25%, formic acid 4%, low boilers 1%, water remainder	Chemical (distillation, secondary oxidation)	F	220	117	—	xx	>0.059*	0.0033	0.002	...	...
25%, formic acid 1.5%, low boilers 1%, water remainder	Chemical (distillation, secondary oxidation)	F	220	129	—	xx	0.0093*	0.001	0.0003	...	...
25%, formic acid 1.5%, low boilers 1%, water remainder	Chemical	F	220	129	—	xx	0.0093*	0.001	0.002	...	...
25%, water 73.5%, formic acid 1.5%	Chemical	F	212	315	..	x	0.008c	0.002	0.001	...	...
21%, water 78%, formic acid 1%	Chemical	F	239	229	..	xx	...	0.026	0.012	...	...
18%, water 81%, formic acid 1%, pressure 1 psig	Chemical	F	208	167	—	x	0.1c	0.0145	0.0076	...	...
17%, water 82%, formic acid 1%	Chemical	F	210	436	..	x	...	0.0018 L0.0007	0.0007	...	...
16%, ethyl acetate 35%, benzene 32%, low boilers 9.5%, formic acid 6-7%	Chemical	F	235	213	—	xx	...	0.018	0.01	...	...
16%, ethyl acetate 35%, benzene 32%, low boilers 9.5%, formic acid 0.39%, water 1.5%	Chemical	F	194	696	—	xx	...	0.0099	0.0024	...	...
15-12%, formic acid 0.3-0.4%, methyl acetate <0.2%, methyl formate <0.2%, water remainder	Chemical	F	265	169	x	xx	...	0.0001	0.0001	0.0001	...
12%, formic acid 1.5-4%, water remainder	Chemical	F	250	355	..	..	...	0.014	0.0023	...	...
12%, formic acid 1.5-3%, water remainder	Chemical	F	246	355	..	..	...	0.0006	0.0001	...	...
12%, formic acid 0.5%, water remainder	Chemical	F	280	169	x	xx	...	0.014	0.0001	0.009	...
12%, formic acid 0.4%, water remainder	Chemical	F	280	169	x	xx	...	0.0001	...	0.0001	...
10%, ethyl acetate 36%, methylethyl ketone 27%, benzene 18%, water 6%, propionate esters 2%, formic acid 0.5%, propionic acid 0.5%	Rayon	..	217	382	—	xx	0.034 0.006	0.0001	...	...	...
8%, water 87%, methanol 4%, formic acid 1%, methyl acetate, acetone	Chemical	F	240	227	x	xx	...	0.02c	0.006b	...	...
7.5%, water 65%, methanol 8%, esters 7.2%, acetaldehyde 2%, ethanol 1%, formic acid 0.3%, propionic acid 0.2%	Rayon	F	158	585	—	xx	0.0003	0.0001	...	...	...
7%, water 65%, methanol 7%, acetone 7%, methyl acetate 3%, ethanol 2%, acetaldehyde 2%, formic acid 0.5%	Rayon	F	191	706	—	xx	0.005c	0.0007	...	...	...
7-5%, water 91%, indirect acidity 1.5%, formic acid 1%, acetaldehyde 0.5%	Chemical	..	208	511	—	x	...	<0.0001	<0.0001	...	...
6%, low boilers 2%, formic acid 1%, water remainder	Rayon	F	257	756	—	xx	...	0.00029d 0.00021d	0.00014 0.00013	...	...
6%, methyl acetate 6%, methyl formate 1%, formic acid 0.5-0.75%, water remainder	Chemical	F	250	95	—	xx	...	0.0061a	0.0021	...	...
6%, methyl acetate 6%, methyl formate 1%, formic acid 0.5-0.75%, water remainder	Chemical	F	230-240	95	—	xx	...	0.002a <0.0001a	0.0034a	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-acid mixtures with formic acid											
6%, methyl acetate 6%, methyl formate 1%, formic acid 0.5-0.75%, water remainder	Chemical	F	175	179	—	xx	...	<0.0001	...	...	...
6-4%, methyl acetate 6%, methyl formate 1%, formic acid 0.5-0.75%, water remainder	Chemical	F	150	81	—	x	...	<0.0001	<0.0001	...	...
4%, formic acid 0.25%, water remainder	Chemical	F	222	63	—	xx	...	0.0002	0.0004	...	...
4%, formic acid 0.25%, water remainder	Chemical	F	217	417	—	x	...	0.0013	0.00012	...	...
4%, formic acid 0.25%, water vapor	Chemical	F	222	63	—	xx	...	0.0002	0.0004	...	...
4%, methyl acetate 7%, methanol 3%, formic acid 0.25%, water remainder	Chemical	F	210-215	63	—	xx	...	nil	nil	...	...
0.5%, acetaldehyde 35%, water 20%, formic acid 3.5%	Rayon	..	216	436	—	—	...	0.006 0.0015	0.003	...	...
0.4%, formic acid 1.65%, water remainder	Chemical	F	230	40	—	xx	...	0.0021d L0.0037d	0.0031d	0.0031d	...
0.3%, formic acid 0.4%, solvent trace, water remainder	Chemical	F	230	1025	—	x	...	nil	...	...	...
acetic and formic acids, ethylene dichloride, water	Pulp and Paper	F	161	31	..	x	...	0.0107	...	0.0057	0.0049
mostly acetic acid, formic, propionic and butyric acids	Petro-chemical	F	650	63	—	x	0.019	0.0009 0.02	...	...	...
organic acids effluent containing vapors of acetic, formic, butyric, propionic acids, steam, hydrogen, carbon dioxide and ash	Chemical	F	R.T.-212	75	xx	xx	<0.0001	<0.0001	...	...	...
acetic acid, ethanol, ethyl acetate, acetaldehyde, formic acid trace	Chemical	F	205	880	xx	xx	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
acetic and formic acids, water	Textile	F	212	35	xx	..	<0.0001	<0.0001	...	...	...
acetic acid, toluene 2 g/l, formic acid	Textile	F	210	10	—	xx	<0.0001	<0.0001	...	...	...
ACETIC ANHYDRIDE											
100%	Chemical	F	277	571	—	x	0.012	0.005	0.003	...	...
100%	Rayon	F	273	287	—	xx	...	0.0001	...	0.0001	0.0001
acetic anyhdride	Chemical	L	283	...	..	..	L0.0003 L0.0002	L0.0003 L0.0007	...	...	...
ACETIC-ANHYDRIDE MIXTURES see also ACETIC-ANHYDRIDE MIXTURES WITH ACETIC ACID											
65%, ethylidene diacetate 33%, acetic acid 2% during 186 days, washed with water 98%, remainder unknown, during 68 days	Chemical	F	244-323	254	—	xx	0.0003	0.0001	0.0001	...	...
55%, ethylidene diacetate 40%, acetic acid 5%	Chemical	F	302	150	..	xx	0.0003	0.0002	...	...	...
50%, acetic acid 10%, esters	Chemical	F	297	369	—	—	...	0.0001	...	...	...
50%, ethylidene diacetate 40%, acetic acid 5%, solids 5%	Chemical	F	302	150	..	x	0.0003	0.0002	0.0001	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-anhydride mixtures											
30%, ethylidene diacetate 65%, acetic acid 5%	Chemical	F	158	150	..	x	0.0001	<0.0001	...	...	...
15%, ethylidene diacetate 65%, solids 20%	Chemical	F	167	150	..	xx	0.0002	<0.0001	...	...	...
acetic anhydride, acetic acid, acetaldehyde, vinyl acetate	Rayon	F	302	888	—	xx	0.002c	0.0001	...	...	...
ACETIC-ANHYDRIDE MIXTURES WITH ACETIC ACID											
99%, acetic acid 1%	Chemical	F	310	637	—	xx	...	<0.0001	nil	...	...
99%, acetic acid 1%	Chemical	F	230-248	165	—	xx	0.009	0.001	...	...	...
98%, acetic acid 2%	Chemical	F	280-291	718	—	xx	0.002	0.0008	0.0004	...	...
98%, acetic acid 2%, permanganate added 150 lb/day	Chemical	F	250-270	718	—	xx	0.014	0.002	0.001	...	...
93%, acetic acid 7%	Chemical	F	300	637	—	x	...	0.00011	<0.0001	...	...
87%, acetic acid 13%	Chemical	F	295	637	—	x	...	0.0005	0.0003	...	...
80%, acetic acid 20%	Chemical	F	268	571	—	x	0.009	0.0006	0.0004	...	...
70%, acetic acid 30%	Chemical	F	273-280	718	—	xx	0.004	0.0008	0.0005	...	...
65%, acetic acid 35%	Rayon	F	160	207	—	xx	...	0.0001	0.0001	<0.0001	...
63%, acetic acid 37%	Chemical	F	290	637	—	x	...	0.00048	0.00028	...	...
60%, acetic acid 40%	Chemical	F	284	1183	..	xx	...	<0.0001 L nil	nil	...	...
60%, acetic acid 40%	Chemical	F	266-277	718	—	xx	0.005b	0.0008	0.0006	...	...
60%, acetic acid 40%	Chemical	F	262	571	—	x	0.02	0.001	0.0004	...	...
60%, acetic acid 40%	Chemical	F	184	375	—	xx	...	<0.0001	<0.0001	...	...
55%, acetic acid 45%	Chemical	F	280	104	—	x	0.0002	0.0001	...	...	...
55%, acetic acid 45%	Chemical	F	280	104	—	x	0.0007	0.0002	...	...	...
50%, acetic acid 50%	Chemical	F	284	150	..	xx	0.002	0.0009	...	...	...
50%, acetic acid 50%	Chemical	F	262-282	718	—	xx	0.007	0.001	0.0007	...	...
44%, acetic acid 56%	Chemical	F	285	637	—	x	...	0.00041	0.00023	...	...
acetic anhydride, acetic acid	....	..	219	735	..	..	0.004	0.0024	...	...	...
acetic anhydride, crude acetic acid	Research	L	246	114	..	..	0.0711	0.0134	...	...	...
crude acetic anhydride, acetic acid	Research	L	230	114	..	..	0.0485	0.0174	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Acetic-anhydride mixtures with acetic acid											
40%, acetic acid 34%, water 20%, pressure 15 psig	Chemical	F	1166- 1184	379	..	..	...	0.0009a	0.00042a	...	...
acetic anhydride, glacial acetic acid, catalyst added	Chemical	F	1250	58	—	xx	...	0.0021 0.0006	0.0019 0.0004	... C0.0001	...
ACETONE MIXTURES											
98%, mesityl oxide, dibutyl alcohol, water	Rayon	F	137	181	—	xx	0.00011	0.0001	...	...	...
90%, diacetone alcohol	Rayon	F	77	181	—	xx	...	0.0001	0.0001	...	...
90% approximately, oleic linoleic acid remainder (still, half immersed)	Soap (solvent recovery)	F	145	6	—	x	nil* 0.0001	0.0001	...	...	...
83%, fatty acids remainder (separator tank)	Soap (solvent recovery)	F	32- 72	131	—	—	<0.0001	<0.0001	...	...	...
60%, methyl acetate 30%, acetaldehyde 10%, pH 5.0-6.0	Chemical	..	176	210	—	x	0.0003	0.00038	...	...	...
45%, methanol 38%, methyl acetate 15%, water 2%, acetic acid 0.1%	Chemical	F	135	210	x	xx	nil	nil	nil	...	...
acetone vapors from distilling a 40% solution in water (in vapor line from top of column)	Plastic (distillation)	F	133	59	—	..	<0.0001	<0.0001	...	...	<0.0001
40%, water 60% (column, in bottom pump discharge line)	Plastic (distillation)	F	145	59	—	x	<0.0001	<0.0001	...	...	<0.0001
26%, water 60%, methanol 13%, methyl acetate 1%	Chemical	F	190	583	—	x	nil	...	...	...	...
16%, methanol 16%, methyl acetate 12%, acetaldehyde 3%, ethyl acetate 1%, ethanol 1%, methylethyl ketone	Rayon	..	198	294	—	xx	<0.0001	<0.0001	...	...	...
acetone, ethanol, ethyl acetate and solvent naphtha mixture with B.P. 60-100 C	Textile	F	70- 86	940	xx	xx	<0.0001b <0.0001*b	<0.0001b	...	...	...
20%, water 80% during 480 days, water 97%, acetone 2%, caustic 1% during 100 days	Chemical	F	165- 225	580	—	x	0.0026	0.0016	...	...	...
ACETONITRILE											
4%, isopropyl-chloride solution	Petroleum	L	192	1	—	—	0.595	0.765	...	...	...
ACETOPHENONE											
66%, phenol 33%	Phenol	F	302	276	—	xx	0.0003	<0.0001	...	<0.0001	<0.0001
ACETYLENE TETRACHLORIDE											
acetylene tetrachloride	Chemical	F	60- 80	22	—	—	0.0446	0.0442	...	...	...
acetylene tetrachloride (liquid and vapors)	Chemical	F	205	17.5	—	x	0.01c	0.0085c	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
crude acetylene tetrachloride, chlorine excess 10-21 g/l, dissolved iron 0.15-1.65 g/l, acidity as hydrochloric acid 0.7-6.6 g/l	Chemical	F	108-120	282	—	x	0.00083*b	0.0049b	...	...	...
acetylene tetrachloride, trichloroethylene vapors, aqueous lime	Chemical	F	185-202	30	—	—	0.0026c	0.0018c	...	...	...
acetylene tetrachloride, trichloroethylene vapors, aqueous lime	Chemical	F	202-220	30	—	x	0.0028c	0.0012b	...	...	...
ACONITIC ACID											
15%, methylethyl ketone 77%, water 8%, hydrochloric acid trace (residue in evaporator consists of aconitic acid 50% and water 50%)	Sugar By-product (evaporation)	F	190	9	x	x	0.016	0.005	...	...	...
15%, methylethyl ketone 77%, water 8%, hydrochloric acid trace (residue in evaporator consists of aconitic acid 50% and water 50%)	Sugar By-product (extraction)	F	100	8.5	x	x	0.005c	0.004c	...	...	...
15%, methylethyl ketone 77% water 8%, hydrochloric acid trace (residue in evaporator consists of aconitic acid 50% and water 50%)	Sugar	F	70-100	82	x	x	<0.0001	<0.0001	...	...	...
0.5%, calcium chloride 12%, methylethyl ketone 8%, hydrochloric acid 1%, water remainder	Sugar By-product (extraction)	F	80	9	x	x	0.0003d	0.0004d	...	...	...
mother liquor obtained after one crystallization of the organic acid followed by removal of the acid crystals by centrifugation	Sugar	F	80-100	15.9	—	—	0.0002* 0.0001	<0.0001	...	...	...
ACRYLIC ACID											
96%, methyl ether hydroquinone 1000 ppm	Rayon	F	77	116	—	—	<0.0001	<0.0001	...	...	...
45%, acetic acid 45%, water 10%	Rayon	..	150	20	xx	xx	0.002	0.0009	...	0.002	...
30%, acetic acid 30%, water remainder	Rayon	F	250	3	..	xx	...	0.0026 L0.0021	...	...	...
acrylic acid	Rayon	F	122	41	—	—	nil	nil	...	...	...
ALKYL ALDEHYDE											
crude alkyl aldehyde	Research	L	266	20	..	..	0.0142	0.0045	...	...	...
crude alkyl aldehyde (vapors)	Research	L	248	20	..	..	0.0917	0.0043	...	...	...
ALKYL AMINES											
alkyl amines mixed (liquid and vapors)	Metal	L	212	31	..	..	nil	nil	...	...	...
alkyl amines, caustic soda, sodium nitrite, methanol, water	Chemical	F	70	27	x	xx	L0.0045	0.0012	...	C0.0007	0.003
ALKYL PHENOL											
alkyl phenol	Metal (distillation)	L	401	45	..	..	0.0008	...	...	...	...
alkyl phenol (vapors)	Metal (distillation)	L	401	45	..	..	0.0002	nil	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
alkyl phenol—boron-trifluoride complex (vapors)	Chemical	F	201	9	x	..	0.032	0.047	...	0.008	0.006
alkyl phenol—boron-trifluoride complex	Chemical	F	201	9	x	..	0.021	0.011	...	0.004	0.003
ALUMINUM CHLORIDE											
aluminum chloride, water, oil	Chemical	F	113-195	30	—	xx	0.011	0.004	...	0.005	...
5%, ammonium chloride 5%, pH 2	Chemical	F	78	88	xx	xx	0.0023c	0.00015a	0.00024c	...	...
aluminum chloride, dust, solvent fumes (mainly benzene)	Chemical	F	R.T.	30	xx	xx	0.0007*b 0.0006b	0.0004b	...	...	...
aluminum-chloride dust, sulfuric acid and bromine vapors, mixture of many fumes (fan scroll)	Chemical (ventilation)	F	R.T.	30	xx	xx	0.004c	0.02c	...	...	...
aluminum chloride, some hydrochloric acid, possibly some moisture, tar residue from isomerization unit with heavy hydrocarbons (immersed in tar at bottom of vessel)	Petroleum	F	225-250	44	—	xx	0.0945a	0.111	...	...	...
aluminum chloride and hydrochloric acid, ethyl benzene, ethylene benzene (bottom of reactor)	Chemical	F	240	35	—	x	corr	corr	...	...	...
ALUMINUM FLUOROSULFATE											
aluminum-fluorosulfate concentrated water solution, solids 15-35%, pH 1.5-2	Chemical (evaporation)	F	190	2.5	xx	xx	0.016	0.011	...	0.0017	...
15% approximately, water solution, pH 2.3	Chemical	F	75	49	x	—	0.0095	0.0016	...	0.0002	...
ALUMINUM NITRATE											
47.8%, water solution, free nitric acid 0.12M	Atomic Energy	L	90	15	—	..	0.168	...	...	...	...
12.7%, water solution, free nitric acid 3.0M	Atomic Energy	L	176	7	—	..	...	0.0003	...	...	...
10%, water solution, ferric nitrate 10%, free nitric acid 2-10%, pressure 300 psi	Chemical	L	400	11	—	—	0.078*	0.182	...	...	...
10%, water solution, ferric nitrate 10%, free nitric acid 2-10%, pressure 300 psi	Chemical	L	400	2	—	xx	0.36*	0.545	...	...	...
ALUMINUM SULFATE											
60-20%	Chemical	F	244	36	—	xx	0.03	0.009	...	...	...
60-20%	Chemical	F	244	36	xx	—	0.005	0.0004	...	...	...
55-50%, pH 2-3	Chemical	F	225-235	8	—	xx	0.634c	0.196	0.09	...	...
50-40%	Research	L	190	>6	—	x	0.058 0.023*	0.0003	...	0.0006	...
40-30%	Research	L	175	>6	..	..	nil*	0.0002	...	...	...
30%	Research	L	220	...	..	xx	0.0001	...	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Aluminum sulfate											
30%	Research	L	220	...	..	—	0.0005	...	...	...	...
30%, manganous acid	Research	L	160	>6	xx	x	<0.0001	...	...	...	...
30-20%	Research	L	B.P.	>6	x	x	0.0001 0.0005	0.324 0.0015	...	...	...
30-20%	Research	L	B.P.	>6	—	x	nil 0.0009	0.110 0.0005	...	...	...
28.2% initially, 57.7% finally, ferrous ion <0.2%, ferric ion <0.1%, chromic oxide trace initially, aluminum oxide trace finally	Chemical	F	225	44	x	xx	...	...	...	0.001	0.0008
28.2% initially, 57.7% finally, ferrous ion <0.2%, ferric ion <0.1%, chromic oxide trace initially, aluminum oxide trace finally	Chemical	F	215	44	x	xx	...	...	...	0.0009	0.0007
28%	Research	L	219	...	..	..	...	0.0001	...	...	...
21.8%	Petroleum	F	120-150	60	x	xx	<0.0001	<0.0001	...	...	<0.0001
20%	Research	L	218	...	xx	..	0.0005	0.0015	...	...	...
15%	Pulp and Paper	F	110	45	—	—	<0.0001	<0.0001	...	...	...
6.1%, sulfuric acid 25 g/l, iron 0.002%	Research	L	160	129	..	x	0.0031	0.0018	...	C nil	...
4%, sulfuric acid 3%, potassium chromium sulfate	Petroleum	F	75-90	60	x	x	0.007	0.003	...	<0.0001	<0.0001
aluminum-sulfate saturated liquor, some crystals, sulfur trioxide trace	Agriculture	L	212	14	..	..	...	L0.006	...	0.005	0.002
aluminum oxide, sulfuric acid, water	Chemical	F	220-250	21	x	xx	...	...	...	0.014	...
aluminum sulfate (vapors)	Chemical	F	150-247	90	xx	xx	0.022	0.008	...	...	...
aluminum-sulfate slurry, sulfuric acid 50%	Research	L	260	>6	—	x	0.0002*	nil	...	...	...
AMINES											
amines in water, sodium chloride, sodium hydroxide 2%, organic chlorides and polymer, pressure 50 psig (reboiler kettle)	Petroleum (methylamine manufacture)	F	260-268	41	—	—	0.0004	0.0003	0.0003	...	...
aryl amines, hydroquinone, ferrous chloride 0.37%, (autoclave)	Chemical	F	320	98	—	x	<0.0001	<0.0001	<0.0001	...	...
100% aminoethyl ethanolamine, pressure 10 psig	Research	L	240	1	—	x	nil	nil	...	...	...
100% aminoethyl ethanolamine	Research	L	240	1	x	x	0.0013	0.0009	...	...	...
20% aminoethyl ethanolamine, pressure 35 psig	Research	L	285	1	x	x	nil	nil	...	...	...
20% aminoethyl ethanolamine, pressure 10 psig	Research	L	240	1	x	x	0.001	0.0068	...	...	...
20% aminoethyl ethanolamine, water, carbon dioxide	Research	L	240	1	x	x	0.001	0.007	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Amines											
20% aminoethyl ethanolamine, carbon dioxide, hydrogen sulfide	Research	L	240	1	x	x	0.0021	0.0029	...	...	...
20% aminoethyl ethanolamine, hydrogen sulfide	Research	L	240	1	x	x	nil	nil	...	...	...
19% amine hydrochlorides, water 65%, ammonia 12%, sodium chloride 3%, ammonium chloride 1%	Chemical	F	250	14	—	xx	0.29	nil	...	...	...
10% aminoethyl ethanolamine, water saturated with carbon dioxide	Research	L	240	1	x	x	nil	0.0002	...	...	...
10% aminoethyl ethanolamine, water saturated with carbon dioxide	Research	L	285	1	x	x	0.001	0.0044	...	...	...
10% aminoethyl ethanolamine, water (autoclave)	Research	L	240	1	—	x	0.0002	nil	...	...	...
10% aminoethyl ethanolamine, water (autoclave)	Research	L	285	1	—	x	nil	nil	...	...	...
polyethylene amines and fatty acids (caustic for cleaning kettles)	Chemical	F	510-555	39	x	xx	0.0003	0.0003	...	...	...
polyethylene amines and fatty acids (caustic for cleaning kettles)	Chemical	F	510-555	39	x	xx	0.007	0.0004	...	...	...
oxime (intermediate in preparation of a monomer), hydroxylamine sulfate 10%, sulfuric acid 7%	Chemical (oximation)	F	105	1	x	xx	0.0007	0.0009	...	0.0035	...
AMMONIA											
90% gaseous mixture with hydrogen cyanide, carbon dioxide and water	Plastic	F	221	30	..	..	0.0001c	0.0001	...	0.0001	0.0001
26% ammonia vapor, carbon dioxide 14%, water remainder (still overhead line)	Metal (distillation)	F	180	65	x	xx	<0.0001	<0.0001	...	...	<0.0001
22%, water 71%, carbon dioxide 7%, ammonium nitrate trace, pressure 29 psig (ammonia surge vessel, bottom)	Petro-chemical (synthetic-urea manufacture)	F	150	300	—	x	0.0003 S0.0076	<0.0001 S<0.0001	...	0.0004	<0.0001
20%, water solution of organic acids, methyl acrylates, ammonium carbonate, pressure 1000 psi	Chemical	F	302-320	300	—	x	0.0001* 0.0002	0.015a	...	...	...
20%, water, low carbon dioxide (ammonia desorber, vapors below liquid trapout tray)	Petro-chemical (synthetic-urea manufacture)	F	215	250	x	x	0.0033 S0.0039	0.0006 S0.0006	...	0.0002	0.0002
20%, water, low carbon dioxide (ammonia desorber, liquid and vapors above trapout tray)	Petro-chemical (synthetic-urea manufacture)	F	150	250	x	x	0.011 S0.019	0.0016 S0.003	...	...	...
20%, carbon dioxide 5%, water, ammonium nitrate, pressure 65 psig (absorber bottom)	Petro-chemical (synthetic-urea manufacture)	F	270	300	x	x	<0.0001 S<0.0001	<0.0001 S<0.0001	...	<0.0001	<0.0001
20% approximately, water solution, monoethanolamine 1-2%, ammonia vapor	Chemical	F	207	36	—	x	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Ammonia											
12%, carbon dioxide 7%, water remainder (half immersed)	Chemical (urea manufacture)	F	85	16	—	xx	0.078 L0.151	0.019	...	...	0.015
12-10%, oxygen 8%, inerts, pressure 100 psig (second-stage leach autoclave, vapors)	Mining	F	175	33	xx	xx	<0.0001 S<0.0001	<0.0001 S<0.0001	...	...	...
10-8%, first stage of ammonia leaching of nickel concentrates, nickel, cobalt, copper and ammonium sulfates; water solution, iron hydroxide and sulfide pulp, some sulfur sesquioxide and sulfur β-trioxide, pressure 100 psig	Mining	F	170	30	x	xx	0.001 S0.001	0.001 S0.002	...	...	...
10-8%, second stage of ammonia leaching of nickel concentrates, nickel, cobalt, copper and ammonium sulfates, water solution, pressure 100 psig	Mining	F	175	33	x	xx	0.0001 S<0.0001	<0.0001 S0.00015	...	...	...
9%, oxygen 14%, saturated with water vapor, nitrogen remainder (leach autoclave, vapors)	Metal	F	170-180	111	x	xx	<0.0001 S0.0001	<0.0001 S0.0001	...	...	...
8% approximately, nickel, cobalt, copper and ammonium sulfates, water solution 150 g/l (autoclave)	Metal	F	175-180	107	xx	xx	<0.0001	<0.0001	...	...	...
8-4%, nickel, cobalt, copper and ammonium sulfates, water solution, solids as copper sulfide 2%	Mining	F	207	22	—	xx	0.0002 S0.005b	0.0001 S0.0002	...	...	...
8-4%, nickel, cobalt, copper and ammonium sulfates, water solution, solids as copper sulfide 2% (copper boil reboiler)	Mining	F	215-225	34	—	xx	0.0001 S0.005	0.0001 S0.007b	...	...	...
8-4%, nickel, cobalt, copper and ammonium sulfates, water solution, solids as copper sulfide 2%, vapors of ammonia 4-5% and water vapor (copper boil reboiler)	Metal	F	215-225	95	—	xx	<0.0001	<0.0001	...	...	...
5%, oxygen 9%, saturated with water vapor, nitrogen remainder (leach autoclave)	Metal	F	170-180	107	xx	xx	<0.0001 S<0.0001	<0.0001 S<0.0001	...	...	...
3.5% approximately, nickel, cobalt, copper and ammonium sulfates, pH 10.2 (stripping autoclave)	Metal	F	200-204	100	—	xx	<0.0001 S<0.0001	<0.0001 S<0.0001	...	...	...
2-1%, water vapor, pressure 10-15 psig (stripping autoclave)	Mining	F	214	23	—	xx	<0.0001 S0.002	<0.0001 S0.003	...	...	...
1%, ammonia liquor, hydrogen sulfide, trace of coal gas (tar decanter)	Coal By-product	F	155-175	63	..	..	<0.0001	<0.0001	...	...	...
1% approximately, ammonia liquor	Coal By-product	F	75	318	..	xx	nil	...	...	...	...
0.5% fixed ammonia, ammonia still liquor, steam, calcium chloride, calcium sulfide, calcium cyanide, no free ammonia	Coal By-product	F	230	144	x	xx	0.0001c	<0.0001c	...	...	...
ammonia, ammonium chloride, cuprous chloride and cupric chloride	Chemical (ammonolysis)	F	420	36	—	x	<0.0001	0.0002	...	...	...
ammonia still waste, calcium chloride, sulfuric acid, manganese sulfate 1-4 g/l, organics and ammonium chloride traces, pH 1-2.5	Coal By-product	F	170	13.5	x	xx	0.025c	0.0025c	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
ammonia liquor, steam, ammonium chloride, cyanide and thiocyanate, hydrogen sulfide, calcium chloride, phenol, complex iron cyanide compounds (bottom of free still)	Coal By-product	F	240	144	x	xx	<0.0001a	<0.0001a	...	...	...
ammonia vapors, hydrogen sulfide, carbon dioxide, phenols, hydrogen cyanide and steam (ammonia still, vapor outlet)	Coal By-product	F	220	144	—	xx	<0.0001	<0.0001	...	...	...
AMMONIA ANHYDROUS											
liquid ammonia, ammonium acetate, pressure 1200 psig	Research	L	483	0.2	—	—	1.06	0.014	...	...	...
liquid ammonia, amines, ammonium chloride, organic chlorides, polymer, pressure 850 psig	Petroleum	F	190	90	—	x	0.002c	0.0006c	...	...	...
99.1%, inerts 0.9% (line)	Chemical	F	932	64	..	xx	0.0995	>0.52	...	...	...
saturated ammonium-bromide solution in liquid ammonia	....	L	68-80	2	—	—	nil	nil	...	...	nil
ammonia anhydrous, ethyl amine trace (column, vapors)	Chemical	F	95	102	—	xx	0.0001	0.0001	...	...	...
AMMONIUM BICARBONATE											
ammonium bicarbonate	Chemical	F	185	61	—	xx	0.0007b	0.022 0.0001a	...	...	...
AMMONIUM CARBONATE											
ammonium carbonate, ammonia, pH 9-10	Chemical	F	85-115	41	x	x	0.0001*	0.0001	...	...	...
AMMONIUM CHLORIDE											
75%, isopropanol, water, sodium chloride, pH 6.5-8.5	Chemical	F	120	183	x	x	0.0006c S0.0008b	<0.0001b S0.0005a	<0.0001c	<0.0001bd	<0.0001bd
75%, isopropanol, water, sodium chloride, pH 6.5-8.5 (transfer line)	Chemical	F	120	12	x	x	0.0003 S0.0007	0.0002 S0.0004	0.0003	0.0002	0.0001
75%, isopropanol, water, saturated with sodium chloride, some hydrochloric acid, some free salt, pH 6-8 (top cover of filter tank)	Chemical (filtration)	F	120	13.5	x	x	0.0003a S0.0009a	0.0001a S0.0002a	0.0002a	0.0001	0.0001
75%, isopropanol, water, excess of sodium chloride crystals, pH 5-7.5 (transfer line)	Chemical	F	140	41	x	xx	0.0005ad S0.0008ad	0.0003ad S0.0005ad	0.0003d	0.0002d	<0.0001
33%, water 34%, zinc chloride 33%	....	L	140	33	—	—	0.0013c	0.0001c	...	...	...
18%, sodium chloride 8%, carbon dioxide 3%, ammonia 2%, water (tubular gas cooler)	Chemical	F	86-176	68	—	x	<0.0001	<0.0001	...	...	...
14-11%, water, some hydrogen sulfide, mercaptans and a nonabrasive solid (Texas reactor)	Rubber	F	194	11.5	—	xx	0.0005c 0.0076	0.0002	...	...	...
0.25%, recirculated water for scrubbing gases, free sulfuric acid 0.2-0.43%, pH 1.6-10 (pipe line)	Chemical	F	120	8.5	xx	xx	0.0006	0.0004	...	...	0.0004
0.25%, recirculated water for scrubbing gases, free sulfuric acid 0.2-0.43%, pH 1.6-10 (gas scrubber)	Chemical	F	120	11	xx	xx	0.0004 <0.0001*	<0.0001	...	C0.0015	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
ammonium chloride, sodium sulfite	Chemical	F	140-147	30	—	x	<0.0001a	<0.0001a	...	...	...
ammonium chloride, sodium sulfite (vapors)	Chemical	F	140-147	30	—	x	<0.0001b	<0.0001	...	...	...
ammonium-chloride slurry, sodium-chloride crystals, glutamic acid and other aminoacids (vacuum crystallizer)	Chemical	F	150	96	—	..	...	0.0025b	...	0.0005c	0.0001
AMMONIUM (BI-) FLUORIDE											
50% to anhydrous ammonium bifluoride, unidentified ore	Metal	F	80-390	10	x	xx	...	...	...	C0.0096	0.0071
45%, suspended ferrous titanate, being concentrated (batch digester)	Mining	F	230-260	...	..	..	0.127 L0.101	0.011	...	...	..
34.5%, glass-etching solution, total hydrofluoric acid 30%, free hydrofluoric acid 24.8%, combined ammonia 12.5%, sodium fluorosilicate 11.5%	Glass	F	60	30	—	—	0.165* 0.177	0.04	...	...	...
20%, titanium fluoride 8%	Mining	L	R.T.	...	..	..	0.018	0.0018	...	...	...
15%, ammonium hydroxide excess, pH moderately basic	Chemical	L	125	94	—	xx	<0.0001	<0.0001	...	...	<0.0001
10%, glass-fortifying solution, hydrofluoric acid total 8.75%, sodium fluorosilicate 8.55%, free hydrofluoric acid 4.9%, combined ammonia 4.6%	Glass	F	45-80	30	—	—	0.0108* 0.0082	0.0067	...	...	...
10%, water solution	....	F	77	61	x	—	0.011	0.0095	...	0.0013	0.0005
6%, water solution	Research	L	200	>6	—	x	0.150	0.140	...	...	...
ammonium-bifluoride solution, hydrofluoric acid, sulfuric acid and iron traces, pH from highly acid to highly alkaline	Chemical	..	R.T.-B.P.	28	—	x	0.077	0.047	...	...	...
AMMONIUM NITRATE											
66%, free ammonia 17%, water 17%	Petroleum	F	R.T.	715	—	x	<0.0001*	<0.0001	<0.0001	...	...
65%, free ammonia 21.7%, water 13.3%	Research	L	128	14-20	..	x	0.0284 0.0127	0.0286 nil	...	...	...
20%, water and carbon dioxide traces, pressure 30 psig (bottom of ammonia desorber, vapors)	Petro-chemical (synthetic-urea manufacture)	F	290	300	x	x	<0.0001 S<0.0001	<0.0001 S<0.0001	...	<0.0001	<0.0001
ammonium nitrate, free ammonia	Petro-chemical	F	...	89	..	..	nil	nil	...	...	...
AMMONIUM PERCHLORATE											
24% approximately, sodium chloride 23%, sodium perchlorate 7.6%, sodium chlorate 0.2%, pH 4.8 (crystallizer)	Chemical	..	175	138	x	xx	...	<0.0001	...	<0.0001	<0.0001

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions						Average corrosion rates (ipy)				
	INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
AMMONIUM PHOSPHATE											
ammonium monophosphate, saturated water solution	Chemical	F	82	150	—	—	<0.0001*	<0.0001	<0.0001	...	...
40% approximately, ammonium monophosphate	Chemical	L	140	22	—	—	<0.0001	<0.0001	...	...	...
ammonium phosphate, water, sulfuric acid 3%	Chemical	F	122-158	30	xx	x	...	0.006	...	...	0.001
ammonium phosphate traces in steam; ammonia, ammonium sulfate, fluorine compounds and silica traces present (agitator)	Chemical	..	212-250	12	xx	x	...	0.031a	...	...	0.001
AMMONIUM SILICOFLUORIDE											
ammonium silicofluoride, alkaline solution, ammonia	Chemical	..	110-130	28	—	x	<0.0001	<0.0001	...	...	...
AMMONIUM SULFATE											
ammonium sulfate, saturated water solution, sulfuric acid 5%	Coal By-product	F	100-116	33	—	x	<0.0001	...	<0.0001	...	...
ammonium sulfate, saturated water solution, sulfuric acid 5%, some crystals (crystallizer)	Coal By-product	F	100-116	33	—	x	0.0001	...	nil	...	...
40% approximately, hydrogen sulfide, free ammonia trace (autoclave, vapors)	Mining	F	140-160	1	—	—	0.03b S0.24b	S0.03b	...	...	...
38% approximately, sulfuric acid 0-75%, ammonia added with the acid, and 20% ammonium sulfide 2 gal/800 gal approximately of reacted solution	Chemical	F	150-200	6	x	xx	0.339*c 0.75c	0.024	...	...	...
36%, sulfuric acid 10%, sulfur dioxide 0.3%	Chemical	..	180	25	x	x	0.0075c	0.0014	...	...	...
6% approximately, zirconium-hydroxide slurry 0.3 lb/gal, pH 8 (vacuum drum filter)	Chemical	..	135	50	—	x	<0.0001	...	...	...	...
6% approximately, zirconium-hydroxide slurry 0.3 lb/gal, pH 8 (vacuum drum filter)	Chemical	..	150	50	xx	x	<0.0001	...	...	...	...
3.2%, pH 5	Research	L	105	128	..	xx	corr	nil	...	C nil	...
2.01%, pH 8	Research	L	105	101	..	..	0.027	0.0068	...	0.002	0.0016
ammonium sulfate, sulfuric acid (vapors)	Chemical	..	>230	9	—	xx	0.0001	0.0001	0.0001	0.002	...
ammonium sulfate, sulfuric acid (filter)	Chemical	..	125-145	77	—	xx	0.0035a	0.00014	0.0007	C<0.0001	...
ammonium sulfate, sulfuric acid (crystallizer)	Chemical	..	145-165	77	—	x	0.032	0.004	<0.0001	C<0.0001	...
ammonium sulfate, sulfuric acid (crystallizer)	Chemical	..	155-175	77	—	x	0.002	0.001	0.001	C<0.0001	...
ammonium sulfate, sulfuric acid, ammonia	Chemical	..	>230	9	—	xx	0.0003	0.0005 0.042 W0.07	0.001	C0.0004	...
ammonium-sulfate slurry, sulfuric acid 4-12%, ammonia	Coal By-product	..	221	15	—	x	...	0.04	0.045	C0.008	...
ammonium-sulfate slurry, sulfuric acid 1-4%	Chemical	F	212	36	xx	x	<0.0001	<0.0001	...	<0.0001	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	Average corrosion rates (ipy) TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
mixtures of dilute or saturated ammonium sulfate, free sulfuric acid 1.5%	Chemical	F	221	13	x	xx	0.0008	0.0005	...	...	...
AMMONIUM THIOCYANATE											
55% approximately, tap water	Agriculture	L	120	2-6	xx	x	0.0022	<0.0001	...	...	...
35%, ammonia 0.5%, ammonium sulfide 0.1% (boiler)	Chemical	F	230	31	—	xx	0.0002	<0.0001	...	...	...
31% approximately	Coal By-product	F	R.T.	27	—	—	<0.0001	<0.0001	...	...	...
30%, ammonia 5%, ammonium sulfide 1%	Chemical	F	70	31	—	—	<0.0001	<0.0001	...	...	...
30%, ammonium-thiocyanate vapors, pH 5.7 approximately (outlet from evaporator)	Coal By-product	F	154	17	—	x	<0.0001	<0.0001	...	...	...
20% approximately, coke-oven gas (ammonium-thiocyanate scrubber)	Coal By-product	F	118-133	61	—	x	0.0006*	<0.0001	...	...	...
10.7% approximately, tap water	Agriculture	L	120	2-6	xx	x	0.004	<0.0001	...	...	...
6.2%, water solution	Coal By-product	F	63-90	14	—	—	<0.0001	<0.0001	...	...	...
ammonium thiocyanate, hydrocarbons, water vapor, toluene	Coal By-product	F	212	16	xx	xx	0.044c 0.001c	0.0002a	...	...	...
AMMONIUM TUNGSTATE											
17% approximately, up to saturation (evaporator)	Metal (evaporation)	F	220	30	—	xx	0.001b	0.0001b	0.0001a	...	...
AMYL ALCOHOL											
12%, *sodium oleate 58%, water 18%, amyl chlorides 10%, amylene 2% during 77 days;* sodium oleate 58%, sodium chloride 25%, sodium hydroxide 1% and water during 77 days (side near bottom of digester)	*Chemical*	*F*	*340*	*154*	—	x	*0.0001*	*0.0001*	...	...	...
AMYL CHLORIDE											
amyl-chloride brine, sodium hydroxide 0.35% (amylene column)	Chemical	F	175	220	x	x	0.0001	0.0001	...	...	...
amyl chlorides mixed, sodium chloride, traces of hydrochloric acid, ferric chloride and water (pipe)	*Chemical*	*F*	*R.T.*	50	x	xx	<0.0001	<0.0001	...	...	...
amyl chlorides mixed, traces of hydrochloric acid, ferric chloride and water (pump discharge)	Chemical	F	R.T.	50	x	xx	0.0044	0.0032	...	...	...
AMYL CINNAMIC ALDEHYDE											
amyl cinnamic aldehyde	Chemical	...	...	30	...	...	...	nil	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
AMYLENE											
amylene, amyl chloride trace (vapors)	Chemical	F	175	23	x	xx	. . .	0.0001	. . .	. . .	. . .
AMYL MERCAPTAN											
amyl mercaptan, ethanol, water, amyl chloride, hydrogen sulfide trace (top of column, vapors)	Chemical (distillation)	F	212	69	x	x	0.0001a W0.0009	0.0001	. . .	. . .	. . .
amyl mercaptan, sodium hydrosulfide, amyl chloride, ethanol, water, sodium chloride, pressure 250-300 psig	Chemical	F	285	40	—	xx	0.105 W0.161	0.061 W0.086	. . .	C0.0095	. . .
amyl mercaptan, ethanol, brine, amyl chloride, diamyl sulfide, hydrogen sulfide trace	Chemical (distillation)	F	230	69	—	xx	0.0001c W0.0005	0.0001b W0.0005a	. . .	. . .	. . .
amyl mercaptan, ethanol, brine, amyl chloride, diamyl sulfide, hydrogen sulfide trace (vapors)	Chemical (distillation)	F	250	74	x	xx	0.0005c W0.0023	0.0004b W0.0013	. . .	. . .	. . .
amyl mercaptan, diamyl sulfide, amyl chloride, amyl alcohol, ethanol, water, hydrogen sulfide trace	Chemical (distillation)	F	322	78	—	xx	0.0015c W0.0018	0.0005a W0.0018	. . .	. . .	. . .
amyl mercaptan, diamyl sulfide, amyl chloride, amyl alcohol, ethanol, water, hydrogen sulfide trace	Chemical (distillation)	F	285	78	x	xx	0.0007a W0.0019	0.0003 W0.0016	. . .	. . .	. . .
AMYL PHENOL											
amyl phenol, sulfuric acid, phenol, phenolsulfonic acid (vapors)	Chemical (distillation)	F	390	50	—	—	<0.0001	<0.0001	. . .	. . .	. . .
amyl phenol, phenol, caustic-neutralized phenolsulfonic acid, sulfuric acid trace	Chemical (distillation)	F	390	50	x	x	0.0001	0.0001	. . .	. . .	. . .
amyl phenol, phenolsulfonic acid, sulfuric acid trace, finely divided clay trace (tank bottom)	Chemical	F	195	106	x	x	corr	corr	. . .	. . .	. . .
amyl phenol, phenol, phenolsulfonic acid, sulfuric acid trace (vapors)	Chemical	F	195	106	x	x	0.0011	0.0009	. . .	. . .	. . .
amyl phenol (vapors)	Chemical (distillation)	F	390	96	x	x	0.0001	0.0001	. . .	. . .	. . .
amyl phenol, phosphoric acid 0.14%	Chemical	F	390	37	—	xx	0.0008*a 0.0008a	0.0002a	. . .	. . .	. . .
amyl phenol, phosphoric acid 0.14% (vapors)	Chemical	F	390	37	—	xx	0.0031*b 0.0027a	0.0022a	. . .	. . .	. . .
diamyl phenol, potassium hydroxide 1-2% (batch still kettle)	Coal By-product	F	230	15	—	xx	0.00016	<0.0001	. . .	. . .	. . .
ANILINE											
aniline, carbon disulfide, hydrogen disulfide, mercaptobenzene, thiazole etc (autoclave)	Chemical	F	390-518	230	x	—	0.00015	0.00025	. . .	C0.0002	. . .
ANTIBIOTICS											
antibiotic fermentation media, neutral, sometimes hydrochloric acid acidified, once sulfuric acid acidified to pH 2.5, occasionally sodium hydroxide alkalized to pH 10.5 (tank bottom head)	Pharmaceutical	F	75	27	x	xx	S0.0001a L0.0001cd	nil a L nil a	nil a	nil	nil

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
antibiotic "APF" (evaporator)	Pharmaceutical	F	150-180	25	. .	. .	nil ad	L nil	. . .	. . .	. . .
antibiotic "APF" (evaporator, vapors)	Pharmaceutical	F	125-150	25	. .	. .	0.0001d	L nil	. . .	. . .	. . .
antibiotic spent-beer solution, water 90%, amyl acetate or acetone, "Methaline chloride" trace, pH 7.5 average	Pharmaceutical	F	74	42	xx	. .	<0.0001	<0.0001	. . .	<0.0001	<0.0001
antibiotic spent-beer solution, water 90%, amyl acetate or acetone, "Methaline chloride" trace, pH 7.3 average	Pharmaceutical	F	172	42	—	—	<0.0001	<0.0001	. . .	. . .	. . .
organic preparation containing ferric ion, pH 7.0 (vacuum evaporator)	Pharmaceutical	F	390	61	—	x	<0.0001a	<0.0001	. . .	. . .	. . .
penicillin broth	Pharmaceutical (fermentation)	F	75	60	x	x	nil	nil	. . .	. . .	. . .
penicillin	Pharmaceutical (fermentation)	F	R.T.	144	. .	. .	0.0001	<0.0001 L0.0001	. . .	. . .	. . .
penicillin	Pharmaceutical (fermentation)	F	75	42	xx	x	<0.0001	<0.0001	. . .	. . .	. . .
streptomycin media, pH 6.2-8	Pharmaceutical (fermentation)	F	85	56	. .	. .	0.0001*	0.0001	. . .	. . .	. . .
streptomycin media, pH 2.0	Pharmaceutical	F	R.T.	46	. .	. .	0.0001*	0.0001	. . .	. . .	. . .
ANTIMONY SALTS											
antimony chlorofluorides, organic chlorofluorides, anhydrous hydrofluoric acid, hydrochloric acid and chlorine (pressure vessel)	Chemical	F	200	35	—	x	. . .	. . .	. . .	0.0003	0.0002
antimony chlorofluorides, organic chlorofluorides, anhydrous hydrofluoric acid, hydrochloric acid and chlorine (vapors)	Chemical	F	200	35	—	x	. . .	. . .	. . .	0.0018	0.0012
antimony trichloride, some hydrochloric acid, water <0.5%	Chemical	F	212	12	x	xx	0.036	0.0002	0.0016 0.0025	0.001	0.0083 0.0089
antimony trichloride, some hydrochloric acid, water <0.5% (vapors)	Chemical	F	212	12	x	xx	0.081 0.0054	0.0003	0.0027 0.0009	0.009 0.0029	0.0067
antimony trichloride 93%, aluminum chloride 7%, system blanketed with hydrochloric acid	Petroleum	L	195	1	. .	x	0.008*	0.003	. . .	. . .	. . .
APPLE POMACE MUSH											
apple pomace mush, sodium tetraphosphate 0.1%, hydrochloric acid 0.05%, malic acid 0.05%, pH 2.9-3.2	Food	F	212	18	—	xx	0.0001* 0.0001	0.0001d	. . .	. . .	. . .

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
ARSENIC PENTOXIDE											
37.5%, sulfuric acid 6.24%, water (circular-path corrosion machine)	Agriculture	L	85	3	xx	x	0.00018	0.00018	...	...	...
37.5%, sulfuric acid 6.24%, water (beaker, half immersed)	Agriculture	L	85	3	xx	x	0.0036	nil	...	...	...
ASCORBIC ACID											
ascorbic acid (top of feed hopper)	Chemical	F	65	21	..	—	0.0001	0.0001	...	...	...
ASPHALT											
asphalt converter, overhead air blown, hydrocarbons, other organics, salt water (enters top at 95 F), oxygen, sulfur dioxide, mercaptans (asphalt-plant gas scrubber)	Petroleum	F	100-500	42	xx	xx	0.0245c	0.0109c	0.0059c	0.0196c	0.0105c
heavy asphalt, crude oil containing naphthenic acid (vacuum-distillation tower, flash section)	Petroleum	F	650-750	22	—	xx	0.0016c 0.0005c	0.0001	<0.0001	0.0001	0.0001
ATMOSPHERE, INDUSTRIAL											
atmosphere at Bayonne, N. J. (sheltered)	....	..	R.T.	4340	xx	—	<0.0001b	nil	nil	...	...
atmosphere at Bayonne, N. J. (exposed)	....	..	R.T.	4340	xx	—	nil	nil	nil	...	...
exhaust mine air, sulfuric acid 0.14%, relative humidity 100%	Mining	F	60-65	70	xx	xx	0.0001d 0.0001*d	<0.0001	...	...	...
damp sulfur-laden atmosphere, (Kingwood railroad tunnel at Tunnelton, W. Va.)	Railroad	F	R.T.	407	xx	x	0.0001*bd 0.0001cd	<0.0001b	...	...	...
locomotive flue gases and steam (tunnel)	Railroad	F	R.T.	1775	..	..	0.0006*b 0.0024b	...	...	...	...
air, at Baton Rouge, La., chlorides and sulfates due to industrial pollution (Braun-Esso compressor)	....	F	R.T.	30	xx	x	...	<0.0001	<0.0001	...	...
air, at Baton Rouge, La., chlorides and sulfates due to industrial pollution (Braun-Esso compressor)	....	F	R.T.	158	xx	x	...	<0.0001	<0.0001	...	...
air saturated with water, small amounts of dust	Mining	F	61	31	..	xx	<0.0001	...	...	...	...
ATMOSPHERE, MARINE											
atmosphere at Kure Beach, N. C., 800 ft from ocean	....	F	R.T.	5474	xx	..	<0.0001*	...	...	...	...
atmosphere at Shore Rack and Kure Beach, N. C.	Research	F	R.T.	360	xx	xx	nil	<0.0001	...	...	...
atmosphere at Shore Rack and Kure Beach, N. C.	Research	F	R.T.	1700	xx	xx	<0.0001	<0.0001	...	...	...
atmosphere at Wilmington, N. C.	Marine	F	R.T.	200	xx	xx	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
atmosphere at Wilmington, N. C.	Marine	F	R.T.	160	xx	—	<0.0001	<0.0001	...	...	...
atmosphere at Passamaquoddy Dam, Maine	Marine	F	R.T.	270	xx	—	nil	<0.0001	...	...	...
atmosphere of coast just south of San Francisco, Calif.	Power	F	R.T.	184	..	..	<0.0001	<0.0001	...	...	...
ATMOSPHERE, PLANT INTERIOR											
air, occasionally solvents and water	Rayon	F	70-125	105	xx	—	...	0.0001	...	0.0001	...
hot air saturated with water vapor, pH of condensate 7.2 (paper drier)	Pulp and Paper	F	120	330	xx	..	<0.0001*	<0.0001	...	...	...
ozonated air, oxygen 5 mg/l, nitrogen pentoxide 0.1 mg/l approximately (ozone generator)	Sanitary	F	R.T.	60	xx	x	0.0001 0.0003*	0.0004	...	...	...
air saturated with chlorine, chlorine 0.013 vol %	Pulp and Paper	F	63	35	—	—	0.124c	0.118c	...	...	...
air saturated with water, some sulfur dioxide (economizer)	Pulp and Paper	F	110	35	—	xx	<0.0001	nil	...	...	...
hot moist air (paper machines)	Pulp and Paper	F	120	189	xx	..	0.0001 0.0001*	0.0001	...	...	...
air, caustic fumes, ammonia fumes 0.005%, humidity 100%	Metal	F	40-110	1280	xx	—	<0.0001	<0.0001	...	...	...
air, some vapors of hydrogen sulfide and carbon disulfide (rayon-spinning-room roof)	Rayon	F	R.T.	152	xx	—	0.0001*	...	...	...	...
air, humidity high, probably sulfur compounds as sulfur dioxide	Textile (wool)	F	175	56	xx	xx	0.0008 0.0007*	0.0004	...	...	...
atmosphere, humidity high, fumes and vapors of vinylidine chloride, methylethyl ketone	Cellophane	F	225	95	xx	x	0.0001	0.0001	...	...	...
air, humidity high during 34 days, and air, humidity high, dilute acetic-acid vapors during 20 days (belt drier)	Synthetic Rubber	F	240	54	xx	x	nil	nil	...	...	...
atmosphere, humidity 100%, in which salt dust and steam flow periodically	Salt	F	75-140	365	xx	x	<0.0001d	0.0001d	...	...	...
air, humidity high, lacquer residuals	Pulp and Paper	..	180-200	28	xx	xx	0.0001	0.0001	...	0.0001	...
BARIUM CHLORIDE											
barium chloride, saturated water solution	Chemical	L	R.T.	2-4	..	..	<0.0001*	...	...	...	...
30%, solution repeatedly evaporated	Chemical	L	212	2-4	..	..	0.0001	...	...	...	...
25%, water solution, free chlorine, pH 1	Chemical	F	95	11	—	xx	...	0.052c	...	...	...
20%, hydrochloric acid excess, sulfide trace, pH 2-3	Coal By-product	F	176	28	—	x	0.25c	0.16c	...	...	0.042cd

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
BARIUM NITRATE											
barium nitrate	Chemical	F	85	7	—	xx	...	0.005c	...	...	...
BEER											
spent beer, organic acids and their salts, lactic acid 0.5%, dicarboxylic acids, oxyacids, traces of formic, acetic, propionic and butyric acids	Brewing (distillation)	F	212	105	—	x	<0.0001	<0.0001	...	...	...
beer, water 5%, alcohol, organic acids, pH 3.4-3.7	Brewing (distillation)	F	212	87	—	—	<0.0001d	<0.0001	...	...	...
beer (fermenter, vapors, liquid)	Brewing	F	45-55	8	..	..	nil	...	...	...	...
beer (fermenter)	Brewing	F	R.T.	40	—	—	<0.0001	<0.0001	...	...	...
beer (open fermenter)	Brewing	F	...	75	..	..	nil	...	...	...	...
ale	Brewing	F	R.T.	70	—	—	nil	...	...	...	...
beer (Beaudelot cooler)	Brewing	F	cool	32	..	..	<0.0001	...	...	...	...
BENZENE											
98.5%, methylaldehyde 0.5%, formic acid <0.5%, formaldehyde <0.5%, methyl formate, etc	Chemical	F	200-220	13	—	xx	0.0012	0.0007	...	...	...
98.3%, water 1.5%, acetic acid 0.04%, decomposition gases 0.02%	Rayon	F	170	275	—	xx	0.0001	0.0001	...	...	...
95% approximately, sulfuric acid 4.5%, impurities from crude benzene (washer)	Coal By-product	F	122-140	44	x	xx	0.0668cd corr	corr	...	...	...
90%, hydrochloric acid 5%, water 5%, chlorinated benzene	Chemical	F	80	60	x	—	...	0.021cd	...	0.014cd	...
benzene, water	Pharmaceutical	F	70	42	x	x	<0.0001a	0.0001	...	...	...
50%, chlorinated benzene 40%, hydrochloric acid 5%, water 5%	Chemical	F	80	60	x	—	...	0.051	...	0.054	...
benzene, oleum, probably some sulfur dioxide and trioxide (vapors during first 12 hours)	Chemical	F	365	1.5	x	xx	0.47 0.43	...	0.77 0.73	...	...
benzene, furnace vapors, water, acetic anhydride, decomposition gases	Rayon	F	220	275	—	xx	0.0019 0.0021	...	0.0011 0.001	...	...
benzene, toluene, xylene, thiophene, condensed vapors, hydrogen sulfide, sulfur dioxide, oxygen, water	Coal By-product	F	113	27	—	—	0.0007bd	0.0005	...	...	...
benzene, toluene, xylene, some ammonia and sulfur dioxide (condenser, condensate)	Coal By-product (tar distillation)	F	185-250	74	..	xx	0.0061c	0.0012a	...	...	...
benzene, toluene, xylene, hydrogen sulfide, thiophene, sulfur dioxide, sulfur, oxygen, steam (light-oil condenser, condensate)	Coal By-product (fractionation)	F	53-155	28	—	—	0.0002bd	0.0001	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
benzene, toluene, xylene, crude light oil and steam (light-oil stripper, vapors)	Coal By-product	F	190-210	46	—	x	<0.0001	<0.0001	...	...	...
benzene, toluene, xylene, thiophene, hydrogen sulfide, oxygen, water, sulfur (light-oil condenser, vapors)	Coal By-product (fractionation)	F	115-257	28	—	x	0.0034bd	0.0003b	...	...	...
benzene, toluene, xylene, thiophene, hydrogen sulfide, oxygen, water, sulfur (light-oil condenser, vapors)	Coal By-product	F	95-220	27	—	—	0.0013bd	0.0005b	...	...	...
benzene, vinyl acetate, some water	Plastic	F	85-105	156	x	—	<0.0001	<0.0001	<0.0001	...	...
BENZENE HEXACHLORIDE											
90%, methanol, sodium nitrate 0.5%	Research	L	230	7	..	..	0.93	0.005	...	...	...
45%, methanol, sodium nitrate 0.5%	Research	L	155	9.5	..	..	0.083	0.0047	...	...	...
25%, methanol, sodium nitrate 0.5%	Research	L	150	9.5	..	..	0.022	0.004	...	...	...
25%, methanol	Research	L	150	6	..	..	1.6	0.12	...	...	...
BENZOYL CHLORIDE											
benzoyl chloride (vapors)	Chemical	L	75	30	—	—	0.0042	0.003	...	...	...
benzoyl chloride	Chemical	L	R.T.	14	x	..	0.0033bd	0.0008d	...	...	...
BORIC ACID											
70%	Chemical	L	302	1	—	—	0.35 0.245	...	...	...	...
50%	Chemical	L	302	1	—	—	0.045	...	...	...	...
30%	Chemical	L	302	1	—	—	0.025	...	...	...	...
15.7% approximately	Research	..	75	70	..	..	<0.0001	...	...	...	...
2.5% (reboiler)	Chemical (distillation)	F	195	4.5	—	xx	<0.0001 0.0002*	0.0001	...	...	...
boric acid, borax, sulfites, sulfates, mixed liquor	Chemical (boric-acid manufacture)	F	130-220	45	x	xx	0.0048cd 0.001*b	0.0001	...	...	...
boric acid, solution saturated with sulfur dioxide	Chemical	F	140	31	xx	—	<0.0001d	<0.0001d	...	...	...
boric acid, sublimed, impurities	Chemical	F	130-220	45	xx	xx	0.0047cd 0.002*cd	0.0002a	...	...	...
BORON TRICHLORIDE											
99%, chlorine trace, dry except during shutdowns, when hydrochloric and boric acid traces are formed by hydrolysis	Chemical	F	55.4	67	—	xx	...	0.0003	...	...	0.0007

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Boron trichloride											
95%, chlorine 5%, dry except during shutdowns, when hydrochloric and boric acid traces are formed by hydrolysis; ferric chloride and aluminum chloride traces (condenser)	Chemical	F	53.6	60	—	xx	...	0.0021d	...	...	0.0019
boron trichloride, chlorine, ferric chloride, aluminum chloride, silicon tetrachloride (filter inlet)	Chemical (filtration)	F	158	24	—	xx	...	0.0019	...	...	0.0008
BORON TRIFLUORIDE											
14%, hydrofluoric acid 0.2%, low pressure (vapors)	Chemical (distillation)	F	212	2.8	x	x	0.29	0.32	...	0.068	0.046
14%, hydrofluoric acid 0.2%, low pressure	Chemical (distillation)	F	212	1.7	x	x	0.73	0.22	...	0.13	0.075
<1.5%, aromatic solvents, cresols, water trace	Coal By-product	F	203	15	x	xx	0.0013	0.0011	...	0.0012	0.0011
0.155%, polymerized hydrocarbon oils, pH 3.4-6.7 (Nevillac reactor)	Chemical	F	77-257	19	x	xx	0.024	0.012	...	...	...
boron trifluoride, polymerized hydrocarbon oils, some hydrofluoric and fluoroboric acids, water (condenser)	Chemical (distillation)	F	105	92	—	x	<0.0001	<0.0001	...	...	...
boron trifluoride trace, polymerized and neutralized hydrocarbon oils (vessel bottom)	Chemical	F	105-230	17.5	x	xx	0.0029	0.0009	...	...	...
boron trifluoride anhydrous, anisole (methylphenyl ether)	Research	..	302	32	—	..	...	0.0003	...	...	...
boron trifluoride anhydrous, fluorides, pH 4-7 (decanter)	Chemical (distillation)	F	77	154	x	xx	<0.0001	<0.0001	...	...	...
BORON-TRIFLUORIDE ETHERATE											
boron-trifluoride etherate in hydrocarbon oil, possibly slight hydrolysis of boron trifluoride	Chemical	F	70-135	42	x	x	0.001 0.002*	0.0005	...	...	...
boron-trifluoride etherate in hydrocarbon oil, possibly slight hydrolysis of boron trifluoride (vapors)	Chemical	F	70-135	42	x	—	0.0007 0.0003*	0.0005	...	...	...
1.5 vol%, various crude hydrocarbon mixtures	Chemical	F	178	15	—	xx	...	0.023	...	...	...
1.5-0.5 vol%, various unsaturated hydrocarbons, water 0-0.08%	Resin	F	185	12	—	xx	0:027*	0.009	0.005	0.009	...
BUTANE											
98%, isobutane 1%, acetic acid 0.5%, water 0.5%	Chemical	F	185	276	x	x	nil 0.0003	nil 0.00015	...	...	...
98%, acetic acid 1%, ketones, esters, water, carbon dioxide	Rayon	F	86-113	363	—	xx	<0.0001	<0.0001	...	...	...
65%, acetic acid 10%, carbonyls and esters 22%, water 3%	Chemical	F	125	108	x	—	nil	nil L nil	...	...	...
60%, water, ethyl acetate, methylethyl ketone, methyl acetate, acetone, esters, ketones, alcohols	Rayon	F	131-156	360	—	x	<0.0001 0.0002	<0.0001 0.0001	...	...	...
56%, various organics 27%, nitrogen 10%, acetic acid 4%, water 2%, carbon dioxide 1%	Chemical	..	347	210	xx	xx	...	0.0003	...	0.0003	0.0002

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Butane											
20%, nitrogen 65%, acids (mainly acetic), esters and water	Chemical	F	340	108	x	x	0.003c	0.0008a S0.0012b	...	...	...
20%, nitrogen 75%, oxygen 0.5%, light hydrocarbons, acids and esters remainder	Chemical	F	125	108	x	x	nil	nil L nil	...	...	...
20%, nitrogen and carbon dioxide, water, ketones, esters, aldehydes trace	Rayon	F	86-113	363	—	xx	0.0001	0.0001	...	...	...
butane, butylene, dibutyl sulfite, sulfuric acid, water trace ("DBS" debutanizer bottom)	Petroleum	F	250	52	—	—	0.006b	0.002a	...	...	...
butane, dry hydrochloric acid, possibly some tar residue and moisture, pressure 250 psi (vapors)	Petroleum	F	225-250	44	—	xx	0.05cd	0.0487bd	...	...	...
butane, some sulfur dioxide and dibutyl sulfate (top of separator, gas stream)	Petrochemical (fractionation)	F	115-120	49	—	—	<0.0001'd	0.0008	...	...	...
BUTANOL											
99%, carbonyls 0.3%, esters, heavy alcohols trace	Chemical	F	265	277	—	xx	0.00035	...	...	...	...
97-96%, hydrochloric acid 3-4%	Pharmaceutical	..	R.T.	18	xx	—	0.0257a	0.0149bd	...	...	...
82%, water 8.5-9%, higher alcohols 8%, carbonyls 1-1.5%	Chemical	F	250	243	—	xx	<0.0001	...	...	...	...
9%, higher alcohols 8%, carbonyls 0.5%	Chemical	..	265	243	—	xx	<0.0001	...	...	...	...
5%, water 95%	Chemical	F	195	39	..	x	0.0018	0.003	0.002	...	...
5%, water 90%, methyl and ethyl alcohol 5%	Chemical	F	195	39	..	x	0.00013	<0.0001	nil	...	...
butanol, propanol (together 42.3%), water 30%, carbonyls 3.8%, acetals 0.9%, sodium formate and acetate	Chemical	F	230	371	—	xx	...	nil	...	...	...
butanol, benzene, dibutyl phthalate (vapor line)	Chemical (distillation)	F	170-380	44	x	x	<0.0001	<0.0001	...	...	...
BUTTERMILK see LACTIC ACID											
BUTYL ACETYL RICINOLEATE											
butyl acetyl ricinoleate, charcoal, acetic acid trace	Rayon	F	140	60	—	—	...	0.0002	...	0.0003	...
BUTYL PHENOL											
paratertiary butyl phenol, formaldehyde, turpentine, boron trifluoride, oxalic acid	Chemical	F	392	75	x	x	0.0098	0.0014	...	0.0007	0.0004
(DI-) BUTYL TIN CHLORIDE											
dibutyl tin chloride, molten (half immersed)	Chemical	F	130-140	28	..	..	...	0.0001	...	<0.0001	...
BUTYRALDEHYDE											
98%, water 1.3%, butyric acid 0.7%	Plastic	F	67	136	x	—	<0.0001	nil	<0.0001	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
BUTYRIC ACID											
80%, sulfuric acid 10%, remainder unknown	Chemical	F	330	10	—	x	0.26c	0.024	0.012	. . .	. . .
25-20%, acetic acid 40-45%, propionic acid 5-10%, formic acid 0.02%, sodium chloride 0.01-0.05%, hydrochloric acid trace	Chemical	F	105	38	x	xx	0.003	0.003	0.002	0.002	0.004
butyric acid, small amounts of manganese sulfate, magnesium sulfate and water (vapors)	Chemical (distillation)	F	212-250	32	—	x	. . .	<0.0001	<0.0001	<0.0001 0.0001	. . .
butyric acid, propionic and acetic acids together 97%, formic acid 2%, water 1%	Chemical	F	248	315	. .	xx	0.015	0.003	0.0015	. . .	. . .
butyric acid, propionic and acetic acids together 20%, some sulfur dioxide, water remainder (vapors)	Chemical	F	105	33	x	x	0.094	0.051	0.029	0.024	0.012
3%, heavy ends 95%, propionic acid 1.5%, acetic acid 0.05%	Chemical	F	284-320	54	. .	xx	0.009	0.0025	. . .	. . .	. . .
CACODYLIC ACID											
cacodylic-acid solution, boiled once, pH 2	Chemical	L	R.T.	3	—	x	. . .	<0.0001	<0.0001	. . .	. . .
cacodylic-acid solution, boiled once, pH 10	Chemical	L	R.T.	3	—	x	. . .	0.0002	0.0002	. . .	. . .
CADMIUM SULFATE											
30% (alternately immersed)	Chemical	L	212	1-4	. .	. .	0.0005	. . .	. . .	. . .	. . .
CALCIUM BROMIDE											
37.97%, water 41.97%, lithium bromide 11.53%, calcium chloride 8.58%, specific gravity 1.56 (under spray nozzles)	Metal (air dehumidification)	F	120	38	xx	xx	0.0009*bd	. . .	0.0014cd	. . .	. . .
CALCIUM CHLORIDE											
58% approximately, sodium chloride 1-1.3%, calcium hydroxide 0.1% approximately (evaporator)	Chemical	F	330	31	—	xx	0.002a	0.0017a	. . .	. . .	. . .
30% approximately, cooling brine	Dairy	F	10	355	—	x	<0.0001bd	<0.0001bd	. . .	. . .	. . .
calcium-chloride cooling brine	Dairy	F	10	372	—	x	0.0001a	0.0001	. . .	. . .	. . .
28.69%, calcium-magnesium-chloride bittern, magnesium chloride 8.69%, sodium chloride 1.06%, specific gravity 1.38 (alternately immersed)	Chemical	F	175	130	—	—	<0.0001bd	<0.0001bd	. . .	. . .	. . .
21.5%, sodium bichromate 0.0017% as inhibitor, pH 7-8.5 (in brine-spray air stream, dehumidifier)	Food (air cooling)	F	3-4	338	xx	xx	<0.0001	<0.0001	. . .	. . .	. . .
21.5%, sodium bichromate 0.0017% as inhibitor, pH 7-8.5 (boiling tank, under spray chamber)	Food	F	90-225	337	x	—	<0.0001	<0.0001	. . .	. . .	. . .
calcium and magnesium-chloride brine liquors, total chlorides 50% (evaporator)	Chemical (air conditioning and refrigeration)	F	B.P.	26	xx	xx	0.0002a	0.0001a	. . .	. . .	. . .

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
calcium, magnesium and sodium-chloride brine in 28% concentration	Chemical (air conditioning and refrigeration)	F	160	31	xx	xx	<0.0001bd	<0.0001ad	...	...	...
calcium chloride, sodium chloride, pH 9.0 (weir box)	Chemical	F	131	107	xx	xx	0.0004*d	0.0001d	...	...	...
fumes and condensate from boiling calcium-magnesium-chloride concentrated solution, free hydrochloric acid 0.63% in condensate	Chemical	..	212-220	39	xx	x	...	0.021c	0.02c	...	...
CALCIUM CITRATE											
calcium-citrate solution, sulfuric acid excess 3%	Sugar (citric-acid manufacture)	F	195-212	0.2	—	xx	0.062	0.035	...	...	...
CALCIUM HYDROXIDE											
calcium-hydroxide slurry, some undissolved calcium hydroxide and silica	Chemical	F	194	203	x	x	<0.0001	...	...	...	...
calcium-hydroxide lime liquors, ammonia fumes, sodium sulfide	Tanning	F	...	180	..	..	<0.0001	<0.0001	...	...	...
calcium hydroxide, calcium carbonate, sodium hydroxide, sodium sulfide	Pulp and Paper	F	120	204	x	x	<0.0001	<0.0001	...	...	...
CALCIUM HYDROSULFIDE											
8.5-7.4% (turbo gas absorber)	Chemical	F	139	46	—	x	<0.0001	<0.0001	...	...	...
CALCIUM HYPOCHLORITE											
15% approximately, bleach	Chemical	F	75	65	x	x	...	0.012cd	0.0033cd	C0.022cd	...
10%, bleach slurry, available chlorine 70-100 g/l, lime excess 20-30 g/l	Chemical	F	90-100	31	x	x	...	0.006cd 0.01cd	0.023cd 0.029cd	...	...
6%	Chemical	L	97	...	..	..	...	0.0216	...	0.0347	...
6%	Chemical	L	140	...	..	..	...	0.0002	...	<0.0001	...
6%	Chemical	L	212	...	..	..	...	0.0005	...	0.0004	...
2%	Chemical	L	97	...	..	..	...	nil	...	0.0006	...
2%	Chemical	L	140	...	..	..	...	<0.0001	...	<0.0001	...
2%	Chemical	L	212	...	..	..	...	0.0002	...	0.0001	...
calcium hypochlorite and lime sludge, available chlorine 40 g/l, some calcium chloride, calcium chlorate, calcium carbonate and free lime	Pulp and Paper	F	60-100	30	x	..	0.017cd	0.0037cd	...	...	...
calcium-hypochlorite bleach liquor, available chlorine 2-3 g/l	Textile	F	65-100	31	—	xx	<0.0001	<0.0001d	<0.0001d	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
CALCIUM LACTATE											
5%, active carbon 0.5%	Dairy	F	140-180	22	—	x	<0.0001	<0.0001	...	...	...
calcium lactate, lactic acid, organic acids, calcium carbonate, pH 4-5.5, initially 6.5-7.5	Food (fermentation)	F	125	303	xx	xx	<0.0001 W<0.0001	<0.0001 W<0.0001 LW<0.0001	<0.0001	...	...
CALCIUM PHOSPHATE											
12%, calcium monophosphate, solids 7.5%, phosphoric acid 3%, fluorides 0.02%, pH 1-2 (extraction tank bottom)	Chemical	F	82	18	x	x	<0.0001	0.0001	...	...	...
calcium phosphate, ion exchanged inositol, converter liquor, some protein	Corn Products	L	75	36	..	..	nil	nil	...	...	...
CALCIUM SULFATE											
10%, roaster calcine, sodium vanadate 5-8%, sodium chloride 3-7%, silicates, hydrochloric acid and chlorine gases (between roaster discharge and baker cooler)	Mining (ore processing)	F	1520	63	..	..	...	0.021	....	...	0.028
CALCIUM SULFITE											
19.3%, calcium-sulfite liquor, milk-of-lime solution 1 lb/gal, sulfur dioxide 10% (gas-absorbing chamber, top)	Pulp and Paper	F	200	68	xx	xx	<0.0001 <0.0001*	<0.0001	...	...	...
CARBON											
activated carbon "SXAC-L" adsorbing acetone, methylene chloride trace	Chemical	..	...	57	..	..	<0.0001d	<0.0001d	<0.0001d	<0.0001a	<0.0001
activated carbon bed "Norit Sorbonorit III" adsorbing acetone containing methylene chloride trace	Chemical	..	...	57	..	..	0.0002bdr	0.0001bdr	0.0001a	0.0001b	0.0001a
activated carbon bed "Lactol," petroleum solvent, steam, some unknown chloride source	Printing	F	R.T.-230	70	xx	—	0.0001*cr	0.0001cr	...	<0.0001c	...
carbon froth, water from coolers (half immersed)	Chemical	F	...	28	xx	x	<0.0001d	<0.0001	...	...	...
coal (coal chutes)	Power	F	R.T.	257	xx	x	0.0047	0.0046	...	...	...
carbon-black sludge, carbonates, chlorides, sulfates, carbon dioxide and sulfur dioxide (half immersed in water seal at cooler end of furnace)	Carbon Black	F	160-205	61	xx	x	0.0008c	<0.0001a	...	...	...
carbon-black slurry, carbonates, chlorides, sulfates, carbon dioxide and sulfur dioxide from cooling water at pH 7 (bottom of primary cooler)	Carbon Black	F	400-900	42	—	xx	0.0011	0.001	0.0007	...	...
carbon-black slurry, carbonates, chlorides, sulfates, carbon dioxide and sulfur dioxide from cooling water at pH 7 (riser of primary cooler)	Carbon Black	F	900-1400	42	..	xx	0.0005	0.0005	0.0004	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
carbon-black slurry and water intermittently, pH 7 approximately (water level of cooler seal, wet and dry, air and slurry)	Chemical	F	160	240	xx	xx	0.0003cd	<0.0001	...	<0.0001	<0.0001
carbon-black slurry (half immersed)	Carbon Black	F	170	21	x	x	<0.0001 0.0011c	<0.0001	<0.0001	...	...
carbon-black slurry, sulfuric acid pH 2 (leaching tank)	Carbon Black	F	110	3	xx	xx	0.0004	0.0005	...	0.0013	...
carbon black loose, entrained combustion gases, water vapor, product occasionally on fire	Chemical	F	120	240	xx	x	<0.0001	<0.0001	<0.0001d	<0.0001	<0.0001
carbon black loose, entrained combustion gases, water vapor, product occasionally on fire	Chemical	F	120	324	xx	x	0.0011c	0.0001c	<0.0001c	0.0001b	0.0004a
carbon-black slurry, water, total solids 7.2%, concentrated carbon black 6.94%, sulfates 6.63 g/gal, ferric oxide 4.24 g/gal, nitrogen as ammonia 0.64 g/gal, chlorides 0.45 g/gal, reduction factor equivalent to potassium permanganate 0.647 g/gal (half immersed)	Carbon Black	F	170	30	xx	xx	0.031c	0.0003	0.0004	...	...
carbon black, hard water (fresh water 52 salt grains/gal), steam (alternately immersed)	Carbon Black	F	178	30	xx	—	0.0021c 0.028c	0.0001	0.0001	<0.0001	...
carbon black, hard water (fresh water 52 salt grains/gal), steam (half immersed)	Carbon Black	F	152	30	xx	xx	0.0066c	0.0001	0.0001	<0.0001	...
carbon black, sulfur, salt and water vapor, oxygen (wet scrubber unit)	Carbon Black	F	420	15	x	xx	0.0002	0.0002	0.0001	...	...
20% carbon-black paste, water 80% (mixer)	Petroleum	F	75	28	..	x	0.0001*d	0.0001	...	...	...
carbon black, hydrogen sulfide 46 grains / 100 cu ft, steam 45-50 vol %, carbon dioxide and monoxide, hydrogen, nitrogen and oxygen 0.2-0.3%	Carbon Black (filtration)	F	220-230	251	xx	—	...	...	0.0043r	...	...
carbon black, laden with fuel gases	Carbon Black	F	160-180	52	..	..	<0.0001	<0.0001	<0.0001	...	...
CARBON DIOXIDE											
33.34%, water 66.66%, ethanolamine trace (vapor line of Girdler reactivator)	Chemical	F	235-240	62	—	xx	0.0001	0.002	0.0001	...	...
26%, oxygen 6%, carbon monoxide 2%, sulfur dioxide, nitrogen trace	Water Purification	..	104-113	75	..	xx	...	0.0012c	...	...	0.002c
12%, nitrogen 88%, condensed water has iron ions 40 ppm, sulfuric and sulfurous acids 10 ppm, nitric and nitrous acids 3 ppm (pipe, gas stream)	Petroleum	F	110	36	—	xx	<0.0001	<0.0001	<0.0001	<0.0001	...
10%, gas stream, carbon monoxide 2%, sulfur dioxide 0.25%, some oxygen	Mining	F	150	73	xx	xx	<0.0001a <0.0001*a	<0.0001	...	...	...
carbon-dioxide and sodium-chloride brine mixture (gas contains carbon dioxide 33-40%, sulfur dioxide 0.05-0.1%, air; brine contains sodium chloride 45.2 g/l, sodium sulfate 12.5 g/l, sodium carbonate 4.7 g/l and borax) (gas scrubber, center)	Chemical	..	80-132	356	xx	xx	<0.0001bd	<0.0001d	...	...	...
carbon dioxide and nitrogen, chlorine trace (gaseous mixture)	Petroleum	..	302-392	198	..	xx	...	0.0022cd	0.002cd	...	0.0013cd

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
carbon dioxide, ammonia 0.2%, water, urea trace, pressure 68 psig (ammonia stripper bottom)	Petro-chemical (synthetic-urea manufacture)	F	315	300	x	x	<0.0001 S0.0001	<0.0001 S<0.0001	...	<0.0001	<0.0001
carbonated water, pressure - 5 psig	Food	L	...	5	...	...	nil	...	...	...	...
CARBON DISULFIDE											
carbon disulfide, water trace, absorbing oil trace (condensate liquid line)	Chemical	F	93	110	—	x	<0.0001* S<0.0001	<0.0001 S<0.0001	...	<0.0001	<0.0001
carbon disulfide, water	Chemical	F	R.T.	240	xx	x	<0.0001	<0.0001	...	...	...
carbon disulfide, water, sulfur <25%, some sulfuric acid and hydrogen sulfide	Chemical	F	60	76	x	x	<0.0001bd <0.0001*bd	<0.0001	...	...	...
carbon disulfide, sulfur 20%	Chemical	F	104	180	—	xx	0.0006*cd	0.0006cd	...	...	...
carbon disulfide, sulfur	Chemical	F	104	363	—	xx	0.0018cd	0.0017cd	...	...	...
carbon disulfide, sulfur (vapors)	Chemical	F	112	363	—	xx	0.0008cd	0.0006cd	...	...	...
CARBON MONOXIDE											
carbon monoxide, high pressure	Chemical	..	392	...	...	...	OK	...	...	...	...
CARBON TETRACHLORIDE											
90%, "Kolene" solvent, benzene 10%	Dry Cleaning	F	R.T.	40	—	—	<0.0001	<0.0001	...	...	...
90%, "Kolene" solvent, benzene 10% (bottom of still)	Dry Cleaning (distillation)	F	287	38	—	xx	0.0014*ad 0.0014ad	0.0008ad	...	...	...
87.5%, water 12%, chlorine 0.4%, hydrochloric acid 0.1% (vapors)	Chemical	F	140-185	3	—	x	1.57cd	1.26cd	...	...	...
crude carbon tetrachloride (column)	Chemical (rectification)	F	176	133	—	xx	<0.0001	<0.0001ad	...	...	...
25-5%, sulfur chlorides 75-95% (sulfur mono- and dichloride, thiocarbonyl chloride etc) (liquid line)	Chemical (distillation)	F	125-130	35.5	—	xx	0.0001*	0.0001	...	...	...
CARROTING SOLUTION											
carroting solution, sulfuric acid 4%, chloric acid 3%, hydrogen peroxide 3%, water remainder	Textile	F	R.T.	47	x	x	<0.0001	<0.0001	<0.0001	...	...
carroting solution, sulfuric acid 4%, chloric acid 3%, hydrogen peroxide 3%, water remainder	Textile	F	R.T.	3	x	x	0.067c	...	...	...	...
CASEIN											
casein, leather finishes, shellac, wax, various resins, both synthetic and natural, slightly alkaline water solution or fine dispersion	Tanning	F	...	180	..	—	0.0001	0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
casein, leather finishes, shellac, wax, various resins, both synthetic and natural, slightly alkaline water solution or fine dispersion	Tanning	F	...	180	..	x	0.0001	0.0001	...	...	...
CELLOPHANE											
cellophane spinning bath	Rayon	F	104	37	xx	xx	0.0039c	...	...	...	...
CERIUM SULFATE											
cerium-sulfate liquor, sulfuric anhydride 11%, sulfuric acid 10.66%, phosphorus pentoxide 4.5%, hydrochloric acid 0.25% approximately during wash cycle	Rare-Earths Separation (filtration)	F	70	22	x	x	0.0015	0.0005	0.0004	...	...
cerium-sulfate liquor, sulfuric anhydride 11%, sulfuric acid 10.66%, phosphorus pentoxide 4.5%, hydrochloric acid 0.25% approximately during wash cycle	Rare-Earths Separation	F	70	63	x	x	0.015	0.005	0.004	...	...
CEROUS CHLORIDE											
cerous-chloride solution, pH 5 (open evaporator)	Chemical (evaporation)	F	212-275	30	x	x	0.0075cd	0.0087c	0.0073cd	C0.005cd	...
CHERRY JUICE											
maraschino-cherry syrup, sucrose 50%, sodium benzoate 0.1%, maraschino flavor	Food	F	66-75	86	—	—	? no pits	? no pits	...	...	...
maraschino cherries, hot processing, sulfur dioxide 600-1000 ppm initially	Food	..	132-160	193	..	..	0.0001	0.0001	0.0001	...	...
CHLORINE											
chlorine, dry	Research	L	600	...	..	..	0.06	0.03	...	...	...
chlorine, dry	Research	L	650	...	..	..	0.12	0.06	...	...	...
5.5 vol % chlorine, air mixture (rubber hose line above flour agitator)	Food (flour bleaching)	F	80	82	xx	xx	0.044	0.022	...	...	...
0.114% available chlorine in bleach solution	Textile (cotton)	L	63	2	..	..	0.001d	0.0007d	...	...	...
0.013% chlorine, air mixture (exhaust side of fan)	Pulp and Paper	F	62	35	—	—	0.124c	0.118c	...	...	...
chlorine fumes (atmosphere)	Petroleum	F	R.T.	184	xx	x	0.0005c	...	...	...	...
chlorine, sodium oxychloride, sodium hydroxide, sodium chloride, sodium-oxide smoke, moist air (atmospheric fumes from sodium cells)	Chemical	F	120-135	90	xx	xx	0.0002	0.0002	...	...	0.0005
chlorine, hydrochloric acid, naphthalene, naphthalene chloride (vapors)	Chemical	F	330	52	—	..	0.0013	0.0012a	0.0014	0.0016	...
chlorine, hydrochloric acid, propionic acid (chlorinator)	Chemical	L	68	2	—	—	0.16	0.18	0.28	...	...
chlorine, hydrochloric acid, propionic acid	Chemical	L	68	1	—	—	0.0075	0.0065	0.0064	...	...
chlorine, saturated water solution	Chemical	L	R.T.	7	..	..	...	0.527 0.0154	...	0.478 0.0015	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
CHLORINE DIOXIDE											
chlorine-dioxide gas	Pulp and Paper	F	180	45	x	x	...	...	corr	...	0.056 0.12
10.8% chlorine-dioxide gas and condensed solution	Pulp and Paper	F	150	14.5	xx	xx	0.33	0.29c	...	...	...
chlorine dioxide, sulfuric acid 60°Bé, sodium perchlorate 32%, methanol	Pulp and Paper	F	135	14.5	x	xx	>0.55	0.15c	...	C0.027	...
7.2% approximately, saturated water solution	Pulp and Paper	F	38	70	x	x	...	L0.0052c	0.0009	0.0026b	0.0032
5-4% approximately, saturated water solution	Pulp and Paper	F	36	14.5	x	xx	0.0051c	0.0001	...	C0.0007	...
chlorine-dioxide spent liquor, sulfuric acid 45%, sodium chlorate 20 g/l	Pulp and Paper	F	155	14.6	x	x	0.016c	0.0025	...	C0.0011	...
CHLOROACETIC ACID											
100% monochloroacetic acid	Chemical	..	66-70	3	x	x	0.013a	0.0002	...	...	...
80% crude monochloroacetic acid, water solution (half immersed)	Chemical	..	R.T.	31	..	—	...	...	...	...	0.0014
78% monochloroacetic acid, water 22%	Chemical	F	122-140	17	—	—	0.0097	0.0025	0.002	0.0018	...
78% monochloroacetic acid, water 22%	Chemical	F	50-77	17	x	—	0.0001d	<0.0001	<0.0001d	<0.0001	...
monochloroacetic acid, dichloroacetic acid 15%, acetyl chloride 15%, some acid crystals	Chemical	F	70	7	..	xx	0.018	0.013	...	...	...
monochloroacetic acid, dichloroacetic acid 15%, acetyl chloride 15%, some acid crystals	Chemical	F	70	5	..	xx	0.0111	0.009	...	...	...
70% monochloroacetic acid, carbon tetrachloride 25%, acetic acid 5%	Chemical	L	105-125	14	..	..	...	0.0084	...	C0.0088	...
48.5% technical grade monochloroacetic acid, water	Chemical	F	12	90	xx	x	<0.0001	<0.0001	<0.0001	...	<0.0001
CHLOROBENZENE											
monochlorobenzene, phenol, water trace	Chemical	F	140-159	57	x	x	0.0053c	0.0066c	...	...	...
chlorinated benzene, hydrochloric acid	Chemical	F	70-105	90	..	..	...	...	...	C0.0132	...
chlorinated benzene	Chemical	F	265	137	..	..	...	L0.0001	0.0001	...	...
CHLORO-DIPHENYLAMINE											
20% approximately 3-chloro-diphenylamine, sulfur 5.34%, iodine 0.19%, monochlorobenzene remainder	Chemical	F	266	30	x	..	...	0.04c 0.09	...	0.059c 0.12	0.044c 0.077

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
CHLOROETHANE											
1, 2-dichloroethane	Chemical	L	935-1035	1	—	..	0.03	...	...	...	...
CHLOROETHYLENE											
perchloroethylene (solvent-recovery still)	Dry Cleaning (distillation)	F	305	64	—	xx	<0.0001*ad <0.0001a	<0.0001a	...	...	...
perchloroethylene (vapors) (solvent-recovery still)	Dry Cleaning (distillation)	F	260	64	—	—	<0.0001*a <0.0001a	<0.0001a	...	...	...
perchloroethylene vapor, water (extractor)	Corn Products	..	<190	12.5	—	—	0.0003ad	0.0001	0.0003	...	...
trichloroethylene (solvent recovery)	Textile (distillation)	F	...	2	—	—	<0.0001	<0.0001	...	...	...
trichloroethylene, air (wool-drier system, vapors)	Textile	F	115	2	—	—	<0.0001* <0.0001 0.0004	<0.0001 0.0003	...	...	...
trichloroethylene, air (wool-drier system, exhaust duct of blower)	Textile	F	185	2	—	—	0.0004* 0.0006	0.0006	...	...	...
trichloroethylene crude (vapors and entrained liquid)	Chemical (distillation)	F	163	228	—	xx	<0.0001	<0.0001	...	...	...
trichloroethylene crude, water (vapors and entrained liquid)	Chemical (distillation)	F	212	230	—	xx	0.0007b	0.0003b	...	...	...
trichloroethylene crude, water (vapors and entrained liquid)	Chemical (distillation)	F	169-198	228	—	xx	<0.0001	<0.0001	...	...	...
trichloroethylene crude, inhibited by controlled addition of gaseous ammonia (vapors and entrained liquid)	Chemical (distillation)	F	163-198	94	—	xx	<0.0001	<0.0001	...	...	...
trichloroethylene, wool grease <2.5%	Textile	F	88	2	—	—	<0.0001 <0.0001*	<0.0001	...	...	...
CHLOROHYDRIN											
epichlorohydrin, caustic soda, "Bis Phenol," trichloroethylene and sodium-chloride brine	Chemical	F	176-212	16.3	x	xx	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CHLORO-METHYLQUINONE											
chloro-β-methylquinone, nitrobenzene 85%, copper chloride, hydrochloric acid <5% during stripping	Chemical	F	212	2.5	—	xx	...	0.0027	...	0.0032	0.0025
CHLOROPHENOL											
chlorophenol, phenol, chlorine, hydrochloric-acid gas, ferric chloride (vapors, liquid)	Chemical	F	123-140	19	—	xx	0.0031d 0.0051d 0.0031*d 0.0005*d	0.0024d 0.0035d	0.0021d 0.003d	0.003 0.0018	...
dichlorophenol (vapors)	Chemical (distillation)	F	330-350	34	..	xx	0.0006	0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
dichlorophenol pure (overhead still pot, vapors)	Chemical (distillation)	F	250-290	34	..	xx	0.0029	0.0007	...	...	...
2,4-dichlorophenol (column)	Chemical (distillation)	F	265-302	21	—	..	0.009	0.004	...	...	...
CHLOROPICRIN											
chloropicrin, water, calcium hypochlorite, lime, calcium chloride 7-8%, calcium carbonate, pH 10-11	Chemical	F	203	8	..	..	0.0013	0.001	...	0.0028	0.0032
chloropicrin, sodium hypochlorite, sodium hydroxide, chlorine, sodium chlorate	Chemical	F	75	10	x	x	0.0009d	0.0006d	...	0.0007d	0.0001d
CHLOROTRIFLUOROETHYLENE											
chlorotrifluoroethylene, hydrofluoric and hydrochloric acids <1.0%, pressure 150 psig (partially liquified)	Chemical	F	70-120	86	..	—	0.0017	0.0015	...	...	0.0012
CHROMIC ACID											
chromic acid (liquid line)	Automotive	F	120	60	..	..	0.0052 S0.0058	0.0128 S0.0190	...	C0.0071 CS0.0161	...
33.33%, "Cromodine," sodium chloride remainder	Metal	L	170	1	..	xx	0.0011	0.0005	...	...	...
33.33%, "Cromodine," sodium chloride remainder	Metal	L	170	2	..	xx	0.0002	...	...	...	...
30%, chromic sulfate 0.45% (evaporation)	Metal (plating)	L	B.P.	2	—	xx	0.555	0.68	...	0.418	...
25%	Research	L	75	3	..	..	nil	0.0007	...	C0.0002	...
25%	Research	L	180	3	..	..	0.73	1.08	...	0.19	...
15%	Research	L	75	3	..	..	0.0003	0.0004	...	...	...
15%	Research	L	150	2.5	..	..	0.0098	0.0142c	...	...	...
15%	Research	L	150	5	..	..	0.0134	0.0258	...	...	...
15%	Research	L	180	3	..	..	0.056	0.018	...	...	...
15%	Research	L	212	2.5	..	..	0.0979	0.3916	...	...	...
15%	Research	L	212	5	..	..	0.1869	0.4272	...	...	...
10%	Research	L	75	3	..	..	0.0002	0.0001	...	0.0002	...
10%	Research	L	180	3	..	..	0.0059	0.012	...	0.036	...
5%	Research	L	75	3	..	..	nil	nil	...	...	...
5%	Research	L	180	3	..	..	0.0007	0.0029	...	...	...
5% approximately, "Cromodine," hydrochloric acid	Metal	..	R.T.	60	..	..	0.0002d	0.0002d	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Chromic acid											
3.4%, chromic oxide 10 oz, sodium sulfate 5 oz, water 2 gal	Printing	F	R.T.	50	..	..	<0.0001	<0.0001a	...	...	...
chromic acid, water solution, sulfuric acid, acidity 3% (developer box)	Textile	F	140-160	6.5	xx	x	0.0003d	0.0003d	...	...	...
CITRIC ACID											
citric acid, pure, dry (drum drier)	Chemical	F	155	52	xx	xx	<0.0001	<0.0001	...	...	...
58% approximately	Chemical	F	130	5	—	xx	0.0086b	0.00082b	...	...	...
51.8-42.8%	Food	F	125	37.5	x	xx	<0.0001	<0.0001	...	...	...
20%	...	L	B.P.	45	..	xx	...	0.0002	...	...	...
10%	Chemical	L	213	0.2	—	xx	0.00062* 0.00103	0.00047	...	...	...
10%, chlorides	Chemical (distillation)	F	125	36	—	xx	...	0.0001	...	0.0015	...
10%, fermentation sucrose solution, hydrochloric acid	Chemical	F	90	60	xx	xx	...	<0.0001	...	0.0006	...
10%, fermentation sucrose solution, hydrochloric acid	Chemical	F	90	50	xx	xx	...	<0.0001	...	0.003	...
6%	Chemical	L	213	0.1	—	xx	...	0.003	...	...	...
citric acid, pH 2 neutralized with calcium hydroxide to pH 7-8	Sugar	F	180-213	0.3	—	x	0.006	0.008	...	...	...
CLAY											
acidified clay, sulfuric acid equivalent to potassium hydroxide 4 mg (Dorr thickener)	Chemical	F	160	106	x	—	0.0001	0.0001	0.0001	...	...
acidified clay slurry, sulfuric acid 0.18-0.53% (thickener)	Chemical	F	140	40	—	x	0.0003*d	0.0001	...	...	...
acidified clay slurry, sulfuric acid 0.18-0.53% (Oliver filter)	Chemical	F	150	40	xx	x	0.0001*	0.0001	...	...	...
acidified clay slurry, sulfuric acid 0.26-0.97% (thickener)	Chemical	F	140	40	—	x	0.0008*	0.0001	...	...	...
acidified clay slurry, sulfuric acid 0.53-1.3% (thickener)	Chemical	F	140	40	—	x	0.0005*	0.0001	...	...	...
acidified clay slurry, sulfuric acid 0.88-2.1% (thickener)	Chemical	F	140	40	—	x	0.0004*	0.0001	...	...	...
acidified clay slurry, sulfuric acid 1.8-3.5% (thickener)	Chemical	F	140	40	—	x	0.0003*	0.0001	...	...	...
acidified clay slurry, sulfuric acid equivalent to potassium hydroxide 60 mg (Dorr thickener)	Chemical	F	125-160	106	x	—	0.0002	0.0001	...	...	...
acidified clay slurry, sulfuric acid 3.5-6.0% (thickener)	Chemical	F	140	40	—	x	0.0001*	0.0001	...	...	...
acidified clay suspension, sulfuric acid 15-20%	Glass and Ceramics	F	70-205	4.5	..	..	0.00108d	0.00036d	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
acidified bentonitic clay slurry, dilute solution of aluminum and iron sulfates, free sulfuric acid 0.15% (Oliver filter)	Chemical	F	126-158	30	—	—	0.0003	0.001	. . .	. . .	. . .
COBALT ACETATE											
cobalt-acetate solution, free acetic acid trace (evaporator)	Chemical	F	227	396	—	—	<0.0001d	<0.0001	. . .	. . .	. . .
COBALTOUS SULFATE											
5.31%, nickel 22 g/l, copper 6 g/l as sulfates, sodium fluoride trace, pH 3	Metal (nickel refining)	F	95-185	3	xx	xx	. . .	nil	. . .	. . .	nil
2.58%, nickel as sulfate 10 g/l, pH 1.2	Metal (nickel refining)	. .	185	23	xx	xx	. . .	0.003	. . .	. . .	0.003
2.37%, nickel as sulfate 100 g/l, pH 2.0	Metal (nickel refining)	. .	77-185	25	xx	xx	. . .	nil	. . .	. . .	nil
0.31%, nickel 0.4 g/l, copper 0.2 g/l, iron 1.5 g/l as sulfates, sodium chloride trace, pH 2.5	Metal (cobalt refining)	. .	104-149	60	—	x	0.0031c	<0.0001	<0.0001	<0.0001	<0.0001
COFFEE											
18% soluble coffee, liquid coffee extract (evaporator)	Food	L	120	38	—	—	<0.0001	<0.0001	. . .	<0.0001	. . .
coffee extract	Food	L	40	30	—	—	nil	. . .	. . .	. . .	. . .
COLUMBIUM											
26%, hydrofluoric acid solution 3.2N	Mining	F	70	42	xx	—	. . .	0.036	. . .	0.002	0.0021
dissolved columbite ore, hydrofluoric acid 4.5N, sulfuric acid 3.5N	Mining	F	70	42	xx	x	. . .	corr	. . .	0.033	0.03
CONDIMENTS											
bean sauce, tomato products	Food	L	155	5	—	—	0.0005	. . .	. . .	. . .	. . .
alcoholic menstrua and vanilla beans	Food	F	65-70	162	—	x	<0.0001 <0.0001*	<0.0001	. . .	. . .	. . .
mustard, ground (grinder)	Food	L	70	1	—	—	nil	<0.0001	. . .	. . .	. . .
salad dressing, vinegar 4%, sodium-chloride solution (cooler)	Food	F	190	10	. .	. .	<0.0001d L<0.0001	<0.0001	. . .	. . .	. . .
sauces used in canning various types of dry-bean packs, tomato puree, chili pepper, vinegar, etc	Food	F	195-212	17.3	—	xx	0.0001*d 0.0001d	0.0001	. . .	. . .	. . .
COPPER CHLORIDE											
10% cupric chloride	Jewelry	L	215	2	. .	. .	. . .	2.1	. . .	. . .	. . .

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
10% cupric chloride	Research (electrolysis)	L	...	1	..	..	0.174c	...	...	...	...
cupric chloride, cupric sulfate and sodium chloride	Petroleum	F	60-80	233	x	..	<0.0001cd	<0.0001b	...	...	...
7.66% cupric chloride, sodium chloride 226.7 g/2345.9 ml, pressure 6 in. of mercury	Chemical	L	78-80	7	—	—	...	...	nil 0.0017	...	...
7.66% cupric chloride, sodium chloride 226.7 g/2345.9 ml, pressure 6 in. of mercury	Chemical	L	78-80	7	xx	—	...	...	nil 0.0002	...	...
cuprous chloride, ammonia, magnesium oxide (carbon-monoxide absorption chamber)	Automotive	L	R.T.	1	—	—	...	0.0565c	...	...	...
COPPER FLUOROBORATE											
44.5%, boric acid 4.07%	Chemical	F	120	4	—	—	...	0.0006	...	...	...
44.5%	Chemical	L	130	7	..	..	0.001* 0.003* 0.001 0.002	...	...	...	...
39.9%, boric acid 4.07%	Chemical	L	75	1	—	xx	...	...	...	nil	...
11.46%, boric acid 4.07%	Chemical	L	120	4	—	—	...	0.0008	...	...	...
5.73%, acid	Chemical	L	120	4	—	—	...	0.0005	...	...	...
COPPER NICOTINATE											
copper nicotinate, water solution, sulfuric acid, pH 1	Chemical	L	75	19	—	xx	0.0666c	0.020c	...	...	...
COPPER SULFATE											
65% approximately cupric sulfate, saturated solution, sulfuric acid 0.4-0.8% (evaporator)	Metal	F	170-220	30	—	xx	0.0002	0.0002	0.0001	...	...
17.5-10% approximately cupric sulfate, neutral leach, silver ion 3-6 g/l as sulfate	Mining	F	160	32	xx	xx	<0.0001	<0.0001	...	...	...
16.5-11% approximately cupric sulfate, concentration 34°Bé, total acid 16.8%, copper ion 4.6%, free acid 3.8% before evaporation; and concentration 48°Bé, total acid 24.3%, copper ion 6.6%, free acid 5.5% after evaporation	Metal (evaporation)	F	215	67.5	—	xx	0.0002ad	<0.0001	...	...	...
12.5% approximately cupric sulfate, nickel ion 5 g/l and cobalt ion 2 g/l as sulfate, pH 2	Metal (nickel refining)	..	<149	36	xx	xx	...	nil	...	...	nil
10-8% approximately cupric sulfate, copper-refinery electrolyte, sulfuric acid 200-235 g/l, nickel ion 20-22 g/l as sulfate, pressure	Metal	F	150	32.9	..	..	<0.0001	<0.0001	...	<0.0001	...
6-4% approximately cupric sulfate, sulfuric acid <0.3%, mining low-acid leach, zinc ion 4-7 g/l, silver ion 2-5 g/l and manganese ion 1-3 g/l as sulfates	Mining	F	140-170	32	xx	xx	<0.0001d	<0.0001d	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
6-4% approximately cupric sulfate, sulfuric acid 3-6%, high-acid leach, zinc ion 5-6 g/l, manganese ion 2-3 g/l and silver ion 1-4 g/l as sulfates	Mining	F	140-170	32	xx	xx	<0.0001d	<0.0001d	...	...	...
5% approximately cupric sulfate, sulfuric acid 10%, manganese dioxide 9-10 g/l	Metal (plating)	F	158	63	xx	xx	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
2.6-1.3% approximately cupric sulfate, sulfuric acid 2.5-4.5%, sodium sulfate <2% (half immersed)	Metal	F	68-140	194	x	xx	<0.0001d	<0.0001d	...	...	...
cupric-sulfate solution "Dacolyte"	Metal (plating)	..	129	30	xx	x	...	nil	...	...	nil
cupric sulfate and hydroxide, zinc, cadmium, arsenic, calcium sulfates and hydroxides, pH 6	Metal (electro-refining)	F	185	111	—	x	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
COSMETICS											
cream hair-dress emulsion	Cosmetic	L	R.T.	30	—	—	<0.0001 0.0004*	...	...	...	...
cold permanent-waving solution, thioglycolate, free ammonia 1%, mineral oil	Cosmetic	L	R.T.	30	..	..	<0.0001 <0.0001*	...	...	...	...
machine-waving lotion, sodium sulfite, ammonia 1%, pH 10	Cosmetic	F	R.T.	30	—	—	<0.0001 <0.0001*	...	...	...	...
hair-waving liquid neutralizing solution, phosphoric acid and hydrogen peroxide, pH 2	Cosmetic	F	R.T.	30	—	—	<0.0001 <0.0001*	...	...	...	...
glycerine lotion, alcohol, alkaline detergent	Cosmetic	L	R.T.	5	..	..	0.0002	...	...	...	...
CREOSOTE											
creosote and steam	Lumber	F	190	41	—	..	<0.0001	<0.0001	...	<0.0001	...
CRESOL											
p- and *m*-cresol mixture, technical (alternately immersed)	Chemical	L	R.T.	11	..	..	<0.0001	...	...	...	...
p- and *m*-cresol mixture, technical (alternately immersed)	Chemical	L	160	11	..	..	<0.0001	...	...	...	...
CRESYLIC ACID											
cresylic acid, water 0.5% (reboiler)	Chemical	F	300	60	—	xx	...	0.0001a	...	0.0001	0.0001
98%, sulfuric acid 2%	Rayon	F	350	55	—	xx	...	0.007a 0.02b	...	0.005b 0.01a	...
crude cresylic acid, water and hydrogen sulfide, organic compounds	Rayon	F	350	135	—	xx	...	0.0008 0.0001	...	...	...
cresylic acid, water, sodium hydroxide	Rayon	F	100	220	—	—	...	0.009c	...	...	...
cresylic acid, water, sodium hydroxide	Rayon	F	100	105	—	—	...	0.02b	...	...	...
crude cresylic acid, sulfur 4%, water 2-4%, zinc powder, caustic, ethylene dichloride	Rayon	F	350	94	—	xx	...	0.0002r 0.0001r	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
cresylic acid, sulfuric acid 2%, organic sulfurous compounds, hydrogen disulfide, water	Chemical	...	350	60	—	xx		0.039cr 0.032cr	...	0.015a	...
(TRI-) CRESYL PHOSPHATE											
90-88%, cresol 8-10%, partial esters 2-8%, hydrochloric acid	Rayon	...	R.T.	360	—	—	...	0.013b	...	0.008b	...
90-88%, cresylic acid 5%, thiophenols 5%, magnesium chloride 1%, hydrochloric acid and organic chlorides trace; residual tar, tricresyl phosphate and magnesium chloride	Rayon	F	B.P.	179	x	xx	...	...	...	0.004a	0.0001a
90-88%, cresylic acid 5%, thiophenols 5%, magnesium chloride 1%, hydrochloric acid and organic chlorides trace; residual tar, tricresyl phosphate and magnesium chloride	Rayon	F	700	306	—	xx	...	0.001ar 0.024	...	0.005a 0.008	...
90-88%, cresylic acid 5%, thiophenols 5%, magnesium chloride 1%, hydrochloric acid and organic chlorides trace; residual tar, tricresyl phosphate and magnesium chloride	Rayon	F	700	140	—	xx	...	...	...	0.0006a	0.0003a
90-88%, cresylic acid 5%, thiophenols 5%, magnesium chloride 1%, hydrochloric acid and organic chlorides trace; residual tar, tricresyl phosphate and magnesium chloride	Rayon	F	700	74	—	xx	...	0.007	...	0.035	...
90-88%, cresylic acid 5%, thiophenols 5%, magnesium chloride 1%, hydrochloric acid and organic chlorides trace; residual tar, tricresyl phosphate and magnesium chloride	Rayon	F	700	36	—	—	...	0.006	...	...	0.001
90-88%, cresylic acid 5%, thiophenols 5%, magnesium chloride 1%, hydrochloric acid and organic chlorides trace; residual tar, tricresyl phosphate and magnesium chloride	Rayon	F	700	22	—	xx	...	0.01 0.0006	...	...	0.0055 0.0003
tricresyl phosphate, traces of diaryl phosphate, monoaryl phosphate and phosphoric acid	Rayon	F	212-240	4.5	...	xx	...	0.025	...	...	...
crude tricresyl phosphate, cresylic acid trace	Rayon	F	176	544	—	—	...	0.0003a	...	0.0003a	...
tricresyl-phosphate scum, sulfuric acid 2 vol%, organic sulfur compounds, water, hydrogen sulfide	Rayon	F	100	135	—	—	...	0.0025a	...	0.002	...
CROTONALDEHYDE											
83%, water 10%, acetaldehyde 0.75%, heavy alcohols, phosphoric acid	Chemical	...	275	147	—	xx	nil	nil	...	...	...
83%, water 10%, acetaldehyde 0.75%, heavy alcohols, phosphoric acid	Chemical	...	275	43	—	xx	0.0001	0.0001	...	...	...
75%, water 15%, acetaldehyde 10%, acidity as acetic acid 0.33%, phosphates trace, pH 4.5	Chemical	F	200	608	—	xx	nil	nil	...	...	...
crotonaldehyde, water 15%, acetaldehyde 10%, acidity as acetic acid 0.33%, phosphates trace	Chemical	...	120	1094	—	—	nil	nil	...	...	...
21.9%, water 45.4%, acetaldehyde 29.5%, butyl butyrate 1.3%, hexadienal 1.3%, butyric acid 0.6%	Chemical	F	250	462	—	x	...	0.0002	0.0002	0.0005	...
CUMENE											
75%, cumene hydroperoxide 25%	Chemical (distillation)	F	212	347	xx	xx	0.0001	0.0001		0.0001	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
DETERGENTS											
alkyl benzene sulfonic acid	Soap	F	120	55	xx	xx	...	0.0063	...	...	0.0039
alkyl benzene sulfonic acid	Soap	F	120	56	x	—	...	0.0022	...	...	0.0006
41-39% ammonium alkyl aryl sulfonate, water 39-40%, ethanol 14.5-16%, ammonium sulfonate 4-7%, pH 6.9-13	Soap	F	62-105	43	x	x	<0.0001 S<0.0001	<0.0001 S<0.0001	...	...	<0.0001
30-28% ammonium alkyl aryl sulfonate, water 46.5-49.5%, ethanol 17.5-19.5%, ammonium sulfonate 2-4%	Soap	F	65	90	—	—	<0.0001 S<0.0001	<0.0001 S<0.0001	...	...	<0.0001
57-53% sodium alkyl aryl sulfonate, active, sodium sulfate <3%, water remainder	Synthetic Detergent	F	150	392	—	xx	<0.0001	<0.0001	...	<0.0001	<0.0001
47-40% sodium alkyl aryl sulfonate	Soap	F	85	95	x	x	<0.0001d S0.0002cd	<0.0001 S<0.0001d	..	...	<0.0001
24% sodium alkyl aryl sulfonate, sodium pyrophosphate 16%, sodium tripolyphosphate 16%, nonyl phenol trace, water remainder, pH 9	Synthetic Detergent	F	175	311	—	x	<0.0001	<0.0001	...	<0.0001	<0.0001
alkyl aryl sulfonate slurry, 60% active, sodium sulfate <3%, pH 8-8.5	Soap	F	130-180	70	—	..	<0.0001d	<0.0001	...	C<0.0001	...
dishwashing compound, mainly sodium polyphosphates, sodium silicates, sodium carbonates, small amounts of anionic surfactants "SAAS" type	Soap	F	140-160	60	x	x	<0.0001	<0.0001	...	...	...
non-ionic detergent slurry, containing water, polyphosphates, soda ash and sodium silicate	Chemical	F	140	10	..	xx	0.00012	<0.0001	...	...	...
cleaning compound, soya fatty acid soaps 3%, non-ionic detergents 2%, sodium tripolyphosphate in water, pH 10-10.5	Soap	F	72	90	—	—	<0.0001	<0.0001	...	...	...
90% "Nytron" synthetic detergent, sodium silicate 10% (half immersed)	Soap	L	R.T.	7	—	—	nil	...	...	...	...
0.2% "Nytron" synthetic detergent (half immersed)	Soap	L	140	0.25	xx	—	0.0001	...	...	...	...
0.2% "Fab" synthetic detergent	Soap	L	140	0.25	xx	—	0.0001	...	...	...	...
0.2% "Oz" synthetic detergent (half immersed)	Soap	L	R.T.	7	—	—	nil	...	...	...	...
"Tide" synthetic detergent	Soap	L	140	0.25	xx	—	0.0001	...	...	...	...
DICHLORO-DIPHENYL-TRICHLOROETHANE											
"DDT," sodium sulfate, diatomaceous earth, traces of sodium, monochlorobenzene and chloral, pH 6-7 (filter)	Chemical	F	270	91	—	xx	0.0012d	0.0008d	...	0.0005d	0.0005d
DYES											
acid dye solution, straight acid, Neolan acid, chromium colors	Textile	..	B.P.	24	..	..	L nil	...	...	...	...
10% "Calcosid" orange Y(II) in methyl "Cellosolve" solution, acidified with acetic acid 99.5% to pH 5.2	Wood Staining	..	80	33	x	—	<0.0001	<0.0001	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions						Average corrosion rates (ipy)				
	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
chromium-chloride dye, 27% hydrochloric acid 1100 lb, water 1000 lb, corn syrup 200 lb, sodium dichromate 725 lb added	Textile	F	150-216	68	..	..	0.005cd	0.002c	...	0.002cd	...
chromium-chloride dye, 27% hydrochloric acid 1100 lb, water 1000 lb, corn syrup 200 lb, sodium dichromate 725 lb added	Textile	F	150-216	68	—	x	...	...	...	0.02	...
cotton dyeing and bleaching solution, no "Textone," regular processing cycles	Textile	F	160-170	194	x	xx	<0.0001cd	<0.0001cd	<0.0001d	<0.0001	...
dyestuffs and developing baths during 250 hours, sodium hydrosulfite and caustic during 5 hours	Textile	..	...	11	xx	xx	L<0.0001	<0.0001	...	...	...
fur washing, bleaching, dyeing solutions, alkalies, organic and inorganic acids, oxidation and reduction agents, concentrations <1.5%	Fur	F	70-100	25	x	x	<0.0001	<0.0001	...	...	...
dyeing solutions, hydrochloric acid and acetic acid during 2.5 days, acetic acid and sodium dichromate during 1.7 days, sulfuric acid during 1.5 days, and sodium perborate during 0.7 days	Textile	..	50-130	6.4	..	..	<0.0001	<0.0001a	...	...	...
dye solution, water, sulfuric acid, acetic acid, sodium dichromate, cupric sulfate, colors, caustic scouring sodium hydroxide 0.5-7% (B.P.)	Textile	..	R.T.-B.P.	180	x	x	0.0001a	0.0001	...	...	...
sulfuric acid dyeing solution, "Palatine" dyes	Textile	..	B.P.	400	x	xx	...	0.0002	...*	...	...
wool dyeing solution	Textile	F	212	21	—	xx	0.0001*	0.0001	...	...	...
water soluble dyes, tallow and wool grease	Tanning	F	100	180	..	..	...	0.0001	...	...	...
various dye liquors	Textile	F	45-202	30	—	x	<0.0001	<0.0001	...	...	...
ERYTHRITOL											
commercial erythritol	Chemical	F	150-220	194	—	—	0.0009b L0.0028b	0.0005	...	...	...
ESTERS, BUTYL ACETATE											
59% *sec*-butyl acetate, propyl acetate 15%, acetic acid 15%, *sec*-butyl alcohol 8%, water 2%, propyl alcohol 0.5%, toluene sulfonic acid trace	Chemical	F	200	92	—	xx	<0.0001	<0.0001	nil	...	...
55% *sec*-butyl acetate, propyl acetate 33%, *sec*-butyl alcohol 6%, propyl alcohol 4%, water 2%, acetic acid 0.01%	Chemical	F	190	52	—	xx	0.0001	0.0001	<0.0001a	...	...
ESTERS, ETHYL ACETATE											
100% ethyl acetate	Chemical	F	171	17	..	xx	0.0002	0.0003	...	...	...
99-92% ethyl acetate, ethanol 0-7%, high boilers <1%	Chemical	F	316	490	—	xx	<0.0001	nil	...	...	...
85% ethyl acetate, ethanol 8%, heavy esters 3%, ethyl propionate 2%, water 1%	Chemical	F	226	17	..	xx	0.0024	0.001	...	...	...
80% ethyl acetate, methylethyl ketone 20%	Chemical	F	158	39	..	x	0.0002	0.0001	<0.0001	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
76% ethyl acetate, ethyl propionate 14%, acetic acid 5%, heavy esters 5%	Chemical	F	176	17	..	xx	0.0001	0.0002	...	...	...
70% ethyl acetate, benzene 23%, water 7%, acetic acid 0.04%	Rayon	F	177	246	—	xx	...	0.0001r	0.0001	C0.0001	...
70% ethyl acetate, benzene 30%, propionic and acetic acids 0.02%	Chemical	F	177	50	..	xx	0.0002r	nil r	nil r	...	...
70% ethyl acetate, benzene 30%, propionic and acetic acids 0.02%, manganous acetate 10 lb/day	Chemical	F	177	34	..	xx	0.0001r	<0.0001r	...	...	...
61% ethyl acetate, benzene 26%, propionic acid 11%, acetic acid 1°%, water 1%, manganous acetate 10 lb/day	Chemical	F	190	34	..	xx	0.06r	0.006	...	...	...
51% ethyl acetate, benzene 33%, acetic acid 10%, water 6%	Chemical	F	120	807	x	x	nil	nil	...	...	...
ethyl acetate, esterification, acetic acid glacial 9500 gal, ethyl alcohol 9000 gal, sulfuric acid 66°Be 25 gal	Chemical	F	158-221	180	—	xx	0.002 0.0013	0.0025 0.0018	0.0017 0.0014	0.001 0.0009	0.0015 0.0014
ethyl acetate, toluene, various volatile resins, plasticizers, waxes and lacquers	Solvent Recovery	F	170-240	318	—	—	0.0002	<0.0001	...	<0.0001	<0.0001
ESTERS, ETHYL ACRYLATE											
20% ethyl acrylate, phosphoric acid 70%, ethanol, ethyl acetate and acetic acid together 10%	Rayon	F	284	63	—	xx	0.04	L0.0075c 0.0069	0.0055b 0.2c	0.01b	...
ESTERS, METHYL ACETATE											
60% methyl acetate, acetaldehyde 10%, water 5%, acetic acid 2%, acetone and alcohols	Chemical (fractionation)	F	223	131	—	x	0.0001*	0.0001	0.0001	...	...
20% methyl acetate, ethyl acetate 20%, methylethyl ketone 18%, acetone 15%, low boilers 14.4%, water 6.5%, acetaldehyde 6%, acetic acid <1%	Chemical	F	144	390	..	xx	...	<0.0001 L<0.0001	<0.0001	...	...
18% methyl acetate, water 60%, acetone 16%, acetaldehyde 4%, acetic acid 0.5%, formic acid 0.1%	Rayon	F	199	1125	—	xx	0.0004	0.0001	0.0001	...	...
14% methyl acetate, water 60%, acetaldehyde 13%, acetone 12%, acetic acid 0.1%, formic acid 0.1%	Rayon	F	172	1158	—	xx	<0.0001	<0.0001	<0.0001	...	...
ESTERS, PROPYL ACETATE											
propyl acetate, butyl acetate and isobutyl acetate together 65%, water, propyl, butyl and isobutyl alcohol together 10%, acetic acid 0.003-2%	Chemical	F	200	57	—	x	0.0002	<0.0001	...	...	...
propyl acetate, propyl alcohol, water, ethyl acetate, ethanol, methyl amyl acetate, methyl isobutyl carbinol, isopropyl alcohol, isopropyl acetate, acetic acid	Chemical	F	167-248	650	—	—	<0.0001	<0.0001	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
ESTERS, VINYL ACETATE											
100% vinyl acetate	Chemical	F	176	150	..	xx	0.0001	nil	...	...	...
99% vinyl acetate	Plastic	F	160	77	x	x	< 0.0001	<0.0001	< 0.0001	...	...
80% vinyl acetate, vinyl propionate 20% during 184 days, and ethyl acetate 60%, other organics 10%, water 30% during 118 days	Chemical	F	162	302	—	xx	0.00001	<0.0001	...	...	...
10% vinyl acetate, acetic anhydride 50%, ethylidene diacetate 30%, acetic acid 10% during 186 days, and ethyl acetate, methylethyl ketone and ethanol together 40%, water remainder during 68 days	Chemical	F	212-293	254	—	xx	0.0015	0.0007	...	...	...
vinyl-acetate residues, sulfuric acid 1%	Plastic	F	220	22	—	x	0.08c 0.13c	0.042d	0.035d	...	...
ETHANOL											
56%, solids 23%, water 15%, ethyl acetate 5%, butyraldehyde 1%, sulfuric acid 0.5% (vapors)	Plastic	F	167	132	..	x	S0.0007 <0.0001*	<0.0001	<0.0001 S0.0003	<0.0001	<0.0001 0.0002
56%, solids 23%, water 15%, ethyl acetate 5%, butyraldehyde 1%, sulfuric acid 0.5%	Plastic	F	167	132	—	x	S0.02 0.0001*	<0.0001	<0.0001 S<0.0001	<0.0001	0.0001
56%, water 15%, ethyl acetate 5%, acetic acid 1%, sulfuric acid 0.5%, butyric acid 0.1%	Chemical	F	167	59	—	x	0.001	0.0004	...	...	...
47-42%, acetate polymer solids 36%, ethyl acetate 5-29%, water 10%, sulfuric acid 1.3-2.5%, acetic acid 0.2-2.3% (vapors)	Plastic	F	167	180	x	x	S0.001 0.0003* <0.0001*	0.0006	<0.0001	<0.0001 S<0.0001	0.0002
47-42%, acetate polymer solids 36%, ethyl acetate 5-29%, water 10%, sulfuric acid 1.3-2.5%, acetic acid 0.2-2.3% (vapors)	Plastic	F	167	180	x	x	S0.0091d 0.003*d	0.0009	0.0011 S0.0017	0.0006	0.0004
42%, water 53%, ethyl acetate 2.3%, acetic acid 1.5%, sulfuric acid 1.3%	Plastic (distillation)	F	185	181	x	x	0.0061	0.0072	0.0068	...	...
9%, water 91%, sulfuric and acetic acids trace (column, vapors)	Chemical (distillation)	F	188	78	—	xx	0.0018	0.0005	0.0005	...	
ETHANOLAMINE											
monoethanolamine pure	Chemical	F	212-320	...	..	..	0.0001	0.0001	...	...	...
95-90% monoethanolamine, water (vapors)	Chemical (distillation)	F	338	35.5	—	x	0.0005	0.0004	...	...	...
95-90% monoethanolamine, water	Petroleum	F	338-374	36	—	..	0.0005	0.0004	...	...	...
28.5% monoethanolamine, water, carbon dioxide and hydrogen sulfide	Petroleum	F	230-272	245	—	xx	0.016c <0.0001 0.022* <0.0001*	0.017c <0.0001	...	...	...
17% monoethanolamine, water, carbon dioxide 2%, pH 10-10.5 (reboiler head)	Petroleum	F	230-240	293	—	xx	<0.0001	<0.0001	...	...	...
15% monoethanolamine, water, carbon dioxide and hydrogen sulfide (bottom tray of absorber)	Petroleum	F	230	270	—	..	<0.0001	<0.0001	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
15% monoethanolamine, ethanol 34%, water 25%, triethylamine 6%	Chemical	F	325	102	xx	x	0.0001	0.0001	...	...	...
diethanolamine, monoethanolamine 5% approximately (vapors)	Chemical (distillation)	F	410	30	—	x	0.015	0.0032	...	...	...
diethanolamine, hydrogen sulfide	Petro-chemical	F	212	110	—	x	<0.0001	<0.0001	...	<0.0001d	<0.0001
diethanolamine, hydrogen sulfide (heat-exchanger bonnet)	Petro-chemical	F	200	110	—	xx	<0.0001	<0.0001	...	<0.0001 0.0002	<0.0001
30% diethanolamine, water, carbon dioxide 14 vol/vol water, pressure 10 psig during 450 hours (reboiler)	Petroleum	F	100-150	83	—	x	<0.0001	<0.0001	...	<0.0001	<0.0002
30% diethanolamine, water, carbon dioxide 30 vol/vol water, pressure 285 psig during 500 hours	Petroleum	F	100-230	83	—	x	0.0001	0.0001	...	0.0001	0.0001
triethanolamine slurry, hydrochloric acid	Chemical	F	90-200	15.3	..	..	0.0009b	0.0004a	...	...	0.0002
mono-, di- and triethanolamine, water <0.5%	Chemical (distillation)	F	338	35.5	—	..	0.0009	0.0005	...	...	...
di- and triethanolamine, monoethanolamine trace	Chemical (distillation)	F	410	30	—	—	0.0052 0.0016	0.0012	...	...	...
ETHYLAMINE											
mono-, di-, and triethylamine, ammonia, water, ethanol, pressure 175 psig	Chemical	F	123	102	xx	xx	0.017	0.0017 0.0002	...	...	...
ETHYL BUTANOL											
91% 2-ethyl butanol, acetals and ketals formed from glycol and carbonyls 6%, water 3%	Chemical	F	300	5	—	xx	...	0.005	0.0035	...	...
90% approximately 2-ethyl butanol, carbonyls 3-4%, butylene glycol 3%, toluene sulfonic acid 0.5%, copper sulfate 0.09-0.6%	Chemical	F	300	24	—	xx	.	<0.0001	nil	0.00066	...
90% approximately 2-ethyl butanol, carbonyls 3-4%, butylene glycol 3%, toluene sulfonic acid 0.5%, copper sulfate 0.09-0.6%	Chemical	F	300	5	—	xx	..	0.0067	0.0028	0.0023	...
ETHYLENE											
ethylene, cracked gases in quench water, organic acid trace, hydrochloric acid and carbon dioxide traces, pH 5 approximately	Petro-chemical	F	160-170	44	—	..	0.002a	0.0005b	...	...	...
ethylene, cracked gases in quench water, organic acid trace, hydrochloric acid and carbon dioxide traces, pH 5 approximately	Petro-chemical	F	160-170	38	—	..	0.019bdr	0.007adr	...	...	0.002
ETHYLENE DIBROMIDE											
ethylene dibromide (vapors)	Petroleum	F	R.T.	60	..	..	0.0004	0.0003	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
ethylene dibromide (column)	Chemical (distillation)	F	200-212	37	..	..	0.021c	0.004c	...	...	...
ethylene dibromide finished fumes	Chemical	F	85	287	—	—	<0.0001bd	<0.0001d	...	...	...
ethylene dibromide crude	Chemical	F	80	287	—	—	0.0005ad 0.0005cd	0.0003ad 0.0003cd	...	...	...
ETHYLENE DICHLORIDE											
ethylene dichloride, "Pella" oil, steam, hydrochloric acid trace (oil stripper)	Petro-chemical	F	210-240	79	—	..	0.017	0.006ad	0.0055ad	..	0.002ad
ethylene dichloride, "Pella" oil, steam, hydrochloric acid trace (vapors)	Petro-chemical	F	100-220	79	—	..	..	0.026r	0.015	..	0.004ad
ethylene dichloride, dilute hydrochloric acid (vapors, liquid)	Chemical (distillation)	F	80	108	x	—	0.0001ad <0.0001	0.0002ad <0.0001	...	0.0002 <0.0001	0.0002a <0.0001
ETHYLENE GLYCOL											
ethylene glycol	Pharma-ceutical	F	−30	112	—	—	0.0001	0.0001	..	...	...
ethylene glycol	Pharma-ceutical	F	115	112	—	—	0.0001	0.0001	...	...	..
ETHYL SUBERIC ACID											
0.108% 2-ethyl suberic acid, sebacic acid 0.102%, diethyl adipic acid 0.024%, heavy organic acid 0.008%, iridecanoic acid trace, remainder water	Chemical	F	500	42	xx	x	..	0.015	0.0086	0.0098	0.0073
FATTY ACIDS											
stearic acid	Research	F	445	1	..	..	0.0262	nil	...	...	...
stearic and oleic acids	Chemical (distillation)	F	475	147	—	x	0.0142cd	<0.0001ad	...	...	...
stearic and palmitic acids vapors, no air (still unit)	Pharma-ceutical	F	221-257	32	—	x	<0.0001	<0.0001	...	...	...
crude fatty acids, mixed	Chemical (distillation)	F	212	43	xx	x	0.0213d	0.0049d	...	...	...
soap fatty acids, mixed	Research	L	230	1.7	..	..	0.0305	nil	...	...	...
soap fatty acids, mixed	Research	L	250	1.25	..	..	0.0218	0.017	...	...	...
vegetable fatty acids, mixed, live steam	Chemical	F	365-374	...	..	..	0.0021	0.0007	...	...	...
cottonseed crude fatty acids (top vapor outlet of vacuum still)	Chemical (distillation)	F	490	42	—	xx	0.01	0.0001	...	...	...
cottonseed fatty acids	Soap	F	530	50.5	x	—	0.0383c	<0.0001ad	...	...	...
vapors from hot linseed expeller cake (Anderson oil expeller)	Chemical	F	170-200	18	xx	..	<0.0001	<0.0001	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
fatty acid "Seedine," acid number 170	Rubber	F	150	122	—	—	<0.0001ad <0.0001*ad	<0.0001ad	...	...	...
90% approximately fatty-acids vapor and liquid from animal foot, stripping steam 20% (high-vacuum column)	Soap (distillation)	F	420	163	—	xx	0.0005 0.00022	<0.0001	...	...	...
40% animal fatty acids, free pitch 60% (high-vacuum column bottom)	Soap (distillation)	F	440	163	—	x	<0.0001	<0.0001	...	...	...
castor-oil fatty acids	Paint and Varnish (distillation)	F	<700	45	xx	xx	0.0015	<0.0001	...	...	...
castor-oil fatty-acid condensate	Chemical	F	75	119	—	—	<0.0001	<0.0001	...	...	...
animal and coconut fatty acids	Soap	F	135	1218	—	—	<0.0001	<0.0001	...	...	...
animal and coconut fatty acids, mainly stearic and oleic acids, pH 3-6	Soap	F	160-200	553	—	—	0.0001	0.0001	...	...	...
fatty acids vapors from fish oils	Chemical (distillation)	F	450-500	210	—	x	0.0016a	0.00013ad	...	...	...
FATTY-ACID MIXTURES											
90% fatty acids, sulfuric acid 5%, sebacic acid 3%, sodium sulfate, potassium sulfate, water remainder	Chemical	F	220-240	12	xx	xx	0.083c	0.256c	...	...	...
fatty acids (C_2 to C_{18}), primary alcohols, sulfuric acid 0.1-0.25%	Chemical (distillation, esterification)	F	212	33.3	...	...	0.02	0.02	...	0.0045	...
90% approximately stearic acid, dilute sulfuric acid 5-15%	Soap	F	215	30	—	x	0.017* 0.0029*	0.0018	0.0016	0.0018	...
stearic acid, dilute sulfuric acid washed, water (cypress tub)	Soap	F	215	57	—	xx	0.001* 0.023* 0.0006*	0.0002 0.0003	...	...	...
stearic and oleic acids, their methyl and isobutyl esters, phosphoric acid, sodium methylate, isobutyl alcohol and methyl alcohol traces	Chemical	F	250	21	—	xx	0.0004	<0.0001	..	C0.0002	...
stearic and palmitic acids, 60°Bé sulfuric acid 0.5% (liquid line)	Soap	F	180	35	—	xx	<0.0001	<0.0001	...	...	...
crude fatty acids and water alternately (water has pH 3 due to sulfuric acid from previous process)	Soap	F	140	730	—	—	<0.0001 W0.0012	<0.0001	...	...	...
60% fatty acids, water 40%, sulfuric acid 1.17%	Soap	F	212	21	—	xx	0.0049ad 0.057	0.0007d 0.0031ad	...	...	...
animal, vegetal and fish oils, sulfuric acid, sodium chloride and sodium sulfate, pH 1-10	Soap	F	130	138	—	xx	0.0021	0.0006	...	0.0005	0.0006
fatty acids, nitriles, ammonia and water, pressure 10 psig (vapors)	Chemical	F	590	51	—	..	0.071	0.031	...	0.0083	0.0062
44.3% fatty acids, sulfuric acid 40 vol% approximately, naphthalene 14.3%	....	F	115-123	30	—	xx	0.0006	0.001	...	0.0007	...
20-0.02% mixture of sebacic, adipic, stearic acids and phthalic anhydride, toluene sulfonic acid 0.5% (liquid, vapors)	Chemical	F	250	7.7	x	xx	0.125 0.016 0.039* 0.012*	0.015 0.005	...	0.004 0.004	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
20-0.02% mixture of sebacic, adipic, stearic acids and phthalic anhydride, toluene sulfonic acid 0.5% (liquid, vapors)	Chemical	F	250	46	x	xx	0.021 0.003 0.007* 0.002*	0.003 0.001	...	0.0008 0.0007	...
FERRIC CHLORIDE											
36% approximately	....	F	77	61	x	—	...	corr	...	corr	corr
10%	Research	L	R.T.	1	..	..	0.145	...	...	...	...
ferric chloride, ammonia, fatty acid	Chemical	F	216	106	x	xx	...	<0.0001		<0.0001	<0.0001
FERRIC HYDROXIDE											
saturated ferric-hydroxide water solution, sulfuric acid 2%, pH 3.5	Chemical	L	60	...	..	..	0.001*	0.0005	...	...	...
FERRIC SULFATE											
10%, citric acid 0.5%, copper ions present	Metal (pickling)	F	170-210	38		xx	0.0004d	<0.0001d	...	C nil	...
5%, ferric-oxide slurry, water	Chemical	F	65	32	—	xx	<0.0001	<0.0001	<0.0001	C<0.0001	...
1.4% approximately, sulfuric acid 43 g/l	Mining	F	150-168	31	—	xx	<0.0001*	<0.0001	...	<0.0001 C<0.0001	...
FERROUS CHLORIDE											
saturated ferrous-chloride water solution, hydrochloric acid 0.09% (evaporator)	Chemical	F	275	1	—	xx	0.0046	0.0054	...	...	...
30%, organic wastes 5%, resorcinol 3%, hydrochloric acid 0.5%, abrasive iron residue, pH 1 (filter press)	Chemical	F	175	10	—	xx	...	0.0017cd S0.0029cd L0.0017bd	0.0014cd	0.0012cd	0.001cd
16.5% approximately, lead ion 0.07-2.5 g/l, tin ion 0.07 g/l as chlorides, pH 1.2	Chemical (evaporation)	L	150	1.75	—	xx	...	0.006 0.08a	...	C0.004 C0.039	...
FERROUS IODIDE											
62%, water solution	Chemical	F	75	2.75	x	x	0.003*b	0.003	...	...	...
0.28%, catalysts in reaction product of an aliphatic ketone and a diamylamine, pressure	Chemical	F	300-570	340	—	xx	<0.0001a <0.0001*a	<0.0001a	<0.0001a	...	...
0.28%, catalysts in reaction product of an aliphatic ketone and a diamylamine, pressure	Chemical	F	300-570	84	—	xx	0.00015ad 0.00015*ad	<0.0001a	0.0003a	...	...
0.28%, catalysts in reaction product of an aliphatic ketone and a diamylamine, pressure	Chemical	F	300-570	55	—	xx	...	0.0001a	...	...	...
FERROUS SULFATE											
24%, trace of wetting agents, pH 2.5 (evaporator-crystallizer)	Metal (pickling)	F	90-130	16	—	xx	0.0001d	0.0001d	...	0.0001	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Ferrous sulfate											
20%, sulfuric acid 19.5%, titanium dioxide 10% as sulfate, solids 2-3%, titanium (3) ion 1.7 g/l as sulfate, hydrogen sulfide trace (Dorr settling tank)	Metal	F	122-158	1	—	—	5.12*	11.5ad	...	...	...
20%, ferric sulfate 16-18%, sodium chloride 10%, sodium hypochlorite 0.5-1%, hydrochloric acid trace (cypress tank)	Chemical	F	203	1.8	xx	xx	0.19c	0.07cd	...	C0.05cd	...
16%, some wetting agents, pH 2.5 (evaporator-crystallizer)	Metal (pickling)	F	180-210	16	—	xx	0.0006cd	0.0003d	...	0.0002	...
10%, sulfuric acid 5%, hydrofluoric acid 5%	Metal	L	120	1.7	xx	xx	0.393	0.191	...	...	...
ferrous sulfate, sulfuric acid, waste pickle liquor, pH 1	Metal (pickling)	F	140	67	x	...	0.0002*cd S0.0007*c 0.0002b S0.0004b L0.0008b	0.00018ad S0.00021	0.00013ad S0.00015ad	0.0003	...
ferrous sulfate, sulfuric acid, waste pickle liquor, pH 1	Metal (pickling)	F	100	67	x	x	0.0005*cd S0.001*c 0.0005cd S0.0007cd L0.0011bd	0.0004cd S0.0004b	0.0002cd 0.00025cd	0.0006cd	...
4%, ferric sulfate, sulfuric acid, pH 2.5	Paint	F	162	27	xx	xx	0.017* 0.017	0.0006	...	...	...
weak ferrous-sulfate solution, possible traces of ferric sulfate and dilute sulfuric acid (pressure vessel, liquid interface)	Paint and Varnish (crystallization)		450	3.3	—	...	...	0.0107	...	0.0122	0.0111 0.0206
FERROUS SULFIDE											
fine ferrous sulfides, rock with 0.03 lb/ton solution lime, pH 9	Mining	F	91	22	xx	xx	0.0003	0.0005	...	...	...
FERTILIZERS											
commercial fertilizer "Swifts 5-10-5," sometimes damp	Agriculture	F	R.T.	290	xx	—	<0.0001d	<0.0001d	...	nil	...
fertilizer, water 67.89%, 75% phosphoric acid 11.16%, potassium chloride 9.7%, anhydrous ammonia 2.45% (half immersed)	Research	L	100	28	xx	—	0.0001	0.0001	...	...	...
liquid fertilizer "Nitrana" (half immersed)	Agriculture	L	100	14	xx	—	0.0001	nil	...	...	...
fertilizer, water 65.05%, 75% phosphoric acid 16.74%, potassium chloride 14.54%, anhydrous ammonia 3.67%, pH 6.6 (half immersed)	Agriculture	L	135	28	xx	—	0.0001	0.0001	...	...	...
fertilizer, water 52.43%, 75% phosphoric acid 18.6%, ammonium nitrate 9.34%, potassium chloride 8.08%, urea 7.47%, anhydrous ammonia 4.08%, pH 6.5 (half immersed)	Agriculture	L	135	28	xx	—	<0.0001	<0.0001	...	...	...
mixed fertilizer, superphosphate, ammonium sulfate, potassium chloride, sand, ammonia, ammonium nitrate and sulfuric acid	Chemical	F	<250	56	...	...	0.0015cd	0.0002bd	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
fertilizers "Uran 32," "Feran 21," "Nitrana 4"	Agriculture	F	60-80	84	—	x	<0.0001 <0.0001*	<0.0001	...	...	...
FISH STICKWATER											
condensed fish solubles, pH 4.2	Chemical	F	90	105	—	xx	<0.0001	<0.0001	...	<0.0001	<0.0001
menhaden fish stickwater, peptones, aminoacids, gelatine-like materials, sodium chloride, calcium and magnesium salts, acidified with sulfuric acid to pH 5 (single-effect evaporator)	Agriculture	F	185	30	x	x	<0.0001d	<0.0001	...	...	...
menhaden fish stickwater, solids 4.95%, acidified to pH 4.5 with sulfuric acid (triple-effect evaporator)	Agriculture	F	212	28	x	x	<0.0001	<0.0001	...	...	...
vapors from menhaden fish stickwater containing 4.95% solids and acidified with sulfuric acid to pH 4.5	Agriculture	F	212	28	xx	xx	<0.0001	<0.0001	...	...	...
untreated menhaden fish stickwater, caustic boilout 15%, washed with hydrochloric acid 5% (evaporator)	Agriculture	F	200-220	51	—	xx	<0.0001	<0.0001	...	...	...
fish stickwater, containing sodium chloride 1%, sulfuric acid 2% (tubular evaporator)	Agriculture	F	124-200	41	—	x	<0.0001	0.0001	...	...	...
fish stickwater, solids 8-30%, acidified with sulfuric acid to pH 5.3 (double-effect evaporator)	Agriculture	F	200	51	x	x	0.0001bd	<0.0001	...	...	...
FLUOBORIC ACID											
64.2%, boric acid 7.09%	Chemical	L	R.T.	32	...	...	0.066	...	...	...	...
fluoboric acid, aluminum-hydrate slurry, pH 1.9-2.1	Metal	F	200	137	xx	xx	...	0.0016cd	...	C0.002cd	0.0023cd
32%, boric acid 1.5%	Chemical	F	75	30	—	—	0.0044a	0.0037	...	C0.0021	...
24.7%	Research	L	175	10	...	...	0.221	0.0472	...	...	...
24.7%	Research	L	175	9	...	...	...	W0.052 0.0309	W0.0475 0.0467	...	...
3.84%, free hydrofluoric acid trace, pH 1.7-1.9	Metal	F	95	137	xx	xx	...	0.0003d	...	C0.0015d	0.0003d
1%, dispersed in organic medium	Chemical	L	220-250	0.13	—	—	0.0053c	0.0013	...	0.0008 C0.0006	...
1%, dispersed in organic medium	Chemical	L	220-250	0.13	xx	—	...	0.0013	...	...	...
0.99%, pH 3.2-3.4	Metal	F	120	127	xx	x	...	0.0055c	...	0.0104cd	0.0009cd
FLUOSULFONIC ACID											
fluosulfonic waste acid containing some oxygen, chlorine, chlorine oxides and sulfuric acid, sulfuric acid 10-25 vol% added (still pot)	Chemical (distillation)	F	490	4.4	...	x	0.11c S0.027c	0.29c 0.029c	0.92c	0.43c	0.49c

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
FLUX											
25% zinc-chloride flux, pH 4	Metal	F	75-80	56	x	x	...	0.018c	..	0.044c	0.003
soldering-flux solution, zinc chloride, ammonium chloride, water (half immersed)	Chemical	F	60	60	—	—	.c	...c	..	...c	...
aluminum-brazing flux, lithium fluoride, sodium fluoride or sodium chloride (alternately immersed)	Metal	L	800-1300	10	xx	—	>0.56	>0.56	.	.	..
FOOD BRINE											
Prague pickle solution, sodium chloride 88%, sodium nitrite 6%, sodium nitrate 4%, some dextrose and glycerine	Food	F	212	50	—	xx	0.0005cr	0.0001	..	<0.0001	<0.0001
vapors arising from Prague pickle solution, sodium chloride 88%, sodium nitrite 6%, sodium nitrate 4%, some dextrose and glycerine	Food	F	175	50	x	xx	0.0004	<0.0001		<0.0001	<0.0001
meat-curing solution, salt 1.4 lb, sugar 0.24 lb and Prague curing powder (contains sodium nitrate, nitrite and chloride) 0.28 lb/1 gal water	Food	F	45	...	..	..	<0.0001r <0.0001*r	<0.0001r	...	...	<0.0001
brine solution, sodium chloride 2-3%, malic acid < 0.2%, pH 5.5-7	Food	F	70	43	x	x	0.0001	0.0001			.
olive brine containing lactic acid, salt and water	Food	F	66-75	95	—	—	0.0001d	0.0001d		...	...
FORMALDEHYDE											
90-80%, vacuum 25-in. mercury (Paraform reboiler)	Chemical	F	180	11.5	—	xx	nil	nil	...	...	...
84% (nozzle on side of Paraform evaporator)	Chemical	F	190-200	35	—	xx	0.0001	0.0001	..	...	...
73% (Paraform first-stage evaporator)	Chemical	F	150	64	—	—	0.0001	0.0001	..	...	...
70-30%	Chemical	F	130-140	99	x	xx	<0.0001	nil	...	...	...
formaldehyde solution	......	F	80	30	—	x	<0.0001*	<0.0001	...	...	...
65-45% (Paraform evaporator)	Chemical	F	170	9	—	xx	0.0003	0.0002	.	...	...
37%	Synthetic Resin	F	75	41	—	—	<0.0001	<0.0001	..	...	...
20%	Chemical	F	275	71	—	xx	...	0.0001	0.0001	...	...
15%	....	..	176	996	—	x	<0.0001	<0.0001	...	...	...
10% (fractionating tower)	Chemical	F	220	87	—	xx	0.0004	0.0006	<0.0001	...	...
5%	Rayon	..	210	560	—	x	0.001	0.0001	<0.0001	...	...
6.7-1%	Chemical	F	283	3	xx	xx	0.0004	0.0004	0.0005	...	...
3.5%	Chemical	F	285	5.8	xx	xx	0.0002	0.0001	nil	...	...
0.15%	Chemical	F	297	5.8	x	xx	<0.0001	0.0001	nil	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
FORMALDEHYDE MIXTURES											
99.5% trioxane, formic acid 0.01%, formaldehyde trace	Chemical	F	245-265	12.5	—	xx	0.01	0.0023	...	...	...
65-50%, formic acid to 7%, sulfuric acid 2-4%, water remainder	Chemical	F	220-225	10	x	xx	...	0.0313	0.03	0.0214	
65-50%, sulfuric acid 2-4%, formic acid 1-3%, water	Chemical	F	220-225	18	—	xx	...	0.0244c		0.0183	...
65-50%, sulfuric acid 2-4%, formic acid 0.5-1%, water	Chemical	F	220-225	15	—	xx	...	0.0982		0.0398	...
60-40% formaldehyde vapors, formic acid 1-4%, sulfuric acid 1-3%	Chemical	F	222	30	—	xx	0.024*	0.017	...	...	...
57.5% approximately trioxane, water 40%, formaldehyde 2%, methyl formate and methylal 0.5%, total acidity as formic acid 0.5%, mineral acid as sulfur dioxide 0.002%, oxygen 6.1 ppm, pH 2.8	Chemical	F	250	33	—	xx	0.0003	0.0007 0.0003	0.0001		...
50-40%, total acidity as formic acid 2.9%, oxygen 4.8 ppm, mineral acid as sulfur trioxide 0.0001%, water remainder, pH 1.9	Chemical	F	250	33	—	xx	0.0423	0.0023 0.0029	0.0023		...
48-37%, methanol 8% max, formic acid, pH 3-5	Chemical	F	120	189	x	xx	<0.0001	<0.0001	...		...
47.5%, acidity as formic acid 0.014%, small amount unsaturates, water remainder	Rayon	F	245	556	—	...	0.0032d	0.0002d			...
46%, water 28%, methanol 26%, formic acid trace (scrubbing column bottom, gas stream)	Chemical	F	437	859	—	xx	<0.0001a L<0.0001c S<0.0001	<0.0001 L<0.0001	...	...	...
42%, water 38%, methanol 20%, formic acid trace, pH 3-3.5 (rectification column)	Chemical	F	167	859	—	—	<0.0001 L<0.0001d S<0.0001	<0.0001 L<0.0001	...	...	
40%, water 37%, methanol 23%, formic acid trace, pH 3-3.5 (scrubbing column bottom)	Chemical	F	158	859	—	xx	<0.0001 L<0.0001 S<0.0001	<0.0001 L<0.0001	...	...	...
25-20%, oils and water remainder (purification column)	Rayon	F	285	627	—	xx	0.0001	<0.0001	...	...	...
22.8% formaldehyde gas, nitrogen 37.5, water 19.4%, methanol 10.1%, hydrogen 8.3%, carbon dioxide 1.8%, carbon monoxide 0.1%, formic acid trace (pipe)	Chemical	F	878	63	—	xx	<0.0001	<0.0001	...	...	...
22%, formic acid 0.076%, water remainder, pH 3.1	Chemical	F	280	306	—	xx	0.0007d	<0.0001d	...	...	...
20%, water 80%, formic acid 0.1%	Chemical	F	235	198	—	x	0.00081c	<0.0001d	...	...	...
20%, water 80%, formic acid 0.1%	Chemical	F	225	198	—	x	nil	<0.0001d nil	...	...	...
18%, formic acid 0.1%, glycols remainder	Chemical	F	245	179	—	xx	0.0002d	<0.0001d	...	...	...
15-12%, formic acid 2%	Chemical (concentration)	F	275	27	—	xx	...	0.073	0.04	...	...
14%, water 81%, methanol 3-4%, pH 3.6	Chemical	F	264	114	—	xx	0.0006	0.0001	...	...	...
formaldehyde, methanol, formic acid (primary condenser, inlet of gas stream)	Chemical	F	140	444	—	xx	<0.0001 L<0.0001 S<0.0001	<0.0001 L<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Formaldehyde mixtures											
0.3%, water 99%, methanol 0.7%	Rayon	..	266	270	—	—	<0.0001	<0.0001	...	...	...
FORMIC ACID											
4.6%	Chemical	L	338	1	—	—	0.14c	0.073c	0.063c	...	...
2%, formaldehyde 0.5-1.5%, resins, higher glycols, water remainder (tower)	Chemical (concentration)	F	300	27	—	xx	0.0184 W0.0113	0.004 W0.0113 L0.0007 WL0.0004	0.0024	...	...
1%, formaldehyde 1%, water remainder, pH 3	Rayon	F	298	296	--	x	<0.0001	<0.0001	...	...	...
formic acid, formaldehyde	Chemical	F	220	60	—	x	0.016c	0.003c	0.001cd	...	...
formic acid, hydrogen peroxide	....	F	160	4.6	—	—	0.0002d <0.0001d	0.0003d	...	0.0004d	0.0002d
0.2%, water 99.6%, unknown 0.2%, pH 3.8 average	Chemical	F	90	43	—	x	0.0001	0.0001	...	...	...
FORMIC-ACID—ACETIC-ACID MIXTURES											
See ACETIC-ACID MIXTURES WITH FORMIC ACID											
FURFURAL											
furfural-water mixture, some naphthalene (column, vapors)	Chemical (distillation)	..	226	40	—	xx	<0.0001	<0.0001	...	...	...
furfural-water mixture, anthracene, phenanthrene carbazole and other creosote residuals (column, vapors)	Chemical (distillation)	F	244	40	—	xx	<0.0001	<0.0001	...	..	...
furfural residue, sulfuric acid, levulinic acid, formic acid 3%, pressure 100 psig	Chemical	F	338	1	..	..	..	4.0	..	0.96	0.63
4.5-3.5% furfural vapors, acetic acid 1.75-2.5%, solids 0.01-0.02%, traces of formic acid, sulfuric acid and acetaldehyde	Chemical	F	330	70	—	xx	0.002	0.0001	0.0001	0.0001	0.0001
4.5-3.5% furfural vapors, acetic acid 1.75-2.5%, solids 0.01-0.04%, traces of sulfuric, formic acids and acetaldehyde	Chemical	F	330	82	—	xx	0.0029 0.0002	0.0009 0.0001	0.0004 0.0001	0.0005 0.0001	0.0002 0.0001
4.5-3.5% furfural vapors, acetic acid 1.75-2.5%, solids 0.01-0.04%, traces of sulfuric, formic acids and acetaldehyde	Chemical	F	330	71	—	xx	0.0044 corr 0.051	0.0009 0.0017 0.012	0.0012 0.0013 0.0088	0.0002 0.0036 0.0024	0.0002 0.0011 0.0009
4.5-3.5% furfural vapors, acetic acid 1.75-2.5%, solids 0.02-0.08%, sulfuric acid, traces of formic acid and acetaldehyde	Chemical	F	298	108	—	xx	0.0018 0.0001	0.0018 0.0001	0.0004 0.0001	0.0004 0.0001	0.0001 0.0001
4.5-3.5% furfural vapors and condensate, acetic acid 1.75-2.5%, traces of formic acid and acetaldehyde (stripping column)	Chemical	F	208-220	132	—	..	0.0001	0.0001	0.0001	0.0001	0.0001
furfural condensate, acetic acid 1.75-2.5% (stripping column bottom)	Chemical	F	208-220	132	—	..	0.0001	0.0001	0.0001	0.0001	0.0001

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
GAS, EXHAUST											
coke-oven gas, leaving sulfate saturator, moisture, some sulfuric acid, tar trace	Coal By-product	F	140-158	133	x	xx	0.0005*cd 0.0008cd	0.0002	...	...	...
mixed gases, air 86.5%, hydrochloric acid 10%, sulfur dioxide 2%, water 1%, sulfuric acid 0.5%	Chemical	F	150-550	42	xx	xx	0.092cd	0.03bd	...	...	...
digester gas from digestion of milk waste	Dairy	F	100-110	79	—	—	0.0001cd	...	<0.0001	...	...
drier exhaust air, water 3.19%, hydrochloric acid 0.06%, sodium fluosilicate with 0.36% hydrochloric acid, air remainder	Chemical	F	100	26	xx	xx	0.015 0.013*a	0.014a	...	...	...
gases containing carbon dioxide, water, fluorine volatiles, and spray condensate containing <2% acid as fluorine compounds	Chemical	F	175	52	xx	xx	<0.16	0.057r	...	0.0037	..
GAS, FLUE											
flue gas, dry	Chemical	L	850	30	—	xx	0.14	0.054	...	...	...
flue gas, sulfur 25 grains 1000 cu ft of 1000-BTU fuel gas	Research	L	80-400	250	..	..	0.0002	0.0001	...	...	...
flue gas, nitrogen, oxygen, carbon monoxide and dioxide, sulfur trioxide (heat exchanger)	Chemical	F	335	60	x	x	0.0097	0.0009a	0.0007	0.0022a	0.0021a
flue gas and condensate, sulfur dioxide 0.1 vol%, sulfuric acid 50-75 lb/hour, solid fine ash 20 lb/hour (boiler)	Power	F	340	240	xx	xx	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
flue gas, carbon dioxide 14%, oxygen 2%, sulfuric acid trace, remainder nitrogen, some moisture, soot	Chemical	F	100	138	xx	xx	0.013c	0.011c	0.004c	0.004c	...
flue gas, carbon dioxide 14%, oxygen 2%, sulfuric acid trace, nitric acid trace, remainder nitrogen, some moisture, soot	Chemical	F	90-130	140	..	xx	<0.0001c	<0.0001	<0.0001	<0.0001	...
Bunker C fuel-oil combustion condensate, sulfuric, sulfurous acids and anhydrides, other combustion products, no additive used	Power	F	...	91	xx	xx	0.027cd 0.027*cd	0.031cd	...	0.006	0.015c
flue gases from kiln burning Bunker C oil, water water, some vanadates (boiler)	Power	F	360	158	..	xx	0.043 0.051	0.0246 0.0333	... ...	0.0027 0.0029	0.004 0.0036
flue gas from boiler fired gas containing sulfur dioxide and trioxide, water and some vanadates	Power	..	330	158	—	xx	<0.0001	<0.0001	...	<0.0001	<0.0001
flue gases from kiln burning Bunker C oil, water vapor from wet diatomaceous earth impregnated with impurities from raw sugar liquor, pH 5-6 (dust chamber)	Sugar	F	60-130	31	..	xx	0.0002c	<0.0001	<0.0001	<0.0001	<0.0001
flue gas, nitrogen 78%, carbon dioxide 18%, oxygen 2%, sulfur dioxide 1%, sulfur trioxide trace, hydrogen sulfide trace, chlorides 0.05%, some magnesium-oxide ash suspended, and solution containing sulfur trioxide 1%, sulfur dioxide combined with magnesium oxide 0.5%, pH 5-5.5, but 3-3.5 during 60 days	Pulp and Paper	F	500	535	x	xx	...	0.0042cd 0.0038cd 0.0027cd 0.0036cd C0.0012cd	0.0019cd 0.0024cd 0.0016cd 0.0049cd	0.0031bd	0.0026bd

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
combustion gases from natural gas and sulfur-bearing oil, water vapor 50% approximately (carbon-black bag collector)	Chemical	F	460	240	—	—	<0.0002a	<0.0001a	<0.0001a	<0.0001a	<0.0001a
combustion gases from natural gas and sulfur-bearing oil, water vapor 50% approximately (carbon-black bag collector)	Chemical	F	410	224	—	—	<0.0001	<0.0001d	<0.0001	<0.0001	<0.0001
combustion gases from natural gas and sulfur-bearing oil, water vapor 50% approximately (carbon-black bag collector)	Chemical	F	340	271	—	—	<0.0001a	<0.0001a	<0.0001	<0.0001	<0.0001
flue gases, products of combustion of sulfuric-acid-digested corn cobs, sulfur trioxide, sulfuric acid, carbon monoxide, carbon dioxide, nitrogen, oxygen, water (heat exchanger)	Chemical	F	400-450	73	x	xx	0.007bd	0.0078cd	0.0068cd	0.009cd	0.0075cd
flue gases, products of combustion of sulfuric-acid-digested corn cobs, sulfur trioxide, sulfuric acid, carbon monoxide, carbon dioxide, nitrogen, oxygen, water (heat exchanger)	Chemical	F	250-275	71	x	xx	0.0072a	0.0063cd	0.0054bd	0.0071cd	0.0051cd
flue gases, products of combustion of sulfuric-acid-digested corn cobs, sulfur trioxide, sulfuric acid, carbon monoxide, carbon dioxide, nitrogen, oxygen, water (heat exchanger)	Chemical	F	300	71	x	xx	0.0008	<0.0001	<0.0001	<0.0001	<0.0001
flue gases, products of combustion of sulfuric-acid-digested corn cobs, sulfur trioxide, sulfuric acid, carbon monoxide, carbon dioxide, nitrogen, oxygen, water (heat exchanger)	Chemical	F	300-400	71	x	xx	0.0004	<0.0001	<0.0001	<0.0001	<0.0001
flue gas from combustion of Ohio strip-mine coal, BTU/lb 12800, ash 12%, sulfur 2.5-4.5% (air heater)	Power	F	240	197	xx	xx	0.0022	0.0021	...	...	0.0003
flue gas from combustion of Ohio strip-mine coal, BTU/lb 12800, ash 12%, sulfur 2.5-4.5%, sulfur dioxide 0.18-0.25 vol%, flyash 1% in the gas (air heater)	Power	F	195	270	x	xx	0.001	0.0014		0.0003	0.0005
flue gas containing sulfur dioxide, combustion products of destructive distillation of furfural residue, liquid running down the mist eliminator has pH 2 (organic-waste incinerator)	Chemical	F	500	50	xx	xx	...	0.003 0.020	0.003 0.017	0.003 0.018bd	0.002 0.013
fuel-oil combustion products, sulfur dioxide, sodium carbonate, calcined alumina in suspension (gas scrubber)	Chemical	F	200-425	20	xx	xx	0.0002bd	<0.0001ad	...	...	...
flue gases (from incinerator)	Public Works	F	...	21	xx	xx	0.006	0.005	0.005	0.007	...
flue gas, water sprayed	Chemical	L	200	30	—	xx	0.029	0.013	...	...	...
flue gas, in spent scrubber water	Chemical	L	120	30	—	xx	0.043	0.011	...	...	...
kiln gas saturated with water vapor (rotating disc type scrubber)	Fertilizer	F	131	58	xx	xx	0.0001	0.0001	...	0.0001 C0.0001	0.0001
hot gases saturated with water vapor, sulfur dioxide 2-4%	Mining	F	170	180	x	x	0.0001	0.0001	...	0.0001	0.0001
wet flue gases, carbon dioxide 14%, oxygen 2%, sulfurous acid trace, nitric acid trace, soot trace, nitrogen remainder	Gas purification	F	90-130	65	—	xx	0.022c	0.003c	0.0001c	0.001c	...
aluminum Soderberg-pot gases and water scrubbing sprays, some fluorine and sulfur dioxide, pH 3	Chemical	F	120	57	x	xx	0.003* 0.0014a*	0.001 0.0008	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
GASOLINE, ALKYLATION											
hydrocarbon mixture, hydrofluoric acid 2-6%	Petroleum	F	100	487	—	—	0.0004cd	0.0004bd	...	...	0.0003ad
95 iso feed to alkylation reactor containing traces of condensate	Petroleum	F	100	400	—	xx	<0.0001	<0.0001	...	...	<0.0001
86% isobutane, n-butane 9%, propane 2%, hydrofluoric acid 2-3%	Petroleum		100	250	—	x	0.001	0.001	...	...	0.0007
oil containing hydrofluoric acid, sodium hydroxide solution 3%	Petroleum	F	270	28	—	x	0.085c	0.071c	...	...	0.0023a
alkylate, butane and lighter, sulfur dioxide and trioxide, water, pressure 200 psi (vapors, liquid)	Petroleum	F	128	384	—	x	L<0.0001	<0.0001a L0.0001	...	C0.0001	<0.0001
GASOLINE, CRACKING											
cracked gasoline distillate, from both gas oil and reduced crude cracking, pressure 100 psi (depropanizer reboiler)	Petroleum	F	300-350	123	—	xx	0.0005	<0.0001	...	...	...
process stream through fluid catalytic cracking unit, hydrogen sulfide 1 mol% in vapors	Petroleum (fractionation)	F	270	330	—	x	<0.0001d	<0.0001	...	...	...
hydrocarbon, some organic acid and hydrogen sulfide, pressure <150 psi (evaporator tower, vapors, liquid)	Petroleum	F	<720	53	...	...	0.001	0.002	...	...	...
stabilized straight-run gasoline, pressure 105 psi (crude stabilizer)	Petroleum	F	325	318	—	—	0.001cd	0.0002cd	...	...	...
gas condensate for reflux, pressure 100 psi (crude stabilizer)	Petroleum	F	150	318	—	—	0.0002cd	<0.0001c	...	...	...
hydrocarbon, water, hydrochloric acid, chlorides	Petroleum	F	105	441	—	—	WL0.0016c	0.0075c W0.0203c	...	...	...
hydrocarbon gases C_1 to C_4, catalytic cracked gasoline and water 50 gpm, carbon dioxide 1 vol%, carbon monoxide 1 vol%, hydrogen sulfide 0.2 vol%, oxygen < 0.05 vol%	Petroleum	F	110	317	x	xx	<0.0001	<0.0001	...	<0.0001	<0.0001
hydrocarbons, water, hydrogen <1.5%, hydrogen sulfide, nitrogen, carbon monoxide and dioxide, together <1% (vapors)	Petroleum (fractionation)	F	270	640	—	xx	<0.0001c	<0.0001c	...	...	...
100% cracked-oil vapor, sulfur 0.5% (tower top tray)	Petroleum (fractionation)	F	760	252	—	xx	0.0027*	0.0006	...	...	...
decomposition products of cracked gas oil (evaporator tower bottom)	Petroleum	F	780-785	58	—	xx	0.001	0.0014	...	...	...
residue from cracked gas oil and vapor, specific gravity 9 API, sulfur 1% (evaporator tower bottom)	Petroleum	F	780	74	—	xx	0.001	0.0009	...	...	...
GASOLINE, DISTILLATION											
hot topped crude oil, sulfur 0.5% approximately (bottom of hot-oil separator)	Petroleum	F	725	100	—	xx	0.0013	0.0008	...	...	...
gasoline, specific gravity 82 API, sulfur 0.021%, hydrogen sulfide 0.0029 lb/bbl, water trace, possibly some ammonia	Petroleum	F	225-250	359	—	xx	0.0012cd	0.0005cd	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
vapors from primary distillation of crude oil, hydrogen sulfide, hydrochloric acid and ammmonium chloride	Petroleum	F	300	70	—	xx	0.0004cd	0.0002bd	. . .	. . .	. . .
mid-continent crude oil, chlorides and sulfides, ammonium compounds, concentration 0.05N, pH 7-9 (top of tower)	Petroleum	F	245	258	—	xx	0.0032bd	0.0016bd	. . .	. . .	. . .
gas oil, specific gravity 40-45 API, some hydrogen sulfide, carbon dioxide trace	Petroleum	F	60	305	x	x	0.0004cd	<0.0001	<0.0001	. . .	. . .
sour naphtha, water, hydrogen sulfide and chlorides	Petroleum	F	390	167	—	x	0.0005c	<0.0001c	. . .	. . .	. . .
gasoline vapors treated with ammonia 4-6 cu ft/hour (top of tower)	Petroleum	F	240-245	355	—	xx	0.0064c	0.0056c	. . .	. . .	. . .
hydrocarbon stream, chlorides 130 ppm, phenols 45 ppm, sulfides trace (primary column, reflux distributor above top tray)	Petroleum	F	285	430	—	x	<0.0001d	<0.0001d	. . .	. . .	<0.0001
high end-point straight-run gasoline, water, ammonia, hydrogen sulfide and hydrochloric acid (top of tower)	Petroleum	F	334	411	x	—	0.0002	<0.0001	. . .	. . .	. . .
hydrocarbon vapors, water, hydrogen sulfide <20 ppm, hydrochloric acid <1.3 ppm (between two stages in overhead condenser from crude fractionator)	Petroleum	F	180	137	—	. .	0.0005bd	0.0002ad	. . .	. . .	. . .
reduced redwater crude oil, superheated steam, sulfur compounds, some naphthenic acids	Petroleum	F	690	175	. .	xx	<0.0001	<0.0001	. . .	. . .	<0.0001
hydrocarbon liquid and vapors in atmospheric distillation of crude oil, chlorides 10 g/bbl, hydrogen sulfide 5-10 g/bbl (top tray)	Petroleum (distillation)	F	300	329	—	. .	0.004a	0.003a	. . .	. . .	. . .
straight-run gasoline distillate (top of tower, vapors, liquid reflux)	Petroleum	F	195-219	156	—	xx	0.0056b 0.011c	0.005c 0.0093c	. . .	. . .	. . .
hydrocarbon, short chain, hydrogen chloride in low concentration (tower, condensate receiver)	Chemical (fractionation)	F	85	113	—	x	0.001a 0.001a	0.0009a 0.0006a	. . .	. . .	0.0007a 0.0004a
hydrocarbon, short chain, hydrogen chloride in low concentration (tower, reboiler section)	Chemical (fractionation)	F	355	113	—	xx	<0.0001	<0.0001	. . .	. . .	<0.0001
hydrocarbon, short chain, hydrogen chloride in low concentration (tower, reboiler section)	Chemical (fractionation)	F	470	113	—	xx	<0.0001	<0.0001	. . .	. . .	<0.0001
crude oil	Petroleum	F	270	168	—	x	0.0003a	0.0002a	. . .	. . .	. . .
distillates, water, hydrogen sulfide and hydrochloric acid traces, pH 6.5-7	Petroleum	F	250	412	—	xx	0.0002a	0.0001a	. . .	. . .	0.0002a
distillates, water, hydrogen sulfide and hydrochloric acid traces, pH 6.5-7	Petroleum	F	175	412	—	—	0.0001a	0.0001	. . .	. . .	0.0001a
overhead from crude-oil fractionation, hydrogen sulfide, hydrochloric acid	Petroleum	F	190	128	—	xx	0.0004ad	0.0002ad	. . .	. . .	0.0003a

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
GASOLINE, FRACTIONATION											
straight-run gasoline liquid and vapor, gravity 61 API, water, hydrogen sulfide, some ammonium chloride, pH of condensing water 8 (heat exchanger)	Petroleum	F	260	165	—	xx	0.0004b	0.0003	...	...	...
straight-run gasoline, moisture, gravity 35.5 API average	Petroleum	F	240-375	76	—	xx	0.012cd	0.0068cd	...	...	...
straight-run gasoline, some hydrochloric acid and hydrogen sulfide	Petroleum	F	250-260	116	—	xx	0.0034a	0.0012a	...	...	...
cracking of Wyoming sour crude oil containing hydrogen sulfide 0.106%, mercaptan sulfur 0.066%, total sulfur 0.27% (top of tower)	Petroleum	F	342-352	132	—	xx	0.007ad	0.0001ad	...	...	...
condensing vapors containing water, hydrogen sulfide, mercaptan sulfur and fixed gases	Petroleum	F	268-378	189	—	x	0.0031c	0.0022c	...	...	...
mid-continent crude, gravity 36 API average, pH 7-9 (top of tower)	Petroleum	F	245	315	—	xx	0.0009cd	0.0003cd	...	...	...
crude oil from various sources, hydrogen sulfide and hydrochloric acid in various concentrations, not desalted, inhibitors added (top tray of fractionator)	Petroleum	F	150-270	330	..	..	0.002	0.002	...	...	...
butane, propane, ethane, hydrogen sulfide, water, ammonia, cyanide (overhead condenser)	Petroleum	F	130	160	—	xx	<0.0001	<0.0001	...	...	...
high-end-point gasoline, hydrochloric acid	Petroleum	F	200-375	116	—	xx	0.018r	0.009r	...	...	...
low-end-point gasoline, hydrochloric acid	Petroleum	F	140-255	116	—	xx	0.0016cd	0.0008bd	...	...	...
low-end-point gasoline, hydrochloric acid	Petroleum	F	130	216	—	xx	<0.0001ad	<0.0001	...	...	...
gasoline, with normal hydrocarbon fractions (vapors, top of tower)	Petroleum	F	...	106	xx	xx	0.0002ad	<0.0001ad	...	...	...
hydrocarbons, water, hydrogen <1.5%, hydrogen sulfide, nitrogen, carbon monoxide and dioxide together <1% (outlet from main fractionator condensers)	Petroleum	F	115	640	—	xx	<0.0001c	<0.0001	...	...	...
GASOLINE, MISCELLANEOUS PROCESSING											
light straight-run gasoline, mercaptans (tower bottom)	Petroleum	F	370	185	—	x	0.0005cd	<0.0001c	...	...	...
C_4-poly gasoline, C_5 5%, water <1%, pH 5.5, pressure 225 psig (depropanizer reboiler)	Petroleum	F	200	88	..	..	...	0.0028	...	C0.0014	...
crude residue (vacuum tower bottom, stripping section)	Petroleum	F	700	750	—	..	0.0003	0.0002	...	...	0.0001
liquid hydrocarbons and hydrogen recycle gas, sulfur 1.2-1.7% in liquid, hydrogen sulfide 3% and ammonia 1% in gas	Petroleum	F	600-650	221	—	xx	0.0004	0.0005	...	...	...
liquid hydrocarbons and hydrogen recycle gas, sulfur 1.2-1.7% in liquid, hydrogen sulfide 3% and ammonia 1% in gas	Petroleum	F	730-775	221	—	xx	0.002	0.002	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
vapors in top of flash tank used in the re-refining of crankcase oil, sulfuric acid 1.5%, pressure	Petroleum	F	600	6	—	xx	0.275cd	0.0189cd	...	...	...
steam distillation of petroleum lubricating oil after treatment with 66°Bé sulfuric acid (distillation receiver top)	Petroleum	F	600	10	—	xx	0.0011	0.0014	...	...	...
steam distillation of petroleum lubricating oil after treatment with 66°Bé sulfuric acid (distillation receiver top)	Petroleum	F	600	30	—	xx	0.0004	0.0005	...	...	...
light flashed distillates and sour water with some hydrochloric acid (vacuum flasher)	Petroleum	F	170	98	—	x	0.0002bd	0.00015ad	...	...	...
West Texas crude, being desalted, sulfur 0.1% approximately, pH 7-8 (condenser, vapors)	Petroleum	F	150-160	158	—	—	<0.0001	<0.0001	...	...	...
mixed Louisiana crude, sulfur 0.26%, salt 3-5 lb/1000 bbl (vacuum flasher)	Petroleum	F	750	238	—	xx	0.0025cd 0.0048*cd	<0.0001cd	..	...	...
tar, gravity 13 API (bottom of Visbreaker column)	Petroleum	F	750	357	—	x	<0.0001	<0.0001	...	<0.0001	<0.0001
gasoline and salt water, total acid <1% calculated as sulfuric acid, hydrochloric acid trace (bottom of Rock tower)	Petroleum	F	90	93	x	x	0.031c	0.01c	...	C0.0012	...
salt water under sour oil, chlorides 5850 ppm, sodium 4225 ppm, sulfates 2500 ppm, bicarbonate 2072 ppm, hydrogen sulfide 1714 ppm, calcium 835 ppm, magnesium 310 ppm, pH 7.8	Petroleum	F	80	360	..	..	<0.0001	<0.0001	<0.0001	...	...
sour water containing some light flashed distillate and hydrogen sulfide (vacuum flasher)	Petroleum	F	130	309	—	x	0.0001cd	0.0001c	...	...	...
10% phenolic water vapor containing chlorides 50-1320 ppm (phenol recovery tower)	Petroleum	F	220	71	—	xx	0.004r 0.03c 0.02*c	0.004r 0.007	0.004r 0.0009	...	...
24° API gas oil, hydrogen sulfide, naphthenic acids (Visbreaker bubble tower)	Petroleum	F	725	35	—	x	0.0003cd	<0.0001	...	<0.0001	<0.0001
GASOLINE, REFORMING											
condensed reactor effluent of hydrocarbons, pressure 460 psig	Petroleum	F	100	258	—	x	0.001	0.0007	...	0.0011	...
reformer effluent, hydrocarbons, hydrogen sulfide 0.02-0.03%, hydrogen, pressure 500 psig	Petroleum	F	875-975	258	—	x	<0.0001	<0.0001	...	<0.0001	<0.0001
reactor effluent flash gas, hydrocarbons, hydrogen sulfide 0.02-0.03%, pressure 460 psig	Petroleum	F	100	258	—	x	0.0009	0.0006	...	0.0012	0.0006
naphtha feed, sulfur 0.01-0.02%, pressure 520 psig	Petroleum	F	600-750	258	—	x	0.0002	0.0002	...	0.0006	0.0003
residue from cracked gas oil and vapor, total sulfur 0.6-0.7% (evaporator tower bottom)	Petroleum	F	770-790	112	—	xx	0.0006	0.0005	...	...	...
hydrocarbon vapors, hydrogen, sulfur 0.053%	Petroleum	F	625	102	..	xx	0.0004a	0.0003a	...	...	...
gas atmosphere, hydrogen 60%, methane 38%, hydrogen sulfide 2% (vapors)	Petroleum	F	700	9	—	x	0.0007	0.0016	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
gas atmosphere, hydrogen 60%, methane 38%, hydrogen sulfide 2% (vapors)	Petroleum	F	900	9	—	x	0.025	0.027	...	...	...
gas atmosphere, hydrogen 60%, methane 38%, hydrogen sulfide 2% (vapors)	Petroleum	F	1100	9	—	x	0.086	0.108	...	...	...
hydrogen 65-55 mol%, hydrocarbons 35-45 mol%, hydrogen sulfide 12-20 grains/100 SCF (vapors)	Petroleum	F	640	130	—	x	0.0008	0.0007	...	...	...
hydrogen 65-55 mol%, hydrocarbons 35-45 mol%, hydrogen sulfide 12-20 grains/100 SCF (vapors)	Petroleum	F	800	130	—	x	0.0013	0.0012	...	...	...
hydrocarbons 70-60 mol%, hydrogen 60-40 mol%, hydrogen sulfide 0.03-0.04 mol% (vapors)	Petroleum	F	650	130	—	x	0.0003	0.0004	...	...	...
hydrocarbons 70-60 mol%, hydrogen 30-40 mol%, hydrogen sulfide 0.07-0.09 mol%, pressure 400 psig (vapors)	Petroleum	F	650	291	—	x	<0.0001	<0.0001	...	...	...
hydrocarbons 70-60 mol%, hydrogen 30-40 mol%, hydrogen sulfide 0.07-0.09 mol%, pressure 400 psig (vapors)	Petroleum	F	555	130	—	x	<0.0001	0.0001	...	...	...
regeneration gas and overflow water, carbon dioxide, oxygen, sulfur dioxide trace, chlorine trace, ammonia trace, pressure 300 psi	Petroleum	F	100-500	57	x	xx	0.0197c 0.0651	0.0121r 0.0178r 0.028r 0.067r	...	...	...
regeneration gas and overflow water, carbon dioxide, oxygen, sulfur dioxide trace, chlorine trace, ammonia trace, pressure 300 psi	Petroleum	F	100-900	47	x	xx	L0.0114c WL0.019c	0.0065c W0.0067c	...	0.0012a	...
virgin naphtha feed, hydrogen sulfide 5 grains/100 cu ft average, recycle gas is 35% of charge and contains 79 mol% hydrogen, pressure 310 psi	Petroleum	F	910	90	—	x	0.0024	0.0025	...	...	...
GASOLINE, STORAGE											
unleaded gasoline (vapors)	Petroleum	F	R.T.	365	—	x	<0.0001	<0.0001	...	...	...
GELATINE											
evaporated gelatine solution containing 20-30% gelatine, salts 0.75%, acidified with hydrochloric acid to pH 3	Food	F	110	100	x	xx	0.0004d	<0.0001d	<0.0001d	...	...
gelatine liquor, acidified with hydrochloric acid to pH 3.8-4.8	Food	F	130-150	55	x	xx	0.0001	0.0001	...	...	...
gelatine solution, solids 4-20%, pH 3.8-6.8	Food	F	173	27	—	xx	...	<0.0001	...	...	...
gelatine, hydrochloric acid <0.6%	Food	F	55	11	—	x	0.0003 0.0003*	0.0002	...	...	...
GLUCONIC ACID											
50%	Chemical	F	110-150	99	—	—	<0.0001	<0.0001	...	...	...
50% approximately, pH 2 (evaporator, liquid level)	Chemical	F	140-150	99	...	...	<0.0001	<0.0001		...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
GLUE											
gum-arabic adhesive solution, sulfur dioxide 1.5 lb/50 gal (liquid level)	Ink	F	R.T.	79	xx	—	nil c	nil	...	...	...
GLUTAMIC ACID											
crude glutamic acid, pH 5.6 (flash chamber above liquor)	Food (evaporation)	F	158	36	—	xx	0.00013ad 0.00024ad	<0.0001	...	...	...
glutamic acid, saturated solution of sodium chloride, pH 3.2 (crystallizer)	Food	F	77	28	xx	xx	0.0021cd 0.0018*cd	0.0011cd	...	...	...
glutamic acid crude, hydrogen peroxide, pH 3.2	Food	F	176	3	..	xx	0.0092cd	0.0012ad	...	...	...
glutamic acid crude, hydrogen peroxide, pH 1.8	Food	F	176	3	—	xx	0.0019cd	0.00084ad	...	...	...
GLYCERINE											
concentrated glycerine saturated with salt, some salt in suspension	Soap (distillation)	F	B.P.	27	..	xx	0.0027	0.0020	...	...	...
concentrated glycerine saturated with salt, salt crystals (vapors)	Soap (distillation)	F	300	89	—	xx	0.00042ad	0.00029ad	...	...	...
concentrated glycerine saturated with salt, salt crystals	Soap (distillation)	F	<320	124	x	xx	0.0079ad	0.0078bd	...	...	...
80-15% glycerine saturated with salt (Wooster-Sanger evaporator)	Soap	F	140-220	91	—	—	0.0003cd	0.0001ad	...	<0.0001d	<0.0001d
30% half-crude glycerine, sodium chloride 20%, free butyric acid trace, water remainder, pH 4	Soap (evaporation)	L	210	12	x	x	0.0013cd	0.0036ad	...	0.003ad	...
10%, purified cellulose sausage casing strip, acetic acid, pH 6	Food	F	130	61	x	x	0.0004cd	<0.0001d	...	...	...
GRAPEFRUIT JUICE											
85% grapefruit juice, orange juice 15%	Food	F	72	36	x	—	<0.0001	<0.0001	...	...	...
GREASE											
wool grease being refined, dilute sulfuric and hydrochloric acids, alcoholic caustic solution, hydrogen-peroxide bleach, strong sodium-hypochlorite bleach, 2-6 batch cycle	Chemical	F	<210	105	xx	x	0.00014 0.0001*	0.0001	..	0.00013 C0.0001	...
wool grease being refined, dilute sulfuric and hydrochloric acids, alcoholic caustic solution, hydrogen-peroxide bleach, strong sodium-hypochlorite bleach, 2-6 batch cycle (tank bottom)	Chemical	F	<210	123	x	x	0.0024 0.0014*	0.0035	...	0.0006 C0.0007	...
76% animal grease, sulfuric acid 22.1%, water remainder	Leather	F	100	3.3	x	xx	0.0004 0.0004*	0.0009	...	...	...
HAFNIUM HYDROXIDE											
hafnium hydroxide suspension in ammonium-sulfate and ammonium-hydroxide solution, pH 7.5-8.5 (filter press, half immersed)	Metal	F	115	58	x	—	<0.0001	<0.0001	...	<0.0001	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
HEXAMINE											
80% hexamine slurry, ammonia 0.1%, formaldehyde 0.01%	Chemical	F	140	32	xx	xx	<0.0001	<0.0001	...	...	...
43% hexamine mother liquor, formaldehyde 0.2%, ammonia 0.1%	Chemical	F	125	28	x	xx	<0.0001	<0.0001	...	...	...
25%, formaldehyde 40%, methanol 3-7%, ammonia 0.3%	Chemical	F	150	32	x	xx	<0.0001	<0.0001	...	...	...
HEXANE											
hexane vapor, low-boiling vapor from tall oil, sulfur dioxide 0.3%, water 5%	Chemical	F	257	250	..	..	<0.0001ad	<0.0001	<0.0001	...	...
HYDRAZINE											
hydrazine, various concentrations	Research	L	...	...	—	..	OK	(*)	(*)	(*)	(*)
HYDROBROMIC ACID											
hydrobromic acid, various concentrations, decomposition products of ethylene dibromide	Chemical (distillation)	F	200-212	37	—	x	0.018cd	0.0035cd	...	...	...
hydrobromic acid, hydrochloric acid, crude ethylene dibromide	Chemical (distillation)	F	168	55	..	..	0.0274bd	0.0058bd	...	...	...
HYDROCHLORIC ACID See also HYDROGEN CHLORIDE											
20%	Metal (plating)	F	124	1.2	—	—	0.18	0.067	...	...	0.036
hydrochloric-acid fumes from tank containing hydrochloric acid 19% approximately	Metal (pickling)	F	160-180	41	xx	x	0.0086c	0.0071c	...	0.0086a	0.0059c
15% (half immersed)	Water Treatment	L	R.T.	3	..	xx	0.153 0.179	0.049	...	...	...
10%	Research	L	150	1	..	..	...	...	...	...	0.00368
10%	Research	L	75	1	..	..	...	...	...	...	0.00166
10%	Plastic	F	75	12	—	..	0.001a	0.001ad	...	0.0006ad	0.0008a
"dilute"	Rubber	F	75	105	xx	x	0.0002d 0.0017cd	0.0001d 0.0012d	...	...	...
5%	Research	L	95	6	xx	x	...	54.1	...	...	...
3.52%	Research	L	77	70	—	—	1.4	...	...	...	...
1%	Research	L	95	6	xx	x	...	0.16	...	...	...
1%	Research	L	140	6	xx	x	...	81.4	...	...	...
0.5%	Research	L	95	6	xx	x	...	0.14	...	...	...

(*) = Molybdenum content above 0.5% catalyses decomposition of hydrazine.

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Hydrochloric acid											
0.36%	Research	L	77	70	—	—	1.4	...	...	...	...
0.036%	Research	L	77	70	—	—	2.0	...	...	...	...
water containing small amounts or traces of hydrochloric acid	Metal (pickling)	F	160-180	41	x	x	0.0016	0.0007	...	0.0022	0.001
moist air containing hydrogen chloride	...	..	R.T.	137	..	..	0.003cd	0.004cd	...	...	...
HYDROCHLORIC-ACID MIXTURES—see also NITRIC-ACID MIXTURES WITH HYDROCHLORIC ACID											
20%, sulfuric acid 5%, nitric acid 5%	Chemical (pickling)	F	120	12	..	..	...	15.23	3.28	...	...
7.5%, non-ionic detergent 0.188%, amine-type inhibitor 0.125%, water remainder	Soap	F	72	90	—	—	0.003c 0.003*c	0.0033	...	0.003	0.0029
6% approximately, "Polyrad" 1110a amine-type inhibitor 0.5%, some ferric chloride and cupric chloride	Petroleum	F	100	4	x	x	0.437c 0.437*c	0.656	...	0.485c	0.414c
1%, boric acid 0.1%, chlorine <100 ppm, water	Chemical	F	77	87	xx	xx	...	0.0004d	...	...	0.0003d
0.015%, free chlorine 0.02 g/l	Pulp and Paper	F	...	90	..	..	<0.0001 <0.0001	nil	...	...	...
water, mineral acids approximately 70-80 ppm, pH 2.8-3.5, pressure 5 psig (heat exchanger)	Heating Water	F	140	68	x	xx	...	<0.0001	<0.0001	<0.0001	<0.0001
wash water, usually low but varying concentration of hydrogen chloride (hydrogen-chloride fume scrubber)	Rubber	F	45-70	210	xx	xx	0.0001c	0.0001b	...	...	...
hydrochloric acid, chlorine, water, boric acid	Chemical	F	77	88	xx	xx	...	>0.1	...	...	0.0068c 0.02c
hydrochloric acid, lactic acid, pH 4.5	Dairy	F	170	60	xx	x	...	<0.0001	...	...	<0.0001
protein hydrolysate mixture, hydrochloric acid, some sulfur dioxide, pH 1.5	Food	L	110	84	x	x	0.0015cd 0.0015*cd	0.0001	0.0001	0.0001	0.0001
HYDROCYANIC ACID											
hydrocyanic acid (liquid)	Chemical	F	45	169	—	—	<0.0001	<0.0001	...	...	...
HYDROFLUORIC ACID											
70% commercial grade	Mining	F	70	42	—	x	...	0.49	...	0.15	0.14
72 vol%, water vapor 17 vol%, sulfuric acid 10 vol%, fluosilicic acid 1 vol% (vapors and condensate)	Chemical	F	350	14	—	xx	corr	0.24 >0.38	...	C0.43	...
65-60%, hydrofluosilicic acid 1.5-2.5%, sulfuric acid, 1.2%, iron ion 0.01-0.03%	Chemical	F	30-80	28	—	—	corr	corr	...	...	...
50%, sulfuric acid 50%	Glass	F	R.T.-140	4	..	..	...	0.99c	...	...	0.026

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Hydrofluoric acid											
50%, air 30%, water 12%, sulfuric acid 7%, silicon tetrafluoride 1% (vapors)	Chemical	F	350	7	xx	xx	0.133 0.139	0.103 0.113	. . .	C0.081	. . .
46.5 approximately, isobutane (regeneration-tower top, vapors)	Petroleum	F	210-220	49	—	—	0.0634c corr	0.001	. . .	. . .	. . .
38%	Petroleum	F	230	2	—	—	. . .	2.0c	. . .	. . .	. . .
37%, glass-etching solution, ammonium bifluoride 9%, water during 200 hours; and 49% hydrofluoric acid, ammonium bifluoride 15%, sulfuric acid, water during 24 hours	Glass	F	167	9.3	—	x	corr*	corr	. . .	. . .	. . .
29%, glass-etching solution, ammonia 14% as ammonium bifluoride, water during 72 hours; and 40% hydrofluoric, ammonia 15% as ammonium bifluoride, ammonium fluosilicate 4%, water during 176 hours	Glass	F	140	10.3	—	x	0.140*	0.1	. . .	. . .	. . .
12%, hydrofluosilicic acid 0.2%	Chemical	F	182	7.2	—	xx	0.160c	0.701c	. . .	. . .	. .
10%	Metal (pickling)	F	50-70	30	—	—	0.00038	<0.0001	. . .	. . .	. . .
10-1%	Petroleum	F	250	49	—	—	0.0359 0.0446	0.0015	. . .	. . .	. . .
8%, some fluosilicic acid (etching of tubes)	Television Tube Manufacture	F	R.T.	120	xx	x	0.017	0.013		C0.0066 0.0064	. . .
8%, some fluosilicic acid (etching of tubes)	Television Tube Manufacture	F	R.T.	120	xx	xx	0.008 0.025	0.0034 0.0086		C0.001 0.001 C0.002 0.002	. .
6%, organic fluorides 71%, benzene 19%	Petroleum	F	275	226	—	—	0.012c	0.012b	. . .	. . .	0.0041
5%, ferrous sulfate 10%, sulfuric acid 5% (alternately immersed)	Metal (pickling)	L	120	1.8	xx	xx	0.393	0.191	. . .	. . .	. . .
3%, fluorine liquor, sulfuric acid 0.5%	Fertilizer	L	R.T.	141	. .	. .	. . .	0.023	. . .	0.008c	0.003
1%, regenerated hydrofluoric acid, isobutane 87%, *n*-butane 9.6%, propane 2.4% (depropanizer, above top tray beside feed inlet)	Petroleum	F	128	226	—	—	0.0008	0.0004	. . .	. . .	0.0006
regenerated hydrofluoric acid, propane (depropanizer accumulator bottom)	Petroleum	F	250	226	—	—	0.0013ad	0.0014	. . .	. . .	0.001
HYDROFLUOSILICIC ACID											
23.1-9.1%	Chemical	F	145	90	x	x	0.038c	0.005	. . .	. . .	. . .
22%	Chemical	F	145	94	—	xx	. . .	0.002cd	. . .	. . .	. . .
20%	Chemical	F	135	38	xx	xx	. . .	L0.005	0.005	0.003a	0.005
20%, phosphoric acid 15%, sulfuric acid 1%	Chemical	F	175	16	xx	xx	. . .	L0.021	0.003 0.015	0.0007	0.005 0.001
16%, water 83%, silica 0.5%, phosphoric acid 0.3%	Chemical	F	120	62	—	—	0.02c	0.016c	. . .	. . .	0.0025 0.013

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Hydrofluosilicic acid											
10%, some hydrofluoric and phosphoric acids	Chemical	F	140	19	xx	x	corr	0.24	0.13	0.025	0.116
9-6%, sodium-fluosilicate crystals with 10-12% crystal water	Chemical	F	100	163	xx	xx	0.0017bd	...	...	...	...
8.5%, electrolytic-lead solution, lead fluosilicate, insoluble anode slimes, lead 80 g/l, total acid 149 g/l	Metal (lead refining)	F	176	60	..	..	0.023	0.001	...	...	nil
hydrofluosilicic acid, water, fluorine 0.2% approximately as hydrofluosilicic acid (gas scrubbing tower base)	Chemical	F	85	22	—	—	...	0.003	0.0018	0.0014	...
spray water and gas containing low concentrations of hydrofluoric acid, sulfur dioxide, and silicon tetrafluoride (gas scrubbing tower)	Chemical	F	122	22	x	xx	...	0.085	0.052	0.0086	...
moist gas having a low content of hydrofluoric acid, sulfur dioxide and silicon tetrafluoride (gas scrubbing)	Chemical	F	122	22	x	xx	0.018* 0.018	0.0012	0.0013	0.0008	...
HYDROGEN											
80% approximately, hydrocarbons 20% approximately, hydrogen sulfide 2-10 grains/100 cu ft during 1 week, then 2 grains/100 cu ft average, hydrogen chloride trace	Petroleum	F	950	250	—	xx	<0.0001	...	...	...	...
HYDROGEN CHLORIDE See also HYDROCHLORIC ACID											
hydrogen chloride, dry, pressure	Petroleum	F	180	234	..	..	...	0.0075	...	...	...
hydrogen chloride, dry	Research	L	400	...	..	xx	<0.005	<0.005	...	...	...
hydrogen chloride, dry	Research	L	<900	...	..	xx	OK	OK	...	...	...
hydrogen chloride, dry	Research	L	>900	...	..	xx	NG	NG	...	...	...
hydrogen chloride, dry	Atomic Energy	F	930	21	..	..	L0.011	...	...	...	...
hydrogen chloride, dry	Research	L	1000	...	..	xx	...	0.17 0.14	...	...	...
95%, dry, acetyl chloride 3%, acetic acid 2%	Chemical	F	52	14	—	xx	0.196	0.139	...	0.042	...
hydrogen chloride, dry, dry chlorine, organic material	Chemical	F	302-527	26	—	x	...	0.0012	...	...	...
hydrogen chloride, dry, caustic soda (autoclave, vapors)	Rubber	F	573	60	—	—	L<0.0001a <0.0001a	0.0001a	...	...	...
hydrogen chloride, dry, caustic soda (autoclave, vapors)	Rubber	F	573	60	—	—	L0.0001a 0.0004a	0.0002a	...	...	...
hydrogen-chloride vapors from vent system and absorber	Rayon	F	R.T.	3.3	—	—	...	0.015r	...	...	...
hydrogen chloride, air	...	..	R.T.	135	..	..	0.0032cd	0.0044cd	...	...	...
hydrogen chloride, hydrogen, "Zircex" process, hot cycle only	Atomic Energy	..	1112	...	..	..	L0.025 L0.021	...	...	0.0077 0.0068	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
	Test conditions						Average corrosion rates (ipy)				
hydrogen chloride, dry, high-boiling ether	Research	L	R.T.	13	..	..	0.0064	0.0017	...	...	...
hydrogen chloride, wet, high-boiling ether	Research	L	R.T.	9	..	..	0.0068	0.0035	...	...	...
hydrogen chloride, purge, high-boiling ether	...	..	212	1	..	..	0.005	0.0046	...	...	...
hydrogen chloride made by volatilizing hydrochloric-acid solution 31.5% (shaft leading to wool-rag carbonizer)	Textile	F	220	37	x	—	0.0065ad	0.0036ad	...	...	...
hydrogen-chloride fumes from tank containing hydrochloric acid 19% approximately	Metal (pickling)	F	160-180	41	xx	x	0.0086c	0.0071c	...	0.0086a	0.0059c
10%, air 90%, some chlorine and water	...	..	R.T.	92	xx	xx	0.01c	0.0082c	...	...	...
hydrogen chloride, chlorine, moist air	...	..	R.T.	92	xx	..	0.01	0.008	...	...	...
hydrogen chloride, chlorine, moist air	...	..	R.T.	118	..	..	0.007c	0.013c	...	...	...
hydrogen-chloride fumes in atmosphere	Petroleum	F	R.T.	184	xx	x	0.0057b	...	...	...	...
HYDROGEN PEROXIDE											
50%, acetic acid, cationic resin, acetylated castor oil during 8 hours; and alkaline wash, water wash, sodium sulfate during 6 hours (epoxydation reactor)	Chemical	F	212	1	xx	xx	0.027d	0.008d S0.059d	...	...	...
30%, stabilized with sulfuric acid	Chemical	L	85	6	—	xx	<0.0001	...	...	...	...
6.1%, stabilized with acetanilide and phosphoric acid	Cosmetic	L	R.T.	30	—	—	<0.0001	...	...	...	...
3%, stabilized with acetanilide	Cosmetic	L	R.T.	30	—	—	<0.0001	...	...	...	...
HYDROGEN SULFIDE											
hydrogen sulfide (generator, vapors)	Chemical	F	...	56	..	..	<0.0001	<0.0001	...	...	...
98%, air, nitrogen	Petroleum	F	90	188	xx	x	<0.0001d	<0.0001a	...	...	...
hydrogen sulfide, water (extraction unit)	Chemical	F	176-302	160	—	—	<0.0001ad	<0.0001ad	...	<0.0001a	0.0002ad
hydrogen-sulfide gas saturated with water vapor	Chemical	F	100-170	60	—	..	...	0.0001	...	<0.0001	...
85-65 mol%, ammonia 3-17 mol%, carbon dioxide 7-12%, small amounts of chlorides, cyanides and hydrocarbons (vapors)	Petroleum	F	260	288	—	xx	<0.0001 <0.0001*	<0.0001	...	...	...
hydrogen sulfide, traces of ammonia, carbon dioxide and hydrocarbon, diethanolamine, water (vapors)	Petroleum	F	215	396	—	x	<0.0001 <0.0001*	nil	...	0.0001	<0.0001
hydrogen sulfide, mercaptans, acidic moisture, pressure 25 psi (Coker bubble tower, bottom head)	...	F	725	242	—	—	L0.0003	L0.0003	...	...	...
hydrogen sulfide, carbon monoxide and dioxide, nitrogen, oxygen trace, some carbon-black dust (bag-filter plenum chamber floor)	Carbon Black	F	220-230	93	—	xx	<0.0001c <0.0001*c	<0.0001c	<0.0001	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
hydrogen sulfide, hydrochloric acid from breakdown of chlorides and sulfur compounds in crude oil (top tray of fractionator)	Petroleum (fractionation)	F	180-220	197	—	xx	0.0008cd	0.0003cd	...	...	...
1.5 vol% hydrogen, hydrogen partial pressure 485 psig	Petroleum	..	750	25	..	..	0.0122 W0.0083 C0.0084 L0.0104 LW0.0078 LC0.0057	0.0112 C0.0113 L0.0119 LC0.0052	...	...	...
1.5 vol% hydrogen, hydrogen partial pressure 485 psig	Petroleum	..	975	41	..	..	0.0239 W0.0171 C0.0154 L0.0250 LW0.0212 LC0.0123	0.0208 C0.0220 L0.0240 LC0.0117	...	...	...
hydrogen sulfide, sour water, light hydrocarbons	Petroleum	F	100	568	—	—	<0.0001	<0.0001	...	<0.0001	...
water contaminated with hydrogen sulfide, monoethanolamine trace (vertical condenser)	Petrochemical (distillation)	F	72	106	—	xx	0.0001ad	0.0001ad	...	0.0001ad	<0.0001d
32 ppm hydrogen-sulfide gas, oxygen 1%, saturated with water vapor	Petroleum	L	85	1	..	..	nil	nil	...	...	...
HYDROQUINONE											
5%, sodium-sulfite inhibitor 0.033%, pH 6.5	Synthetic Rubber	F	90	5	—	x	0.00011 <0.0001*	<0.0001	...	...	...
2.5%, pH 3.6-2.9 (circular-path corrosion machine)	Rubber	L	120	10	xx	xx	<0.0001	<0.0001	...	...	...
2.5%, pH 3.5 (tank bottom)	Synthetic Rubber	F	54	25	x	xx	nil nil*	nil	...	...	...
HYDROXYACETIC ACID											
10%	Research	L	B.P.	...	—	—	0.38	nil	...	...	...
INK											
printing ink, blue (half immersed)	Ink	F	R.T.	79	x	—	nil	nil	...	...	...
IODINE											
iodine, pressure 400-mm mercury	Research	L	842	...	—	—	0.12	0.081	...	...	...
10%, non-ionic detergent 90%, some hydrochloric acid	Soap	F	72	90	—	—	0.002 0.002*	0.0003	...	0.0002	0.0001
9.3%, isopropyl alcohol 11%, hydrochloric acid 2%, non-ionic detergent remainder	Soap	F	72	90	—	xx	0.0071 0.0071*	0.0023	...	0.0073	0.0039
KEROSENE											
99%	Chemical	F	410	276	—	xx	nil	nil	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Kerosene											
94%, butane 5%, acetic acid 0.7%, organic acids trace	Chemical	F	122	276	x	x	nil	...	...	...	...
roofing felt stock from rags, small amount of kerosene, paper, sawdust, consistency 0.5%, pH 7 approximately (cylinder machine)	Construction	F	60	100	xx	x	<0.0001	<0.0001	...	...	...
KETENES											
25%, carbon dioxide 17%, carbon monoxide 12%, acetic acid 11%, butadiene 10%, allene 10%, ethylene 7%, acetic anhydride 1%	Rayon	F	68	200	—	xx	C [illegible] LC	0.0001	...	...	...
KETONES											
high-boiling ketone	Research (distillation)	L	284	7	..	..	0.0134	0.002	...	...	...
high-boiling ketone (vapors)	Research (distillation)	L	266	8.6	..	..	0.0026	0.0003	...	...	...
94% methyl-isopropyl ketone, ethyl-vinyl ketone 3%, methylethyl ketone 0.1%, alcohols 0.1%, hydroquinone 25 ppm, water remainder	Chemical	F	175	60	—	x	<0.0001	<0.0001	<0.0001	...	...
80% methyl-isopropyl ketone, ethyl-vinyl ketone 15%, vinyl-isopropyl ketone 0.5%, dimer 4%, methylethyl ketone 0.1%, alcohols 0.1%, water remainder	Chemical	F	190	60	—	x	<0.0001	<0.0001	<0.0001	...	...
44% methyl-isopropyl ketone, water 50%, dimer 3%, phosphoric acid 1%, vinyl-isopropyl ketone 1%, alcohols 1%	Chemical	F	230	60	—	x	0.0025a	0.0021	0.0013	0.0006	...
38% 4-hydroxy 3-methyl 2-butanone, water 50%, methyl-isopropyl ketone 10%, formaldehyde 2%	Chemical	F	225	125	—	x	<0.0001	<0.0001	...	...	...
7% methyl-isopropyl ketone, water 80%, dimer 10%, formaldehyde 1%, vinyl-isopropyl ketone 1%, alcohols 1%	Chemical	F	225	60	—	x	0.00013	0.00016	<0.0001	...	...
2.8% methyl-isopropyl ketone, 4-hydroxy 3-methyl 2-butanone 3%, ethyl-vinyl ketone 0.6%, phosphoric acid 0-6%, formaldehyde 0.4%, water remainder	Chemical	F	220	17	—	x	0.0001	0.0001	0.0001	0.0002	...
LACTIC ACID											
85%	....	..	B.P.	8	..	xx	...	0.036	...	...	...
>80%, reduced pressure (still pot, liquid)	Chemical (distillation)	F	330-355	6.5	—	..	...	0.0005	0.0006	...	...
60%, solution saturated with calcium sulfate, iron 100 ppm	Dairy	F	110	15	—	x	0.0039cd 0.0027*cd	0.0005cd	...	...	...
60-30% lactic-acid vapor, vacuum 26 in. of mercury (continuous evaporator)	Corn Products	F	115	42	—	xx	0.0026*cd 0.003cd	<0.0001ad 0.0003ad W0.002d	<0.0001d	...	...
45% (accelerated corrosion test)	Chemical	L	R.T.	14	xx	xx	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Lactic Acid											
1%, methylene blue 0.01%, possibly cupric ions (tank bottom)	Pulp and Paper	F	70	90	xx	—	<0.0001* <0.0001 S<0.0001ad L<0.0001	<0.0001 S<0.0001 L<0.0001a	<0.0001	<0.0001	<0.0001 S<0.0001
polylactic acid, indefinite	Chemical	F	180	38	—	xx	<0.0001	<0.0001	...	...	...
LACTOSE											
milk-sugar solution, hydrochloric acid 0.015-0.03% (vacuum evaporator)	Dairy	F	132	15	—	xx	<0.0001	<0.0001	...	...	...
LEAD FLUOSILICATE											
lead-fluosilicate electrolyte, total hydrofluosilicic acid 13.32%, free hydrofluosilicic acid 8.49%, lead 6.9% as lead fluosilicate, pH <0 (pump tank)	Metal (lead refining)	F	117	25	x	x	0.0072	0.0063	0.0062	0.0065	...
LEAD OXIDE											
oxides, carbonates and chlorides of lead, tin and antimony, aqueous slurry (direct-fired evaporation pan)	Chemical	F	B.P.	123	—	xx	...	0.0007	...	0.0001	0.0001
LEAD-PLATING SOLUTION											
lead, tin and antimony plating solution, mainly fluoborates	Metal (plating)	F	70	59	—	—	0.0003	0.0003	...	...	0.0009
LEMON JUICE											
lemon juice, pH 2.5	Chemical	L	70	71	xx	—	<0.0001 S<0.0001 <0.0001*	<0.0001	...	...	...
LEVULINIC ACID											
pure levulinic acid (vapors)	Corn Products (distillation)	F	260	38	x	xx	...	0.034cd	0.043bd	...	...
98%	Corn Products	F	100	57	—	—	0.0009d 0.0008*d	0.0003	...	...	...
crude levulinic acid (vapor head of acid still)	Corn Products (distillation)	F	225	29	x	x	0.0133cd 0.0124*cd	0.0038bd	...	...	...
levulinic-acid vapors, hydrochloric acid 3.5%, formic acid 2.5% (evaporator, vacuum)	Corn Products	F	140	10	—	x	0.2cd 0.19*cd corr corr	0.061cd 0.093cd	...	...	...
LITHIUM BROMIDE											
lithium bromide (vapors during 400 hours, liquid during 600 hours above 212 F, then liquid during 600 hours below 212 F)	Metal	F	205-217	67	...	...	...	0.0007cd	...	0.0006bd	0.003bd

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
lithium bromide (liquid during 1000 hours above 212 F, then 600 hours below 212 F)	Metal	F	205-217	67	. .	. .	. . .	<0.0001a	. . .	<0.0001d	<0.0001d
LITHIUM CHLORIDE											
30% (evaporator)	Air Conditioning	F	240	40	—	xx	<0.0001*r	<0.0001r	. . .	. . .	. . .
30% during 26 days, calcium chloride 25% during 146 days, vacuum (bottom of column)	Chemical (dehydration)	F	20-68	172	—	x	<0.0001*	<0.0001	. . .	. . .	. . .
vapors from a boiling lithium-chloride 30% solution (evaporator)	Air Conditioning	F	240	40	—	x	corr.r	0.0069cr	. . .	. . .	. . .
MAGNESIUM CHLORIDE											
48% (boil-down kettle)	Chemical (evaporation)	F	330	55	—	xx	0.0043	0.0032r	. . .	. . .	. . .
42% (evaporator)	Chemical	L	312	35	xx	—	0.0001cr	. . .	. . .	. . .	. . .
36-35%, sodium chloride 0.8%, calcium chloride 0.4%, traces of iron, copper, nickel, manganese and sulfates, pH 5-6 (heating coil)	Metal	F	160	31	—	x	0.0002ad	0.0002ad	. . .	. . .	. . .
7%, magnesium chlorate 3%, chlorine 3%, magnesium hydroxide 0.25-1%, pH 6.2-6.4 (top of absorption tower)	Chemical	F	131	20	. .	. .	>0.28 corr	>0.29 corr	. . .	C0.445cd	. . .
MAGNESIUM OXIDE											
magnesium oxide, carbon dioxide, moisture, some sulfur dioxide (type N Roto-Clone hydrostatic precipitator)	Chemical	F	160	235	xx	xx	0.0001 0.0001b 0.0001c 0.0011c 0.0014c	0.0001 0.0001 0.0001a 0.0002c 0.0001c	. . .	. . .	. . .
MALEIC ACID											
40%	Research	L	125	4	xx	x	0.147	nil	. . .	. . .	. . .
20-18%	Chemical	F	95	253	xx	x	<0.0001	<0.0001	. . .	C<0.0001	. . .
18-10%, small amounts of naphthoquinone and phthalic acid	Coal By-products	F	36	27	xx	x	<0.0001	<0.0001	. . .	C<0.0001	. . .
10%	Research	L	125	1	xx	x	0.16	nil	. . .	. . .	. . .
5%	Research	L	125	4	xx	x	0.0005	nil	. . .	. . .	. . .
MALIC ACID											
2.7-2.1%, concentrated apple juice, soluble solids 72% (mostly sugars), pH 3.3-3.45 (Majonnier vacuum pan)	Food	F	135	42	—	xx	<0.0001	<0.0001	. . .	. . .	. . .
0.55-0.33%, apple sauce, soluble solids 21% (mostly sugars), sodium chloride trace, pH 3.4-3.7, temperature 216 F initially	Food	F	R.T.	57	—	—	<0.0001	<0.0001	. . .	. . .	. . .
0.45-0.35%, fresh apple juice, soluble solids 12-14% (mostly sugars), pH 3.55-3.65 (tank bottom)	Food	F	50-85	42	xx	x	<0.0001	<0.0001	. . .	. . .	. . .

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Malic acid											
0.45-0.35%, hard cider, alcohol 6.5-7.5%, acetic acid 0.2-0.4%, pH 3.55-3.65	Food	F	65	88	xx	x	<0.0001	<0.0001	...	...	...
MALT											
moisture and sulfur fumes from kiln drying of green malt (exhaust ventilator stack)	Brewing	F	65	223	—	xx	<0.0001	<0.0001	...	...	...
MANGANESE CHLORIDE											
37% neutral manganous-chloride solution (half immersed)	Chemical (evaporation)	F	220	19	xx	xx	0.033	0.026	...	...	...
9.3% manganese-chloride solution, pH 3	Chemical	L	168	75	x	—	...	0.0002d	...	0.0001d	0.0001d
MANGANESE SULFATE											
manganese-sulfate solution, specific gravity 1.25-1.35, sulfur dioxide 0.5 g/l, mostly pH 4-5 (tripod leg of first effect evaporator body)	Mining (evaporation)	F	235	11	—	xx	0.0005*bd	0.0003a	...	...	...
manganese-sulfate solution, suspended solids 5-15%, sulfuric and sulfurous acids, pH 1-2	Mining	F	140	8	xx	x	corr	0.0029	...	...	...
manganese sulfate, traces of calcium, iron, silicon, copper	Chemical (evaporation)	L	212	2.4	—	—	0.008c	0.0009	...	...	...
manganese sulfate, sulfuric acid, sulfurous acid of varying concentrations	Mining	F	60-145	23	x	x	...	0.0001	...	0.0002 C<0.0001	...
8% approximately, neutral leaching solution from leaching of reduced manganese ore, ammonium sulfate 130 g/l, ferrous sulfate 20 g/l, pH 6.5-7.5	Mining	F	80	91	xx	xx	0.0001	0.0001	...	...	...
manganese-sulfate solution obtained with manganese dioxide and oxide ore and sulfuric acid 5% approximately	Chemical	F	180	245	xx	xx	0.0006	0.0005	0.0005	0.0005	0.0005
MERCAPSOL											
25.5°Bé mercapsol solution, sodium hydroxide 19.3%, naphthenic acid 15%, cresols 10%, water	....	L	220-230	3.1	xx	—	0.0033 L0.0045	0.0022 L0.0018	...	nil	...
25.5°Bé mercapsol solution, sodium hydroxide 19.3%, naphthenic acid 15%, cresols 10%, water	....	L	220-230	2.4	xx	x	0.0087 L0.0087	0.0058 L0.0069	...	0.0016	...
25.5°Bé mercapsol solution, sodium hydroxide 19.3%, naphthenic acid 15%, cresols 10%, water	....	L	220-230	2.4	xx	xx	0.013 L0.011	0.016 L0.011	...	0.0051	...
25.5°Bé mercapsol solution, sodium hydroxide 19.3%, naphthenic acid 15%, cresols 10%, water	....	L	220-230	12	xx	xx	0.0006	...	...	0.0002	...
25.5°Bé mercapsol solution, sodium hydroxide 19.3%, naphthenic acid 15%, cresols 10%, water	....	L	220-230	16.5	xx	xx	0.0006	...	...	0.0002	...
MERCURIC CHLORIDE											
mercuric-chloride solution	Tanning	F	...	180	..	..	0.0001*	0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions						Average corrosion rates (ipy)				
	INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
METHACRYLIC ACID											
methacrylic acid, methyl methacrylate during 330 days, and air during 110 days (cracking unit)	Chemical	F	77	440	—	—	<0.0001	<0.0001	...	...	<0.0001
METHANOL											
95-15%, ammonia, hydrogen sulfide, various mercaptans, water and air together 1-10 g/l (vapors)	Paper (distillation)	F	180	762	x	xx	<0.0001d	<0.0001	...	...	...
60%, acetone 23%, methyl acetate 15%, water 2%, acetic acid 0.03%, pressure 16 psig	Chemical	..	165	355	..	..	<0.0001	nil	nil	...	...
50%, acetone 35%, 2, 2-dimethoxy propane 8%, methyl acetate 3%, ethanol 2%, methylethyl ketone 1%, water 1%	Rayon	F	158	473	—	xx	<0.0001 nil	<0.0001	...	...	...
36%, methyl acetate 38%, methylethyl ketone 33%, water 3%	Chemical	F	149	150	..	xx	<0.0001	<0.0001	...	...	...
36%, methyl acetate 38%, methylethyl ketone 33%, water 3%	Chemical	F	104	417	..	x	<0.0001	<0.0001	...	...	...
35%, acetone 25%, methyl acetate 20%, acetaldehyde 12%, water 5%	Rayon	F	144	707	—	xx	<0.0001	<0.0001	...	...	...
22%, water 55%, acetone 20%, methylethyl ketone 1%, ethanol 1%, traces of esters and ammonium hydroxide	Rayon	F	180	435	—	xx	<0.0001	0.0001	...	...	...
19%, water 60%, acetone 16%, ethanol 1%, methylethyl ketone 0.5%, ethyl acetate trace, sodium hydroxide injected, pH 7.2	Rayon	F	223	294	—	xx	<0.0001	<0.0001	...	...	...
10-5% methanol and methylal, traces of formic acid and carbon dioxide, water remainder	Chemical	F	200	52	—	xx	0.0001	<0.0001	...	...	...
8%, caustic 1-15%, amine salt 12%, sodium chloride 7%	Chemical	F	85	20	x	xx	0.0001	L0.0002	...	...	...
5-3% methanol and methylal, water 95-98%	Chemical	F	210-220	52	—	xx	<0.0001	<0.0001	...	...	...
0.5%, water 98-99%, *sec*-butanol 0.5%, methylethyl ketone trace, formaldehyde trace	Chemical	F	225	37.4	—	x	0.00027	0.00018	...	...	...
(DI-) METHOXYBUTANE											
dimethoxybutane crude (liquid)	Metal	L	266	48	..	..	0.0002	0.0002	...	...	...
METHYLALDEHYDE											
95-92%	Chemical	F	120	7	—	x	0.00021a	0.00038	...	...	...
0.02%	Chemical	F	212	390	x	x	<0.0001	<0.0001	...	...	...
(DI-) METHYL CHLORACETYL											
dimethyl chloracetyl	Chemical (chlorination)	F	32	25	—	xx	<0.0001	<0.0001	...	...	...
dimethyl chloracetyl	Chemical (distillation)	F	212	17	—	xx	0.0006	0.0005	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
METHYL CHLORIDE											
methyl-chloride atmosphere, fatty amine 75% solution in isopropanol, amine hydrochloride, quaternary ammonium chlorides, some free hydrochloric acid, pH 3-8	Chemical	F	190	55	—	xx	0.0003ad S0.0004ad	0.0002ad S0.0002ad	0.0002ad	0.0002	0.0001
METHYLENE CHLORIDE											
99.3%, methanol 0.5%, acidity as hydrochloric acid 0.0007%, chlorine 5.4 ppm, copper ion 5 ppm, iron ion 1 ppm (activated carbon solvent recovery)	Textile	F	75-100	56	—	—	nil a	nil	...	...	...
methylene chloride, formaldehyde, traces of oils and water	Rayon	F	140	628	—	x	<0.0001	<0.0001	...	...	...
methylene chloride, formaldehyde, traces of oils and water	Rayon	F	185	628	—	x	<0.0001	<0.0001	...	...	...
methylene chloride, formic acid, methylaldehyde	Rayon	F	100	22	x	x	0.00016	0.00016	...	...	...
methylene chloride wet, traces of hydrochloric acid and other corrosives	Plastic (solvent recovery)	F	70	59	—	—	<0.0001	<0.0001	...	...	<0.0001
methylene chloride wet, being dried in a calcium chloride bed, calcium-chloride concentrated solution in regenerating cycle (drier)	Plastic (solvent recovery)	F	70	57	—	—	<0.0001	<0.0001	...	...	...
methylene-chloride vapors, water vapor, possibly traces of hydrochloric acid and other corrosives (top of column)	Plastic (solvent recovery, distillation)	F	100	59	—	x	<0.0001	<0.0001	...	...	<0.0001
methylene chloride, pyridine, water, acetone, hydrochloric acid trace (vapors)	.... (distillation)	F	100-248	56	—	x	<0.0001	<0.0001	...	<0.0001	<0.0001
90%, methylaldehyde 10%	Rayon	F	100	22	x	x	0.00011 0.00018	0.00011	...	...	...
90%, methanol 10%, acetone 0.5-1%, water 0.2-0.3%, acidity as hydrochloric acid 1 ppm after carbon dioxide removal	Chemical	F	65-85	400	x	x	<0.0001	<0.0001	nil	...	...
40%, acetone 50%, water 10%, traces of hydrochloric acid and phenolic-type products (reboiler)	Plastic (distillation)	F	175	60	—	x	0.0001ad	0.0001ad	...	0.0001d	0.0001d
22.5%, water 75%, methanol 2.5% (liquid outlet from adsorber condenser)	Textile (solvent recovery)	F	100-140	53	xx	x	nil	nil	...	...	...
22.5%, water 75%, methanol 2.5% (vapor inlet to adsorber cooler)	Textile (solvent recovery)	F	100-250	51	x	xx	0.0008r	0.0001r	...	...	...
2.5%, water 95%, methanol 2.5%, acetone 0.2%, acidity as hydrochloric acid 0-10 ppm	Chemical	F	75-85	396	x	x	0.0001	0.0001	...	...	...
0.5%, water 98.5%, methanol 1%, acidity as hydrochloric acid 0.007%, copper ion 12 ppm, chlorine ion 6 ppm, iron ion 2.5 ppm	Textile (solvent recovery)	F	75-85	560	—	—	nil	nil	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
METHYLENE TETRAMINE											
hexamethylene tetramine, an alkyl chloride during 90 days; and ammonia, aryl-alkyl chloride during 10 days (autoclave)	Chemical	F	303	100	—	x	<0.0001*a	<0.0001	<0.0001	...	...
METHYLETHYL KETONE											
90%, ethyl acetate 5%, water 5%	Chemical	F	167	390	..	x	0.0002	0.00017	0.00012	...	...
90%, water vapor 10%, hydrochloric acid trace (evaporator, vapors)	Sugar By-product	F	190	9	x	xx	0.110c	0.007d	...	...	...
82%, water 14%, methanol trace, *sec*-butanol trace	Chemical	F	180	3.8	—	x	0.00028	0.00013	...	...	...
80.1%, pentane 9.1%, water 9%, ethyl acetate 0.6%, tertiary butyl alcohol 0.3%, methyl acetate 0.2%	Chemical	F	167	4	..	xx	0.0002	0.0002	...	...	...
73%, water 15%, methyl isopropyl ketone 4%, formaldehyde 2-3%, alcohols 2%	Chemical	F	160	125	—	x	<0.0001	<0.0001	...	...	...
57%, ethyl acetate 47%, water 6%	Chemical	F	162	42	..	x	nil	nil	nil	...	...
50%, ethyl acetate 40%, water 10%	Chemical	F	176	25	..	xx	<0.0001	0.0002	...	...	...
44%, ethyl acetate 37%, other esters and ketones 14%, water 7%	Chemical	..	162	29	..	xx	0.0001a	0.0001	...	...	...
25%, water 75%, ethyl acetate, other esters and ketones	Chemical	..	167	29	..	xx	0.0001	0.0002	...	...	...
20%, methyl acetate 20%, ethyl acetate 15%, acetone 15%, acetaldehyde 10%, water 7%, alcohols 5%, methyl formate 4%	Rayon	..	140	535	—	xx	0.012a	0.0007	...	...	...
18%, water 80%, alcohols 1%, triethanolamine 1%, formaldehyde trace	Chemical	F	200	3.8	—	x	0.00021	0.00019	...	...	...
15%, water 70%, ethyl acetate 15%	Chemical	F	176	39	..	x	0.0003	0.0002	<0.0001	...	...
13%, ethanol 35%, water 18%, other esters and ketones 22%, butanol 12%	Chemical	F	181	29	..	xx	0.0005	0.0004	...	...	...
5%, water 95%	Chemical	F	190	39	..	x	0.0002	0.00022	0.00015	...	...
1%, water 99%	Chemical	F	210	39	..	x	0.00015	<0.0001	<0.0001	...	...
(TRI-) METHYL PHOSPHATE											
50%, high boilers 50%	Chemical	..	300	106	—	—	0.0001	nil	...	...	...
8.7%, ethyl acetate 84%, light ends and high boilers 2.45%, water remainder	Chemical	..	...	135	—	xx	0.0001	0.0001	...	...	...
trimethyl phosphate, light ends, acidity as acetic acid 0.31 g/l, pH 4.8	....	..	255	241	—	xx	nil	nil	...	...	...
MILK											
milk	Dairy	L	145	28	..	..	0.00017	...	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
dealbuminized milk whey	Dairy	F	190	31	xx	—	<0.0001ad	<0.0001	...	...	...
oxidized sludge effluent from the digestion of milk waste, total solids 1000-1500 ppm, pH 7.5 (clarifier)	Dairy	F	80	79	—	—	<0.0001	...	<0.0001	...	...
oxidized sludge and mixed liquor from the digestion of milk waste, total solids 0.8-1.2%, pH 5-7.7 (aeration tank)	Dairy	F	82	79	xx	xx	<0.0001	...	<0.0001	...	...
sludge and liquids from digestion of milk waste, total solids 1.5%, pH 7.2	Dairy	F	104	79	—	—	<0.0001	...	<0.0001	...	...
digester sludge (excess oxidized sludge and whey), total solids 1-7%, pH 4.5-7.5	Dairy	F	105	79	—	—	<0.0001	...	<0.0001	...	...
digestion supernatant liquor from the digestion of milk waste, total solids 3000 ppm, pH 7.5	Dairy	F	98	79	—	—	<0.0001	...	<0.0001	...	...
digester gas from digestion of milk waste	Dairy	F	95	79	—	—	<0.001cd	...	<0.0001	...	...
digester gas from digestion of milk waste	Dairy	F	105	79	—	—	0.0001cd	...	<0.0001	...	...
digester gas from digestion of milk waste, steam from heater	Dairy	F	110	79	—	—	<0.0001bd	...	<0.0001	...	...
MIXED ACIDS (SULFURIC-ACID—NITRIC-ACID MIXTURES)											
60% sulfuric acid, nitric acid 20%, water 20% (nitrocellulose boiling tub)	Explosives	F	212-215	12.5	—	—	...	0.0006	0.0003	...	...
59% sulfuric acid, nitric acid 22%, water 19%	Chemical	L	150	7.2	..	..	...	...	0.0013	...	0.0005
59% sulfuric acid, nitric acid 22%, water 19%	Chemical	L	181	2.4	..	..	...	...	0.0065	...	0.0043
40% sulfuric acid, nitric acid 20%, water remainder	Research	L	150	...	—	..	0.004	0.0046	...	0.0012	...
23% approximately sulfuric acid, nitric acid 26% approximately, water remainder	Metal (pickling)	F	150	31	—	x	0.00013*	0.00011	...	C0.00014	...
MOLASSES											
molasses acidified with sulfuric acid containing small amounts of phosphoric acid, pH 6-6.5 (cooker)	Sugar	F	195-210	1	..	x	0.0019	0.0015	...	...	...
fumes from molasses mixing tank, sulfur dioxide, acetic acid, calcium chloride (blower)	Food	F	R.T.-150	33	xx	x	<0.0001bd	<0.0001ad	...	...	...
NAPHTHA											
naphtha 400 API, some hydrogen sulfide and aliphatic acids after vapor-phase clay treatment	Petroleum (distillation)	F	100	400	—	—	<0.0001	<0.0001	...	<0.0001	<0.0001
naphtha, IBP 257 F, EP 400 F, specific gravity 47.3, sulfur 0.008%, small amounts of dissolved ammonia, traces of water and hydrogen sulfide (sump of top tray of column)	Petroleum (distillation)	F	320	538	—	x	<0.0001b	<0.0001a	...	...	...
heavy naphtha from West Texas crude, sulfur 0.4-0.5%, hydrogen sulfide, traces of hydrochloric acid, carbon dioxide and water	Petroleum (distillation)	F	85	156	x	—	<0.0001d	<0.0001d	<0.0001	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
light petroleum naphtha, cracked (top tray of bubble tower)	Petroleum (fractionation)	F	230	215	—	..	0.0167cd 0.0133*cd	0.0186cd	...	...	...
light naphtha (top of tower, vapors)	Petroleum	F	200-300	750	..	..	0.0001bd	0.0004ad	...	...	<0.0001a
light naphtha, ammonia, hydrogen sulfide, water, chlorides trace, pressure 45 psig	Petroleum	F	100	369	—	xx	L nil	L nil	...	...	...
96% solvent naphtha, some nitrogen oxides possibly evolved (still column, vapors)	Chemical	F	170	35	—	..	0.0003 S<0.0001	<0.0001 S0.0002	..	<0.0001	<0.0001
virgin naphtha stock, hydrogen 24 vol%, hydrogen sulfide 0.21 vol%, hydrocarbons remainder, small amounts of ammonia and hydrochloric acid	Petroleum	F	576	150	—	xx	0.0014	...	...	.	...
polymerized naphtha, resin distillate, boron trifluoride etherate 5%	Coal By-product (tar distillation)	F	123-195	66	—	xx	0.04	0.015	...	0.012	0.0075
NAPHTHALENE											
crude naphthalene, associated neutral coal tar oils (B.P. 200-300 C) (column)	Coal By-product (tar fractionation)	F	440	65	—	xx	<0.0001	nil	...	...	...
naphthalene	Chemical (distillation)	F	185	36	—	x	...	<0.0001	...	...	...
naphthalene, naphthalene sulfonic acid, sulfuric acid 66°Bé and 50°Bé (conical washer bottom)	Coal By-product	F	190	45	xx	xx	corr corr*	corr	..	...	...
naphthalene, sulfuric acid 60°Bé, caustic wash 10%, water wash, cyclic operation (washer bottom)	Chemical	F	199	12	—	xx	corr	corr	0.56	0.34	...
washing naphthalene, sulfuric acid 66°Bé 1.1-1.3 vol%, water washing and neutralizing with 10% caustic soda 8-16 vol%	Coal By-product	F	200-210	20	xx	xx	0.0672	0.141	...	...	...
65% naphthalene, tar acids 19%, ammonium chloride 0.7 lb/1000 gal, pH 5.5 (column)	Coal By-product (tar fractionation)	F	380	60	—	xx	<0.0001cd <0.0001*d	nil	...	..	...
naphthalene, chloronaphthalene, calcium chloride, calcium oxide, hydrochloric acid trace	Chemical	F	300-360	63	—	—	0.0005 0.0002	0.0004 W0.0006 0.0002	0.0003	0.0002	
NAPHTHANATES											
naphthanates and thallates of lead, cobalt and manganese	Paint and Varnish	F	R.T.-350	382	..	x	<0.0001	<0.0001	..	<0.0001	...
NAPHTHENIC ACID											
naphthenic acid	Chemical	F	450	15	x	xx	0.057	0.0003	0.0002	0.0003	...
naphthenic acid in distillates from South American petroleum, sulfur 2.4%	Petroleum	F	500	174	—	x	<0.0001	<0.0001	...	...	...
naphthenic acid in heavy distillate from South American petroleum, sulfur content of gasoline 1.7%	Petroleum	F	554	59	—	x	0.0236	0.0002	..	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
heavy distillate from Lagunillas fuel containing naphthenic acids, neutralization value: potassium hydroxide 2.5 mg/g (high vacuum tower)	Petroleum (gasoline condensing)	F	500	107	—	xx	0.0365 L0.0187	0.0011	...	...	...
naphthenic acid (liquid line)	Chemical	F	450	15	x	xx	0.057 0.057*	0.0003	0.0002	0.0003	...
NICKEL AMMONIUM SULFATE											
24.3% approximately, free ammonia 30 g/l, oxygen partial pressure <300 psig	Mining	F	300	11	xx	xx	S0.0004	S0.0009	...	...	...
24.3% approximately, nickel-ammonium-sulfate vapors, free ammonia 30 g/l, oxygen partial pressure <300 psig	Mining	F	300	11	xx	xx	S0.0001	S0.0002	...	...	...
21.7% approximately, free ammonia 30 g/l, hydrogen partial pressure 375-400 psig, total pressure 500 psig (vapors, liquid)	Mining	F	300	1	—	xx	S0.02 S0.007	S0.003 S0.004	...	...	...
NICKEL CHLORIDE											
nickel-chloride solution being evaporated	Metal (plating)	F	200	26	—	—	L0.0015a	0.0013ad	...	...	...
NICKEL-PLATING SOLUTION											
purified nickel-plating electrolyte, nickel 42.8%, sodium sulfate 31.6%, boric acid 21.5%, calcium sulfate 1.21%, chlorine ion 0.053%, copper ion 0.001%, iron ion 0.001%, pH 5.2	Metal (plating)	F	116-120	121	—	x	<0.0001d	<0.0001	...	...	...
nickel-plating bath, nickel chloride 27 oz/gal, nickel phosphate 12 oz/gal, boric acid 5.5 oz/gal, pH 3-3.5	Metal (plating)	F	135	42	x	x	0.0007	0.0005	...	...	...
NICKEL SULFATE											
39.1-23%, copper 0.0015-0.02 g/l (evaporator)	Mining	F	191	232	—	—	<0.0001	<0.0001	...	...	...
1.0-0.75%, hydrochloric acid, pH 3-3.5	Metal (plating)	F	160	176	—	x	0.0051cd	0.0005cd	...	<0.0001d	<0.0001d
NICOTINE											
nicotine solution	Agriculture (insecticides)	F	high	31	—	—	0.0146	0.00233	...	...	...
NICOTINIC ACID											
nicotinic acid, niacene amine, diammonium phosphate, ammonia	Chemical	L	535	...	—	x	0.31	0.45	...	...	...
NITRIC ACID											
99%	Chemical	L	90	90	—	—	W0.026	...	...	...	...
99%	Chemical	L	110	90	—	—	W0.048	...	...	...	...
99%	Chemical	L	130	90	—	—	W0.05	...	...	...	...
98.5%	Explosive	F	86	30	—	—	0.09	0.074	...	0.203	0.042

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Nitric acid											
98.5% (vapors)	Explosive	F	86	30	—	—	0.058	0.059	. . .	0.064 0.017	0.02
97%	Chemical	L	90	90	—	—	W0.0125	. . .	. . .	. . .	. . .
97%	Chemical	L	110	90	—	—	W0.027	. . .	. . .	. . .	. . .
97%	Chemical	L	130	90	—	—	W0.025 W0.024	. . .	. . .	. . .	. . .
white fuming nitric acid	Aircraft and Missile	L	160	7	. .	. .	L0.15	. . .	. . .	. . .	0.043
white fuming nitric acid	Aircraft and Missile	. .	R.T.	30	. .	. .	L0.0045	. . .	. . .	. . .	0.0005
95.6-94.5% white fuming nitric acid, water 3.5-3.9%, nitrogen dioxide 0.94-1.67%	Aircraft and Missile	L	R.T.	10	—	—	0.0008	0.0008	. . .	. . .	. . .
95.6-94.5% white fuming nitric acid, water 3.5-3.9%, nitrogen dioxide 0.94-1.67%	Aircraft and Missile	L	122	10	—	—	0.045	0.05	. . .	. . .	. . .
95.6-94.5% white fuming nitric acid, water 3.5-3.9%, nitrogen dioxide 0.94-1.67%	Aircraft and Missile	L	160	10	—	—	0.16	0.2	. . .	C0.05	. . .
95%	Chemical	L	90	90	—	—	W0.0012	. . .	. . .	. . .	. . .
95%	Chemical	L	110	90	—	—	W0.0007	. . .	. . .	. . .	. . .
95%	Chemical	L	130	90	—	—	W0.0014 W0.001	. . .	. . .	. . .	. . .
white fuming nitric acid, inhibited	Aircraft and Missile	. .	R.T.	30	. .	. .	L0.0002	. . .	. . .	. . .	0.0002
white fuming nitric acid, inhibited	Aircraft and Missile	. .	160	7	. .	. .	L0.001	. . .	. . .	. . .	0.0067
92.8-92.3% red fuming nitric acid, nitrogen dioxide 4.9%, water 2.3-2.9%	Aircraft and Missile	L	R.T.	10	—	—	0.0006	0.0008	. . .	. . .	. . .
92.8-92.3% red fuming nitric acid, nitrogen dioxide 4.9%, water 2.3-2.9%	Aircraft and Missile	L	122	10	—	—	0.065	0.075	. . .	. . .	. . .
92.8-92.3% red fuming nitric acid, nitrogen dioxide 4.9%, water 2.3-2.9%	Aircraft and Missile	L	160	10	—	—	0.17	0.26	. . .	C0.05	. . .
red fuming nitric acid, specific gravity 1.55-1.59, nitrogen dioxide 13-18%, water 2-5%	Chemical	L	R.T.	2	—	—	0.0004	. . .	. . .	. . .	. . .
red fuming nitric acid, nitrogen dioxide 6.5%, water 2-3%	Research	L	250-300	0.3	—	—	1.2	2.5	. . .	. . .	. . .
red fuming nitric acid, nitrogen dioxide 6.5%, water 2-3%	Research	L	50-80	2	—	—	0.0006* 0.0004	0.0007	. . .	. . .	. . .
69.5%	Research	L	98	2	xx	—	. . .	0.0004	. . .	. . .	. . .
65%	Research	L	B.P.	. . .	—	—	0.016	0.016	. . .	. . .	. . .
65%	Research	L	251	2	—	—	0.0051	0.0045	. . .	. . .	. . .
65%	Research	L	251	6	. .	. .	C0.0102	C0.0148	. . .	. . .	. . .

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Nitric acid											
65%	Research	L	251	2	—	xx	...	...	...	...	0.011
65%	Research	L	251	6	—	xx	...	...	...	...	0.011
65%	Research	L	251	10	—	xx	...	...	...	...	0.017
65%	Research	L	251	6	—	—	...	0.0193	...	...	...
60%	Research	L	210	2	..	..	...	0.0034	...	...	...
60%	Research	L	98	6	xx	—	..	0.0002	...	...	.
50%	Research	L	98	6	xx	—	...	<0.0001	...	...	...
42%	Research	L	200	...	..	..	0.0033	0.0042	...	...	...
40%	Research	L	98	6	xx	—	...	<0.0001	...	...	...
30%	Research	L	98	6	xx	—	...	<0.0001	...	...	...
25%	Research	L	130	...	—	—	0.0002	0.0001	...	...	...
20%	Research	L	98	6	xx	—	...	<0.0001	...	...	...
10%	Research	L	98	6	xx	—	...	<0.0001	...	...	...
10%	Research	L	212	6	xx	—	...	0.0002	...	...	...
10%	Chemical	L	B.P.	30	..	..	0.0003	...	...	...	...
10%	Research	L	75	1	..	..	...	...	...	...	<0.0001
10%	Research	L	150	1	..	..	...	...	...	...	<0.0001
10%	Mining	F	120	70	xx	—	<0.0001	<0.0001	...	...	...
6%	Research	L	210	2	..	..	...	nil	...	...	...
5%	Research	L	98	6	xx	—	...	<0.0001	...	...	...
5%	Research	L	212	6	xx	—	...	0.0002	...	...	...
5%	Metal	L	86	14	xx	xx	<0.0001 L<0.0001	...	...	...	...
5%	Metal	L	140	14	xx	xx	<0.0001 L<0.0001	...	...	...	...
5%	Metal	L	195	14	xx	xx	<0.0001 L<0.0001	...	...	...	...
NITRIC-ACID MIXTURES WITH HYDROCHLORIC ACID											
70%, hydrochloric acid 2%, water	Chemical	F	70	...	..	..	nil	...	...	...	...
70%, hydrochloric acid 2%, water	Chemical	F	200	...	..	..	0.0001	...	...	...	...
67%, hydrochloric acid 0.1%, water	Chemical	L	B.P.	2	..	..	0.0094 0.0091	...	...	...	...
67%, hydrochloric acid 0.1%, water	Chemical	L	B.P.	6	..	..	0.0088	...	...	...	...
65%, hydrochloric acid 0.1%, water	Chemical	L	B.P.	2	..	..	0.0079 0.0083	...	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Nitric acid mixtures with hydrochloric acid											
65%, hydrochloric acid 0.1%, water	Chemical	L	B.P.	6	..	..	0.0078 0.0077	...	...	...	...
65-46%, zirconyl nitrate 11-13%, chloride ion 5 ppm, water	....	..	258	10	..	..	0.063c L0.12	0.16	...	0.049	0.026
60%, hydrochloric acid 40%, water	Metal	L	...	0.007	..	..	65.4	...	...	...	...
55%, hydrochloric acid 5%, water	Chemical	L	212	5	—	xx	0.0049 0.045 0.015* L0.0063	...	...	...	..
35-20%, raffinate solution, chlorides 500-1000 ppm, fluorides 50 ppm (vapors, liquid, concentrator column)	Mining (uranium refining)	F	<175	200	—	x	0.0004	0.0005 0.0007	...	0.0004a 0.0004	0.0005
30% approximately, raffinate solution, chlorides 885 ppm average (vapors, liquid, concentrator column)	Mining (uranium refining)	F	<175	320	—	x	...	0.001ad 0.002d	..	0.0009 0.0003	0.001 0.0004
1%, hydrochloric acid 10% (pickling tank)	Metal	F	R.T.-160	2	—	—	>2.74cd	1.64d	...	...	..
NITRIC-ACID MIXTURES WITH HYDROFLUORIC ACID											
65%, hydrofluoric acid trace	Metal	L	251	2	—	xx	L0.006 L0.06	...	...	...	
50.25%, pickling solution for aluminum, water 36.75%, hydrofluoric acid 13.7%	Metal (pickling)	F	75	3	—	—	0.038 0.058*	0.06	...	C0.172	...
20%, hydrofluoric acid 3%	Metal (pickling)	F	120	2	—	x	>2.7* >2.7	0.95	...	0.151	0.185
20-15%, hydrofluoric acid 3%	Metal (pickling)	F	130	1.8	—	x	>5.9	L0.193	0.218	0.161	0.203
12-8%, sulfuric acid 5-8%, hydrofluoric acid 1.1-1.2%, phosphoric acid <1%, "Virgo" salt detergent	Metal (pickling)	F	100	101	..	xx	0.002	0.0001 0.0014	0.0004 S<0.0001	0.0001	0.0005
11-10%, sulfuric acid 11-15%, hydrofluoric acid 0.9-1.1%	Metal (pickling)	..	70	3.3	—	xx	1.29c	1.65	...	...	...
10%, hydrofluoric acid 3%	Research	L	176	0.3	..	xx	...	3.78 L 8.8 L62.2 W 5.72	...	...	...
NITRIC-ACID— SULFURIC-ACID MIXTURES											
See SULFURIC-ACID MIXTURES and MIXED ACIDS											
NITRIC-ACID MIXTURES (other than those listed above)											
65%, potassium dichromate 1%	Research	L	B.P.	...	—	—	1.97	3.19	...	...	...
65%, potassium dichromate 5%	Research	L	B.P.	...	—	—	7.65	9.37	...	...	...
concentrated nitric acid, organic acids as gluconic, saccharic acids, nitrogen dioxide and oxide, water, corn starch	Chemical	F	165	1	—	x	0.002	0.0023 OK	...	0.0033	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Nitric acid mixtures											
60%, smelter slag	Mining	F	235	70	xx	xx	0.0015	0.002	...	...	...
60%, unreacted slag	Mining	F	...	11	—	—	0.00296	0.00242	...	...	...
59.5%, water 39%, chromic acid 1%	Rubber	F	68-82	42	x	xx	0.0061 0.0061*	0.0076 L0.0113	0.0116	...	...
58.5%, phosphoric acid 44%, nitrogen dioxide 1.5%	Research	L	112	15	—	x	0.012	0.013	...	...	...
58%, metal nitrates 11-13%, chloride ion 5 ppm based on zirconium	Chemical	F	258	10.3	—	xx	0.063c L0.12c	0.16c	...	0.049c	0.026
45-40%, zirconyl nitrate 0.8M, sulfate ion 0.05M, iron ion 0.003M (concentrator column, vapors above reboiler pot)	Chemical (fractionation)	F	190	44.7	x	xx	0.0016	...	...	0.0022	0.0008
45-35%, saturated with zirconyl nitrate	....	..	245	34	..	..	0.049	0.086	...	...	...
45-35%, saturated solution of 10-35% zirconyl-nitrate crystals (evaporator, vapors, liquid)	Chemical	F	245	29	xx	xx	0.027 0.026	...	...	0.047 0.042	0.026 0.021
45-35%, metal nitrates (mainly zirconium) 10-20%, chloride ion 3-20 ppm	Chemical	F	250	21	—	xx	0.016 0.01 L0.033 L0.027c	0.049 0.043c	...	0.029 0.017	0.0058 0.013
40%, nitrogen tetroxide, nitrous acid, water (absorption tower)	Chemical	..	95	15	xx	xx	0.0001 S0.0001 0.0004* S0.0025*	nil L0.0001	...	...	nil
36%, potassium nitrate 30% approximately, some sodium nitrate, iron, calcium and magnesium nitrates and sulfates, small amount of chlorides, water remainder (evaporator)	Chemical	F	165	8	—	xx	...	0.0014	0.0015	0.0006 C0.0007	0.0005
nitric acid, nitrogen oxides <36%, methyl ethyl pyridine, niacin, pressure (liquid, vapors)	Pharmaceutical	F	<415	79	—	xx	0.0044 S0.0069a 0.0088 L0.0052b 0.0091 S>0.073 L 0.017	0.021 0.017	...	...	...
35-25%, nitrous acid traces (concentrator column)	Chemical	F	240	33	—	xx	0.01	...	...	0.025	0.007
30%, largely reacted slag	Mining	F	215	70	xx	xx	0.002	0.002	...	...	...
30%, nicotinic acid, methyl ethyl pyridine	Chemical	F	617	1.3	—	xx	0.0062 0.39 L0.39 L1.4	0.43 1.2	...	...	...
29-26%, free acid 20% approximately, remainder nitrates of iron, magnesium, lead and aluminum, fluoride ion 3%, sulfate ion 2% (raffinate evaporator)	Atomic Energy	F	160-190	52	xx	xx	0.0013 S0.04c	0.0012 S0.03c	0.0009	...	0.0004
25%, potassium dichromate 2.5%	Research	L	130	...	—	—	0.0018	0.0026	...	...	...
25%, potassium dichromate 5%	Research	L	130	...	—	—	0.0043	0.0069	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Nitric acid mixtures											
21-2%, metal nitrates 0.2-2.5%, sulfate trace, chloride ion 3-13 ppm based on zirconium	Chemical	F	222-265	10.3	—	xx	0.0052 L0.0098	0.012	...	0.0074	0.0046
20%, 2,5-dialkyl pyridine, niacin	Chemical	L	365-375	...	..	..	0.031	0.039	...	...	...
20%, 2,5-dialkyl pyridine, niacin (vapors)	Chemical	L	365-375	...	..	..	0.063	0.071	...	...	...
20% approximately, reacted slag	Mining	F	...	11	—	—	0.00014	0.00016	...	...	...
18%, terephthalic acid 6%, formic acid 0.2%	Chemical	L	303	1	xx	—	0.025 0.041	...	0.019	...	...
18%, formic acid 0.2%	Chemical	L	350	1	xx	—	0.064	...	0.056	0.043	...
18%, terephthalic acid 6%, formic acid 0.2%	Chemical	L	390	1	xx	—	0.5	...	0.32	...	...
18% approximately untreated nitric acid, raffinate containing free nitric acid 3N, combined nitrates of iron, copper, calcium, cobalt 2.7N, some phosphates and arsenates of these metals, calcium sulfate 20 g/l, chloride ion 50 ppm	Mining	L	195	10	—	x	0.0005	0.0002	...	0.00015	0.0004
nitric-acid liquor, high concentrations of iron and other inorganics (evaporator, vapors)	Mining	F	212	60	—	xx	0.0045	0.004	...	...	...
14% approximately raffinate, free nitric acid 4N, sulfates of iron, copper, cobalt, calcium 16N, phosphates and arsenates of these metals, chloride ion 50 ppm approximately	Metal	L	210	5.7	—	x	0.01	0.003	...	...	...
raffinate treated with sulfuric acid, free nitric acid 4.6N, free sulfuric acid 0.4N, sulfates of copper, iron, cobalt and calcium, phosphates and arsenates of these metals, chloride ion 50 ppm	Metal	L	250	8.4	—	x	0.0175ad	0.02		0.013	0.026
13.25%, "Zircex" solutions, hydrogen ion 3M, uranyl chloride 0.4M (vapors)	Atomic Energy	.	B.P.	0.13	..	..	2.16	...	...	...	...
13.25%, "Zircex" solutions, hydrogen ion 3M, uranyl chloride 0.4M (vapors)	Atomic Energy	.	B.P.	28	..	..	...	...	.	0.0012 S0.0006	...
13.25%, "Zircex" solutions, hydrogen ion 3M, uranyl chloride 0.4M (vapors–liquid interphase)	Atomic Energy	...	B.P.	0.13	..	..	29.2	...	...	...	...
13.25%, "Zircex" solutions, hydrogen ion 3M, uranyl chloride 0.4M (vapors–liquid interphase)	Atomic Energy	..	B.P.	28	..	..	...	...	...	0.0042 S0.0057	...
13.25%, "Zircex" solutions, hydrogen ion 3M, uranyl chloride 0.4M	Atomic Energy	.	B.P.	0.13	..	..	2.13	...	...	...	...
13.25%, "Zircex" solutions, hydrogen ion 3M, uranyl chloride 0.4M	Atomic Energy	..	B.P.	28	..	..	...	...	...	0.0045 S0.013	...
2.65%, "Zircex" solutions, uranyl chloride 0.4M (vapors)	Atomic Energy	..	B.P.	7	..	..	...	...	...	0.0081 S0.0098	...
2.65%, "Zircex" solutions, uranyl chloride 0.4M (vapors–liquid interphase)	Atomic Energy	..	B.P.	7	..	..	...	...	...	0.543 S0.333	...
2.65%, "Zircex" solutions, uranyl chloride 0.4M	Atomic Energy	..	B.P.	0.17	..	..	7.28	...	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Nitric acid mixtures											
2.65%, "Zircex" solutions, uranyl chloride 0.4M	Atomic Energy	. .	B.P.	7	. .	. .	. . .	. . .	. . .	0.68 S0.845	. . .
NITROGEN											
90%, carbon dioxide 6%, carbon monoxide 1%, traces of butanes, pentanes, water and aldehydes	Rayon	F	86-131	1178	—	xx	<0.0001	0.0001	. . .	. . .	. . .
OIL, CRUDE											
oil-field crude oil (vapors)	Petroleum	F	60	399	—	—	<0.0001c	<0.0001	. . .	. . .	. .
crude oil, sodium chloride 67 lb/1000 bbl, sulfur 0.342% as sulfides (top of crude flash tower)	Petroleum (distillation)	F	230	43	—	xx	0.011*cd 0.008cd	0.005cd	. . .	. .	. . .
oil-field crude oil, salt water	Petroleum	F	60-130	399	—	x	<0.0001	<0.0001	. . .	. .	.
Illinois crude oil, API gravity 37, salt 100 lb/1000 bbl, sulfur 0.4% (vacuum pipe still)	Petroleum	F	250-350	463	—	x	<0.0001	<0.0001	. . .	. . .	. . .
sweet crude, small amount of hydrogen sulfide (flash tower)	Petroleum	F	825	73	—	x	0.0006	0.0008	0.0006	0.0015	0.0008
OIL, FUEL											
light fuel oil, some water, ethylene dichloride and hydrochloric acid	Petroleum	F	225	45	—	xx	0.02*cd	0.045c	. . .	. . .	. . .
light fuel oil, some water, ethylene dichloride and hydrochloric acid	Petroleum	F	150	45	—	xx	0.004*ad	0.003a	. . .	. . .	. . .
diesel oil, pentachlorphenol 5%	Chemical	F	225-232	46	—	—	<0.0001	<0.0001	. . .	. . .	. . .
fuel-oil washing, acid wash with 66°Bé sulfuric acid 4 lb/bbl during 4 hr/day, and caustic wash with 10°Bé sodium hydroxide 1 vol%	Petroleum	F	80-105	56	xx	xx	0.018*b	0.018a	0.017a	. . .	. . .
combustion products of gases from oil burners, sulfur dioxide, sulfur trioxide, selenium dioxide (uptake from slimes roasting)	Chemical	F	1100	42	xx	x	0.007b	0.007a	. . .	0.008	0.006
OIL, LUBRICATING											
lube oils, azeotropic solution of water and phenol 10% (alternately immersed)	Petroleum	F	210-230	230	—	xx	0.0002	0.0002	. . .	. . .	. . .
sour lube oil, hydrocarbons 58%, water 40%, sulfuric acid 2% (heavy oil agitator bottom)	Petroleum	F	100	15	—	—	0.008ad 0.019ad	0.006a	. . .	. . .	. . .
lubricating oils, sulfuric acid, total acidity 25%	Petroleum	F	220	10	—	—	0.566	0.56	. . .	. . .	. . .
lube-oil fraction of heavy crude prior to neutralization, naphthenic acids, organic sulfides, some stripping steam (vacuum tower, vapors)	Petroleum (distillation)	F	620	183	x	xx	0.0016cd 0.0016*cd	0.0001	. . .	C0.0001	. . .

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
OIL, MISCELLANEOUS see also WATER, OIL WELL											
98% mineral oil, water 2%, caustic added at reflux 200 lb/day	Rayon	F	392-401	1168	—	xx	<0.0001	0.0002	...	...	...
80% absorption oil, butane and pentane 18%, carbon monoxide and dioxide 2%, water trace	Rayon	F	131-158	1168	—	xx	<0.0001	<0.0001	...	...	...
light oil washing with sulfuric acid concentrated and sodium hydroxide 20%, carbon disulfide, hydrogen sulfide, water 5% (liquid level)	Coal By-product	F	52-140	189	xx	xx	0.002d	0.003d	...	0.0014 C0.0006	...
light oil (benzene, toluene, xylene) washing with sulfuric acid 92-98% and with caustic soda 16 vol%	Coal By-product	F	115	30	x	xx	0.02cd 0.051c 0.005a	0.017 0.048 0.005a	...	C0.025 C0.033 C0.004	...
crude benzol washed with sulfuric acid 93%, diluted to 50% acid in cycle, followed by neutralization with milk of lime	Coal By-product	F	110	41	—	xx	0.073c 0.02 0.077c	0.09c 0.087 0.015	...	0.017 0.012 0.002	...
non-condensible gases and condensate of light gas oil, condensed steam (vacuum-still condensate line)	Petroleum	F	90-120	50	...	...	0.00067ad	<0.0001	...	...	...
hydrocarbon oil, small amount of sulfuric acid, neutralized with caustic solution 10% (vapors)	Chemical	F	110	57	xx	xx	<0.0001	<0.0001	...	<0.0001	...
hydrocarbon oil, small amount of sulfuric acid, neutralized with caustic solution 10%	Chemical	F	120	57	xx	xx	<0.0001c	<0.0001b	...	<0.0001c	...
light oil, steam distilled with creosote wash oil (top, bottom of still)	Chemical (coal)	F	284-320	...	...	...	nil 0.0002	nil 0.0002	...	...	...
cracked petroleum gas oil, combined sulfur < 1.27%, mercaptans, organic sulfides (second-stage tar separator)	Petroleum	F	760	17.5	...	xx	0.0042	0.0037	...	...	...
gas oil from crude charge, sulfur 0.5% (bottom tray of tower)	Petroleum (fractionation)	F	715	116	—	xx	0.0005	0.0005	...	...	...
OIL, VEGETABLE											
stripper oil, d-limonene 95%, lighter alcohol, esters and other components during 7 days, and alcohol 65-60%, water during 239 days (freezer)	Beverage	F	−30	246	xx	xx	<0.0001	<0.0001	...	...	...
vapors and droplets of peroxides, aldehydes, acrolein, fatty acids, oil traces, all suspended in air (fume box at base of venturi scrubber)	Chemical	F	30-200	253	xx	xx	<0.0001	<0.0001	...	...	...
OXALIC ACID											
50-20%, sulfuric acid 1.5-3%, suspended crystals, solids	Chemical	F	125	25	—	xx	0.0003d	0.0004	...	C0.00044	...
oxalic acid, "Oakite" solution, sodium bisulfate, unknown wetting agent 2% approximately	Metal (pickling)	L	180	4	—	—	0.0002 0.068	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
OZONE											
0.23% ozone in air, nitrogen pentoxide 0.1 mg/l approximately	Chemical	F	R.T.	60	xx	x	0.0001	0.0004	...	...	...
ozonated tap water	Water Treatment	..	35-70	105	xx	xx	<0.0001	<0.0001	...	...	...
PAINT AND VARNISH											
ester gum, drying oils (vapors, liquid)	Paint and Varnish	F	550-600	20	—	xx	0.0002 0.0019 0.0004	0.0001 0.0001	...	...	...
neutralized varnish, acetic acid 63.7%, water 16%, methyl acetate 2.5%, ammonium sulfate 2.2%, formaldehyde 1.7%, ammonium acetate 0.3%	Plastic	F	122	73	x	—	<0.0001	<0.0001	<0.0001	...	...
PALM OIL											
palm oil	Metal	F	350-450	30	—	x	<0.0001	<0.0001	<0.0001	...	...
palm oil	Metal	L	300	5	—	—	0.0001	...	...	...	...
PAPER, ACID PULPING, COOKING LIQUOR											
sulfite-digester liquor, free sulfur dioxide 7.02%, combined sulfur dioxide 1.21% (initial composition average), cooking acid has sulfur dioxide 7.42% total, pH 1.32, pressure 65-70 psig	Pulp and Paper	F	131	55	—	x	<0.0001	<0.0001	<0.0001	...	...
sulfite liquor, free sulfur dioxide 6.3%, combined sulfur dioxide 1.2%	Pulp and Paper	F	172	51	..	..	0.0005bd	0.0001	0.0001	...	...
sulfite cooking acid, total sulfur dioxide 6%, combined sulfur dioxide 1% (at start of cooking)	Pulp and Paper	F	260	96	..	xx	C0.0002	0.0004 0.0025c C0.0002	0.0007 0.0005	...	...
calcium-bisulfite cooking liquor, free sulfur dioxide 4.4%, combined sulfur dioxide 1.1%	Pulp and Paper	F	79	172	x	—	L0.0001	0.0001	0.0001	0.0001	...
sulfite pulping vapors, large amount of wet sulfur dioxide	Pulp and Paper	F	180	17	x	xx	...	0.0002b	0.0001	...	...
PAPER, ACID PULPING, PULP STOCKS											
paper stock, weakly acid to pH 5 (flow box)	Pulp and Paper	F	65	109	xx	xx	0.00014cd	<0.0001ad	...	...	...
paper stock, consistency 3% approximately, sulfuric acid 4 mg/l	Pulp and Paper	F	84	76	..	xx	<0.0001	<0.0001	...	...	...
water suspension of sulfite fiber 0.4%, sulfite waste liquor trace, pH 6.1 (flat screen header)	Pulp and Paper	F	35	48	xx	xx	nil	nil	nil	...	...
PAPER, ACID PULPING, SPENT LIQUOR											
ammonium sulfite-bisulfite solution, sulfur dioxide 3%, pH 6.2 (top of packing in absorption tower)	Pulp and Paper	F	103	1	xx	xx	0.0001	0.0002	0.0002	0.0003	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Paper, acid pulping, spent liquor											
ammonium sulfite-bisulfite solution, sulfur dioxide 3%, pH 6.2 (top of packing in absorption tower)	Pulp and Paper	F	107	2.2	xx	xx	0.0003	0.0004	0.0004	0.0004	...
digester liquor, sulfur dioxide 4.7-5%, calcium bisulfite 3.4%	Pulp and Paper	F	70	188	..	x	...	0.0001	0.0001	0.0001	...
sulfite pulp suspension, consistency 0.52%, dissolved solids 1500-2000 ppm (sulfite screen head box)	Pulp and Paper	F	45	97	—	—	<0.0001	<0.0001	...	...	...
sulfite pulp, consistency 0.25-0.6%, pH 4.5-6 (Johnsson screen head box)	Pulp and Paper	F	51	106	xx	xx	0.0001	0.0001	...	...	...
wash water from sulfite stock, pH 5.75 (sulfite seal pit)	Pulp and Paper	F	60	140	—	..	<0.0001	<0.0001	...	C<0.0001	...
wash water from sulfite stock, pH 5 (white-water seal box)	Pulp and Paper	F	84	140	xx	..	<0.0001	<0.0001	...	C<0.0001	...
sulfite waste liquor, pH 3.5	Pulp and Paper	F	265	132	x	x	0.0001ad	0.0001ad	...	...	...
sulfite waste liquor	Pulp and Paper	F	190	180	xx	xx	0.0001	0.0001	0.0001	0.0001	...
water vapor with organic sulfide, remainder sodium-base sulfite liquor recovery, pH 4.5 (evaporator, vapors)	Pulp and Paper	F	228	6.4	—	—	0.0001	0.0001	...	0.0001	...
PAPER, ALKALINE PULPING, COOKING LIQUOR											
sodium hydroxide 11.5% expressed as sodium oxide, sodium carbonate and sulfide etc 1.5%, cooking Western red cedar (blow end cone of rotating digester)	Pulp and Paper	F	<350	31	x	x	0.0002*	0.0006	0.001	...	...
sodium hydroxide 11.5% expressed as sodium oxide, sodium carbonate and sulfide etc 1.5%, cooking hemlocks 90% and spruce 10% (blow end cone of rotating digester)	Pulp and Paper	F	<350	31	..	..	0.0002*	0.0006	0.0006	...	...
PAPER, ALKALINE PULPING, PULP STOCKS											
kraft pulp stock, alum sized, pH 6.5-7 (paper machine, flow box)	Pulp and Paper	F	90	43	—	x	<0.0001	<0.0001d	...	...	...
flue gas from kraft black-liquor recovery furnace, sodium sulfate, sodium carbonate, sulfur dioxide, sulfur trioxide, hydrogen sulfide, methyl mercaptan, water, organic oxidation products, sodium compounds as sodium sulfate 1.7 lb/min (venturi scrubber)	Pulp and Paper	F	160-200	66	xx	xx	0.012cd	0.0002cd	...	0.0001bd	0.0001bd
flue gas from kraft black-liquor recovery furnace, sodium sulfate, sodium carbonate, sulfur dioxide, sulfur trioxide, hydrogen sulfide, methyl mercaptan, water, organic oxidation compounds, sodium compounds as sodium sulfate 10 lb/min (venturi scrubber)	Pulp and Paper	F	400-435	66	xx	xx	0.0001ad	<0.0001ad	...	<0.0001ad	<0.0001ad
sodium carbonate, sodium sulfide, calcium carbonate (mud thickener)	Pulp and Paper	F	180	204	—	xx	<0.0001	<0.0001	...	...	...
PAPER, ALKALINE PULPING, SPENT LIQUOR											
47-43% black liquor	Pulp and Paper	..	450	25	—	—	0.021	0.047	...	...	..

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
47-43% black liquor	Pulp and Paper	. .	450	60	—	—	0.028	0.049	. . .	. . .	. . .
PAPER, BLEACH SOLUTIONS											
caustic filtrate, pH 9.5	Pulp and Paper	F	140	45	xx	x	L<0.0001d	L<0.0001	<0.0001d	<0.0001	<0.0001
bleached sulfite white water after last washing stage of calcium hypochlorite (white-water flume from deckers)	Pulp and Paper	F	70-85	87	x	x	<0.0001d	<0.0001	. . .	. . .	<0.0001
zinc-hydrosulfite bleach, pH 4.2 (Oliver washer vat)	Pulp and Paper	F	139	209	x	x	0.0001	0.0001	. . .	. . .	. . .
bleached sulfate pulp containing some residual chlorine (first-stage bleach washer)	Pulp and Paper	F	68-78	31	x	xx	0.002cd	0.001cd	0.0007d	0.0004ad	0.0003ad
waste water from chlorination washer, chlorine 0.035-0.07 g/l	Pulp and Paper	F	60-90	83	. .	x	<0.0001d	<0.0001d	. . .	. . .	. . .
chlorine-dioxide water, chlorine-dioxide gas, hydrochloric acid 0.2 g/l, pH 3.5 (filtration box)	Pulp and Paper	F	160	45	xx	x	. . .	L0.0008 0.0006	0.0002b	0.0002	0.0003
bleaching solution, sodium hypochlorite 40 g/l	Pulp and Paper	F	95	17	—	—	0.0003c	0.0003	. . .	0.0003	. . .
bleaching solution, sodium hypochlorite 150 g/l	Pulp and Paper	F	85	17	—	—	0.0014	0.0003c	. . .	<0.0001	. . .
bleaching solution, calcium hypochlorite 40 g/l	Pulp and Paper	F	95	17	—	—	0.0062c	0.0428c	. . .	0.0003	. . .
hypochlorite solution, calcium chloride 1.5 g/l, calcium hypochlorite 0.1 g/l, pH 7.2 (washer)	Pulp and Paper	F	120	68	xx	xx	L0.0004bd	L0.0002a	0.0003a	0.0003a	0.0001a
kraft pulp stock with residual chlorine-dioxide bleach, pH 6.5 (head box)	Pulp and Paper	F	155	14	x	xx	0.0003a	0.0001a	. . .	C0.0002	0.0001
PAPER, GROUNDWOOD PULP STOCKS											
paper-mill head-box stock, groundwood and sulfite pulp 0.5-0.6%, chlorine 1 ppm, pH 5.2-6	Pulp and Paper	F	97	169	xx	xx	0.0001*	0.0001	. . .	. . .	. . .
groundwood pulp to deckers, alum 300 ppm, slimicides, pH 5	Pulp and Paper	F	120-127	161	x	x	<0.0001	<0.0001	. . .	. . .	. . .
groundwood stock, air dry alum 6-8 lb/ton, pH 4.4-4.7 (entrance to bull screen)	Pulp and Paper	F	130	152	x	xx	<0.0001	<0.0001	. . .	. . .	. . .
groundwood feed, alum 300 ppm, consistency 0.46%, slimicides, pH 5	Pulp and Paper	F	125	161	x	xx	<0.0001	<0.0001	. . .	. . .	. . .
groundwood pulp stock, sulfuric acid and sulfur dioxide, pH 4.2-4.4 (Fourdrinier)	Pulp and Paper	F	87	210	x	xx	0.0001	0.0001	. . .	. . .	0.0001
groundwood pulp, consistency 3-4% (washer flume bottom)	Pulp and Paper	F	140	163	x	x	<0.0001d	<0.0001	. . .	. . .	. . .
vapors from groundwood pulp grinders (exhaust fan)	Pulp and Paper	F	91-130	189	—	x	<0.0001*	<0.0001	. . .	. . .	. . .
PAPER, NEUTRAL SULFITE, COOKING LIQUOR											
sulfur dioxide, being absorbed in sodium-carbonate solution, sulfuric and sulfurous acid, carbon dioxide, free sulfur in the gas (fan inlet)	Pulp and Paper	F	160	45	x	x	. . .	0.001	0.0007	0.0007	. . .

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions						Average corrosion rates (ipy)				
	INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
neutral sulfite semi-chemical cooking liquor, specimen in sulfur-dioxide gas during 52 days, in liquor without sulfur dioxide during 81 days, sodium sulfite 14 lb/cu ft and sodium carbonate 3.5 lb/cu ft in finished liquor (absorption tower)	Pulp and Paper	F	140	133	xx	xx	. . .	0.0001	0.0001	C0.0001	. . .
PAPER, NEUTRAL SULFITE, PULP STOCKS											
neutral sulfite, semi-chemical pulp (vacuum stock washer vat)	Pulp and Paper	F	176	125	xx	xx	0.0001	0.0001	. . .	. . .	. . .
PAPER, NEUTRAL SULFITE, SPENT LIQUOR											
spent neutral sulfite semi-chemical liquor (evaporator)	Pulp and Paper	F	131-216	56	x	x	0.0001	0.0001	. . .	0.0001	0.0001
spent neutral sulfite semi-chemical liquor (evaporator, vapors)	Pulp and Paper	F	131-216	6	x	x	0.0002*	0.0004	. . .	C0.0002	0.0001
spent neutral sulfite semi-chemical liquor (evaporator)	Pulp and Paper	F	131-233	6	x	x	0.0001*	0.0006	. . .	C0.0003	. . .
water, steam, carbon dioxide, sodium carbonate and sulfate, sulfur dioxide and trioxide (exhaust gas from tower, being absorbed in soda-ash solution)	Pulp and Paper	F	212	95	. .	xx	0.038c	0.0089	. . .	0.0062	. . .
sodium-sulfite liquor, sodium sulfide, sodium sulfite, thiosulfate and polysulfide, pH 10 (vacuum evaporator)	Pulp and Paper	F	212	6.4	—	x	0.0001	0.0001	. . .	0.0001	. . .
sodium-sulfite liquor, sodium sulfide, sodium sulfite, thiosulfate and polysulfide, pH 10 (evaporator)	Pulp and Paper	F	212	9	—	—	0.0022	0.0001	. . .	0.0002	. . .
PAPER, PAPER BOARD, WASTE											
filler stock containing waste paper 75%, top liner stock 25% (mixture of sulfite, soda and kraft pulps with envelope cuttings), alum treated to pH 4.3	Pulp and Paper	F	75-110	140	—	xx	<0.0001	<0.0001	. . .	. . .	. . .
waste paper pulp 0.25%, sodium chloride 1% (cylinder mold)	Pulp and Paper	F	115	180	xx	xx	<0.0001	<0.0001	. . .	. . .	. . .
waste paper pulp 0.25%, sodium chloride 1% (cylinder mold)	Pulp and Paper	F	115	180	xx	xx	0.0012cd	<0.0001	. . .	. . .	. . .
PAPER, PARCHMENTIZING											
parchmentizing solution, sulfuric acid 65.5-68.5%, nitric acid	Pulp and Paper	F	60	88	. .	. .	. . .	<0.0001	<0.0001	<0.0001	<0.0001
parchmentizing solution, sulfuric acid 54%, calcium sulfate	Pulp and Paper	F	65	53	x	x	. . .	0.0001	0.0001	0.0001	0.0001
parchmentizing solution, sulfuric acid 35-40%	Pulp and Paper	F	65	50	xx	xx	. . .	0.0001	0.0001	0.0001	0.0001
parchmentizing solution, sulfuric acid 35-40%	Pulp and Paper	F	60	53	x	x	. . .	0.0001	0.0001	0.0001	0.0001
parchmentizing solution, sulfuric acid 35-38%, nitric acid	Pulp and Paper	F	70	88	. .	. .	. . .	<0.0001	<0.0001	0.0001	<0.0001
parchmentizing solution, sulfuric acid 5-8%	Pulp and Paper	F	70	53	x	x	. . .	0.0001	0.0001	0.0001	0.0001

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
PAPER, SIZING SOLUTION											
glue alum paper size, pH 5-6 during 7.7 days, and starch alum size, small amount of zinc sulfate during 1.3 days	Pulp and Paper	F	140	9	x	x	0.0001*a	0.0001a	...	...	...
PAPER, WHITE WATER, ACID											
white water from bleach sulfite dissolving pulp, pH 3.7-4 during 167 days, and 5-5.5 during 83 days	Pulp and Paper	F	60	250	xx	xx	0.0001	0.0001	...	...	...
white water, consistency 0.25%, sulfites 38 ppm, thiosulfites 22 ppm, pH 3.8-5 (paper machine wire pit)	Pulp and Paper	F	118	100	x	x	<0.0001	<0.0001	...	<0.0001	<0.0001
paper-machine white water, fiber 0.07%, alum, sulfite waste liquor, phenyl mercuric acetate trace, pH 4.3 (canal from suction box)	Pulp and Paper	F	83	35	xx	xx	<0.0001	<0.0001	...	...	...
sulfite white water, alum, size, titanium dioxide, some pulp (pump box)	Pulp and Paper	F	70	79	xx	xx	<0.0001*	<0.0001	<0.0001	...	...
PAPER, WHITE WATER, GROUNDWOOD											
groundwood white water (groundwood screen shower pond)	Pulp and Paper	F	88-118	231	xx	xx	<0.0001*	<0.0001	...	...	...
groundwood white water, consistency 0.06% (groundwood screen shower pond)	Pulp and Paper	F	108	295	xx	xx	<0.0001*	<0.0001	...	...	...
groundwood white water, total acidity as calcium carbonate 53.4 ppm, pH 4.2 average (groundwood screen shower pond)	Pulp and Paper	F	123-136	134	xx	x	<0.0001	<0.0001	...	...	<0.0001a
groundwood white water, consistency 0.06%, pH 5.3 average	Pulp and Paper	F	108	141	xx	x	<0.0001	<0.0001	...	...	...
PAPER, WHITE WATER, NEUTRAL SULFITE											
semi-chemical neutral sulfite liquor, pH 7.2	Pulp and Paper	F	110	82	x	—	L0.0001	0.0001	0.0001	0.0001	...
PAPER, WHITE WATER, NEWSPRINT											
paper-machine white water (riffler)	Pulp and Paper	F	80-106	231	xx	xx	<0.0001*	<0.0001	...	...	...
paper-machine white water, groundwood 78-82%, sulfite 18-22%, consistency 0.3% approximately, pH 4.4 approximately	Pulp and Paper	F	66	150	—	xx	<0.0001* <0.0001	<0.0001	...	...	...
newsprint white water, groundwood and sulfite furnish, small amounts residual wood acid, sulfurous acid, calcium bisulfite, bleach liquor (paper machine)	Pulp and Paper	F	95	186	xx	xx	<0.0001*	<0.0001	...	...	...
paper-machine white water, total acidity as calcium carbonate 37.3 ppm average, pH 4.3 average	Pulp and Paper	F	87-107	140	xx	xx	<0.0001	<0.0001	...	...	<0.0001
paper-machine white water, consistency 0.002-0.01%, pH 5 (riffler)	Pulp and Paper	F	92	974	x	x	nil	nil	...	...	...
paper-machine white water, aluminum sulfate and hydroxide, pH 5.2 average (Fourdrinier)	Pulp and Paper	F	60-85	185	..	..	0.0001*	0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
PAPER, WHITE WATER, PAPER BOARD, WASTE											
rich white water from hardboard manufacture, pH 4.3-4.6	Pulp and Paper	F	110	275	xx	xx	<0.0001	<0.0001	...	...	...
PAPER, WHITE WATER, SODA											
soda-pulp white water	Pulp and Paper	F	60	32	xx	xx	<0.0001	<0.0001	...	...	...
PAPER, WHITE WATER, SULFATE											
kraft and semi-chemical white water, pH 6-8 (log sluicing)	Pulp and Paper	F	45-85	222	xx	xx	<0.0001	<0.0001	...	...	...
kraft white water, sulfate 0.045 g/l, sulfide 0.025 g/l, chloride 102 ppm, pH 7.3-8.2 (log sluicing)	Pulp and Paper	F	45-85	98	xx	xx	0.0001	0.0001	...	...	...
PARKERIZING SOLUTION											
"Parco" compound solution, phosphoric-acid base	Metal	F	...	30	...	...	0.0001 0.0001*	<0.0001	...	...	...
"Parco Lubrite"	Metal	F	200	30	...	...	<0.0001 <0.0001*	0.0001	...	...	...
"Bonderite K" solution, sodium 0.6-2%, chlorate 0.5-1%, phosphate 0.25-1%, nitrate 0.25-1%, chloride 0.1-1%, zinc 0.25-0.75%, phosphoric acid 0.25-0.5%, copper 0.005-0.01%, pH 2-2.5	Metal	F	150-160	33	xx	xx	0.0006d	0.0001	...	...	...
"Bonderite D 180" solution	Metal	F	...	30	...	...	<0.0001	<0.0001	...	...	...
"Bonderite 160" solution	Metal	F	...	30	...	...	<0.0001	<0.0001	...	...	...
PECTIN											
thin pectin liquor, lactic acid 0.26%, malic acid 0.05%, carbon 0.03%, pH 3.8	Food	F	90-150	3.8	xx	xx	<0.0001 <0.0001*	<0.0001	...	...	...
thin pectin liquor, malic acid 0.2%, sulfur dioxide 0.065%, pH 2.7	Food	F	120	30	xx	x	<0.0001d	<0.0001	...	...	...
2% pectin extract from apple pomace, saturated with sulfur dioxide	Food	F	70-190	39	x	—	<0.0001d	<0.0001	...	...	...
2% pectin extract from apple pomace, saturated with sulfur dioxide (vapors)	Food	F	120	39	x	—	<0.0001d	<0.0001	...	...	...
PENTANE											
pentane vapors (compressor discharge)	Chemical	F	175	56	—	xx	0.026c	0.027c	0.028c	...	...
PESTICIDES											
pesticide solution for spraying vegetable crops, "Dithane" emulsion, "New Green," "Malathion," "20-20-20" soluble fertilizer, zinc, copper, "Aldrin," sulfur (spray tank bottom)	Agriculture	F	40-100	346	—	xx	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
variety of pesticides, "Ovatran," "DN" dry mix, sulfur, copper sulfate, zinc copper oil, zinc copper sulfur mixture, oil emulsion	Agriculture	F	60-120	230	x	xx	nil	<0.0001	...	...	...
hydrated lime, copper sulfate, lead arsenate, "Parathion," "Microfine," "Rapid Grow" soluble fertilizer	Agriculture	F	90	277	—	xx	<0.0001	<0.0001	...	...	...
"DDT" powder, wettable sulfur, "Malathion" emulsion	Agriculture	F	90	277	—	xx	<0.0001	<0.0001	...	...	...
heptachlor emulsion, copper sulfate, magnesium sulfate, "Ziram" wettable powder, "Zireb" wettable powder, "Parathion" emulsion, "Parathion" wettable powder, "DDT" emulsion, "TDE" emulsion, "Toxaphen" emulsion, "10-20-10" liquid fertilizer	Agriculture	F	70-85	258	—	xx	<0.0001 <0.0001*	<0.0001	...	...	...
"Diathane" 2 qt/100 gal, "New Green" 1 pt/100 gal, "Malathion" 1 lb/100 gal, water-soluble plant food "20-20-20" 5 lb/100 gal, zinc 0.5 lb/100 gal, cobalt, water	Agriculture	F	40-100	151	—	xx	<0.0001	<0.0001	...	...	...
pesticide solutions for spraying tomatoes, "Marzate" wettable powder, "Parzate" wettable powder, tribasic copper sulfate, "Zerlate" wettable powder	Agriculture	F	60-100	420	—	xx	0.0001	0.0001	...	...	...
2,4-dichlorophenoxyacetic acid ester of butyl alcohol (top of still, vapors)	Chemical	F	140-203	13	x	xx	0.197	0.138	...	0.085	...
monochlorobenzene, sulfur dioxide, water	Chemical	F	65	157	x	—	0.001cd	0.0006cd	...	C0.0005r	...
chloral, hydrochloric acid	Chemical	F	70	156	—	—	0.0008a	0.0005d	...	C0.0003	...
"Bordeaux" mixture, wettable sulfur, copper salts, nicotine sulfate, summer-oil emulsions, separately and in combinations (spray tank bottom)	Agriculture	F	60-75	3.2	xx	xx	0.0002	<0.0001	...	...	...
"Bordeaux" mixture, wettable sulfur and lime-sulfur, separately and in combinations (spray tank bottom)	Agriculture	F	76	1.3	xx	xx	0.0006 0.0074*	0.0003	...	...	...
pesticide solution for spraying citrus fruit, sulfur, lime sulfur, zinc, copper, iron, manganese, borax, molybdate, oil, magnesium, "D.N.," "Ovatron," "Sistox," "Parathion," "Malathion," "2-4-D"	Agriculture	F	40-100	266	—	xx	<0.0001	nil	...	...	..
PETROLEUM—see GASOLINE and OIL											
PHARMACEUTICALS											
mixture of acetone, phenol, water, liver compounds, pH 5.8-8 (condenser)	Pharmaceutical	F	70-150	42	—	x	<0.0001	...	<0.0001	<0.0001	...
alcohol slop from liver extraction	Pharmaceutical	F	...	91	..	..	<0.0001	<0.0001	...	...	...
alcohol slop from pharmaceutical extraction	Pharmaceutical	F	...	91	..	..	<0.0001	<0.0001	...	...	...
alcohol slop from insulin extraction	Pharmaceutical	F	...	91	..	..	<0.0001d	<0.0001	...	...	...
alcohol recovered from insulin extraction, mineral acids trace, organic acids trace, sodium and ammonium salts trace (column)	Pharmaceutical (fractionation)	F	...	91	—	x	0.001cd <0.0001	<0.0001cd <0.0001	...	...	...
salicylic, acetic and acetylsalicylic acids, acetic anhydride	Pharmaceutical	F	140	33	—	xx	0.0008ad	0.0006	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
15% sulfuric acid and sugar from the digestion of tuber Barbasco, neutralization with lime at end of run (autoclave)	Pharmaceutical	F	249	30	—	xx	...	0.1cr	...	0.051 C0.051	...
10% "Roccal" germicide, pH 10.3 initially	Pharmaceutical	L	R.T.	20	—	—	<0.0001	<0.0001	...	...	...
intravenous solution, dextrose 10-50%, water, sodium chloride 0.9%, calcium chloride, potassium chloride, dilute citric acid, sodium citrate, sodium lactate, extremely dilute vitamin solutions, pH 4-7	Pharmaceutical	F	70	62	—	x	<0.0001	<0.0001	...	...	...
PHENOL											
phenol, pure	Chemical	L	590	1	—	—	nil	nil	...	...	...
95%, acetophenone 5% (bottom of column)	Chemical (distillation)	F	311	276	—	x	<0.0001	<0.0001	...	<0.0001	...
phenol (bottom of column, vapors)	Chemical (fractionation)	F	302	125	—	xx	0.0217	0.0034	...	...	...
used plant phenol, some sulfur compounds	Chemical	L	590	1	—	—	nil	0.001	...	...	...
80-70%, α-methyl styrene, acetophenone and mesityl oxide 5%, water 1-3%, pH 4-5 (top of head of vertical reboiler of cracking still)	Petrochemical (distillation)	F	435	3.5	—	..	0.1	0.002	...	...	...
phenol, hydrochloric acid 0.26%	Chemical	L	378	1	—	—	0.037	0.023	...	...	...
phenol, hydrocarbon alkylation, phosphorus trichloride 1%, boron trifluoride 0.7%, hydrochloric acid, possibly hydrofluoric acid liberated	Chemical (alkylation)	F	175	12	—	x	...	0.0008 S0.0015	...	0.0007	0.0009
pure phenol, sulfur 0.5% as butyl disulfide	Chemical	L	590	1	—	—	0.002	0.001	...	...	...
phenol, amyl phenol, some sulfuric acid, amylene (vapors, liquid)	Chemical	F	113	25	—	xx	0.0288 0.0004a	0.0055 <0.0001	...	...	...
phenol, amyl phenol, some sulfuric acid, amylene, sulfurous acid (digester, vapors, liquid)	Chemical	F	230	17	—	—	0.0191r 0.153	0.0124ar 0.0506	...	...	...
10% phenolic water, chlorides 1320 ppm (tower, vapors, liquid)	Petroleum	F	220	43	..	..	0.0029 0.0117* 0.00184	0.0025 0.0168	...	...	...
10% phenolic water, chlorides 10-1320 ppm (tower, vapors)	Petroleum	F	220	71	—	xx	0.004*r 0.004r	0.004r	0.004r	...	...
phenol, acetone, cumene, sulfur dioxide 100 ppm (decomposer drum bottom)	Chemical	F	150	217	—	xx	0.0001	<0.0001	...	<0.0001	<0.0001
phenol, acetone, cumene, sulfur dioxide 100 ppm (decomposer drum)	Chemical	F	150	16	..	xx	0.0003	0.00015	...	0.00014	...
phenol, cumene, α-methyl styrene, water, neutral or very mildly acid (bottom of column)	Chemical (distillation)	F	304	109	—	x	<0.0001	<0.0001	...	<0.0001	...
phenol, cumene, α-methyl styrene, water, neutral or very mildly acid (bottom of column)	Chemical (distillation)	F	304	52	—	x	<0.0001	<0.0001	...	0.00014	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
phenol, α-methyl styrene, acetophenone, cumene trace, neutral or very mildly acid (bottom of column)	Chemical (fractionation)	F	304	54	—	x	<0.0001	<0.0001	...	<0.0001	...
phenol, α-methyl styrene, acetophenone, cumene trace, neutral or very mildly acid (bottom of column)	Chemical (fractionation)	F	304	40	..	..	<0.0001	0.0001	...	<0.0001	...
PHENOLPHTHALEIN											
phthalic anhydride, phenol, zinc chloride, small amount sulfuric acid (vapors, liquid)	Pharmaceutical	F	214	28	—	x	0.11 0.0047	0.027 0.0057	...	C0.017 0.0048	...
PHENYLACETIC ACID											
phenylacetic acid, some chlorides, possibly other organics	Chemical	L	390	18	..	..	0.033	0.024	...	...	...
(DI-) PHENYL AMINE											
molten mixture of diphenylamine 3 parts, sulfur 1 part, iodine 0.5% approximately, to form phenathiazine and hydrogen-sulfide gas	Coal By-product	F	212-221	14	—	xx	0.064	0.0004	...	...	...
PHENYLARSINE											
92% approximately diphenylarsine, triphenylarsine 8%, some tar	Chemical (distillation)	L	240-260	1	—	xx	0.0018	0.0009	...	...	...
81% approximately phenyldichlorarsine, diphenylarsine 17.5%, triphenylarsine 1.5%, some tar	Chemical (distillation)	L	180-185	1	—	xx	0.0039	0.0067	...	...	...
55% phenyldichlorarsine, arsenic trichloride 32%, diphenylarsine 12%, triphenylarsine 1%, some tar	Chemical (distillation)	L	195-202	1	—	xx	0.0178	0.0018	...	...	...
mixture of arsenic trichloride, phenyldichlorarsine, diphenylarsine, triphenylarsine, some tar	Chemical (distillation)	L	195-520	3.3	—	xx	0.0012	0.0009	...	...	...
(DI-) PHENYL CARBONATE											
88%, phenol 11%, aluminum chloride complex 1%	Chemical	L	380	7	—	x	0.182* 0.196*	0.087 0.089	...	...	...
(TRI-) PHENYL PHOSPHITE											
triphenyl phosphite, technical	Rubber	F	75-85	10	x	x	0.0001	0.0001	0.0001	...	...
PHOSPHORIC ACID											
117%	Research	L	450-485	...	..	..	0.98	0.18	...	...	...
106.1-103.6% superphosphoric acid	Research	L	220	...	..	..	0.13	0.0005	...	C0.0001	...
92% plant phosphoric acid	Research	L	358	>6	xx	xx	corr	corr	...	...	...
92% plant phosphoric acid	Research	L	358	>6	--	xx	corr	corr	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Phosphoric acid											
90% plant phosphoric acid	Research	L	260	>6	xx	xx	0.015	...	0.01	...	...
90%	Research	L	210	...	..	..	...	C0.02 C0.05	...	...	...
90%	Research	L	280	...	xx	..	0.015	0.024	...	...	...
87-82.2%, impurities, lower oxides of phosphorus	Chemical	F	190-215	5	xx	xx	0.579	0.021	..	0.005	...
87-82%	Research	F	190-215	...	..	..	0.58* NG	0.021	...	0.005	...
85%	Research	L	125	...	..	..	C0.05 C0.2	...	...	...	...
85%	Research	L	175	...	..	..	C0.05 C0.2	...	...	...	...
85%	Research	L	200	...	xx	..	0.0054	0.0012	...	...	...
85%	Research	L	208	...	xx	..	...	0.002	...	...	...
85%	Research	L	208	...	—	..	...	0.28	...	...	...
85%	Research	L	235	...	xx	..	...	0.005 0.003	...	...	...
85%	Research	L	235	...	—	..	...	0.05 0.023	...	...	...
85%	Research	L	255	...	xx	..	...	0.013 0.01 0.018	...	...	...
85%	Research	L	255	...	—	..	...	0.11 0.14 0.093	...	...	...
85%	Research	L	280	...	xx	..	...	0.012 0.025 0.1	...	...	...
85%	Research	L	280	...	—	..	...	0.3 0.4 0.24	...	...	...
85%	Research	L	300	...	xx	..	...	0.12 0.27	...	...	...
85%	Research	L	300	...	—	..	...	0.3 0.29	..	...	...
85%	Research	L	320	...	..	..	...	0.5	...	...	...
85%	Research	L	325	...	..	..	...	C>0.2	...	...	...
85%	Research	L	245-410	...	..	..	...	C>0.2	...	...	...
85%	Research	L	B.P.	...	—	—	1.17 85.5 68.2	33.6	...	...	...
85% plant phosphoric acid	Research	L	208	...	xx	..	...	0.001 0.002	...	...	...
85% plant phosphoric acid	Research	L	208	...	—	..	...	0.004 0.005	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Phosphoric acid											
85% plant phosphoric acid	Research	L	235	...	xx	..	...	0.004 0.008	...	...	...
85% plant phosphoric acid	Research	L	235	...	—	..	...	0.018	...	...	...
85% plant phosphoric acid	Research	L	255	...	xx	..	...	0.015 0.03	...	...	...
85% plant phosphoric acid	Research	L	255	...	—	..	...	0.051 0.11	...	...	...
85% plant phosphoric acid	Research	L	280	...	xx	..	...	0.07 0.12	...	...	...
85% plant phosphoric acid	Research	L	280	...	—	..	...	0.24 0.47	...	...	...
85% plant phosphoric acid	Research	L	300	...	xx	..	...	0.063 0.12	...	...	...
85% plant phosphoric acid	Research	L	300	...	—	..	...	0.3	...	...	...
85%, chlorides, sulfates, nitrates, traces of lead, iron and arsenic	Petroleum	F	430	167	..	..	0.0181	0.007	...	...	...
85%, chlorides, sulfates, nitrates, traces of lead, iron and arsenic	Petroleum	F	430	121	..	..	0.0187 0.0007 0.0029d 0.0015	0.0028d 0.0006 0.0014	...	...	...
85%, chlorides, sulfates, nitrates, traces of lead, iron and arsenic	Peroleum	F	430	117	..	..	0.0008 0.0065 0.0033b	0.0005 0.0034 0.0013a	...	...	...
85%, chlorides, sulfates, nitrates, traces of lead, iron and arsenic	Petroleum	F	430	46	..	..	0.0261a	0.0074a	...	...	...
85-78%	Research	L	R.T.	...	..	..	0.0001	0.0001	...	...	...
85-78%	Research	L	220-240	...	..	..	0.23	0.005	...	0.0092	0.01c
84%	Research	L	320	...	..	..	C>0.2	...	...	...	...
82%, pressure	Research	L	235	...	..	..	...	C0.02 C0.05	...	...	...
82%, pressure	Research	L	290	...	..	..	...	C0.05 C0.2	...	...	...
80%	Chemical	L	R.T.	...	x	..	<0.0001	0.0001	<0.0001	...	...
80%	Research	L	75	...	..	..	C0.05 C0.2	...	...	...	...
80%	Chemical	L	175	...	x	..	<0.0001	0.0006	...	...	...
80%	Research	L	255	...	..	..	C0.05 C0.2	...	...	...	...
80% plant phosphoric acid	Research	L	150	>6	—	xx	0.0009	<0.0001	...	...	...
80% plant phosphoric acid	Research	L	200	>6	—	xx	0.0002	0.0004	...	...	...
80% plant phosphoric acid	Research	L	200	>6	xx	xx	...	0.0032	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Phosphoric acid											
80% plant phosphoric acid	Research	L	200	...	xx	..	...	0.0033	...	...	...
80% plant phosphoric acid	Research	L	200	...	—	..	...	0.0004	...	...	...
80% plant phosphoric acid	Research	L	240	>6	xx	xx	<0.004	...	...	...	...
80% plant phosphoric acid	Research	L	294	>6	xx	xx	NG	NG	...	...	...
80-75%	Research	L	167	...	..	..	0.0006*	0.0035	...	...	...
80-70%, small amount of fluorine compounds	Research	L	185-212	...	..	..	0.66*	0.112	...	...	...
80-10%	Research	L	75-210	...	..	..	...	C0.005 C0.02	...	..	...
75%	Chemical	F	122	60	xx	—	...	0.0005c S0.0002a	0.0001a 0.0002a	0.0001	...
75% (top of absorber)	Chemical	F	153	328	xx	x	0.0001	0.0001	0.0001	C0.0001	...
75%	Chemical	F	158	23	..	xx	0.096	0.0005 W0.0004	0.0003	0.0001	...
75%	Chemical	F	158	39	..	xx	...	0.0004	0.0002	...	...
75%	Chemical	L	158	45	..	xx	corr	0.0003 W0.0005	0.0007	nil	...
75%	Chemical	L	159	13	..	—	...	0.0016 W0.0023 L0.0024 WL0.0022	...	...	...
75%	Chemical	L	171	12	..	xx	...	0.0032 L0.0005	0.0034	C0.0002	...
75%	Chemical	L	175	13	..	—	...	0.0088 W0.0033 L0.0106 WL0.0079	...	...	...
75%	Chemical	L	175	21	..	xx	...	0.0026 W0.0023 L0.0003 WL0.0004	...	...	...
75%	Chemical	L	190	12	..	xx	...	0.0006 L0.0021	0.0013	C0.0003	...
75%	Chemical	L	199	>6	..	xx	...	W0.0083 WL0.0056	...	...	...
75%	Chemical	L	210	12	..	xx	...	0.0031 L0.0301	0.0188	C0.0074	...
75%, pressure	Research	L	310	...	..	..	...	C>0.2	...	...	...
75%, pressure	Research	L	240-435	...	..	..	C>0.2	...	...	...	...
75% commercial phosphoric acid	Chemical	F	172	...	..	..	...	<0.001 W<0.001	<0.001	<0.001	<0.001
75% commercial phosphoric acid	Chemical	F	194	...	..	..	...	0.0015 W0.0015	0.001 W0.001	<0.001	<0.001

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Phosphoric acid											
75% commercial phosphoric acid	Chemical	F	208	...	..	..	...	<0.001 W>0.001	<0.001 W0.0011	<0.001	<0.001
75% commercial phosphoric acid	Chemical	F	221	...	..	..	...	...	0.0007	0.0009	0.0013
75% approximately	Chemical	L	250	30	xx	xx	...	0.0074	0.0099	<0.0001	0.0039
70%	Research	L	255	...	..	..	C0.05 C0.2	...	...	...	...
70%	Research	L	B.P.	1.2	..	xx	...	0.022 0.42 S0.42	...	...	...
70%	Research	L	B.P.	1	..	xx	1.5	0.78	...	...	...
70% plant phosphoric acid	Research	L	260	>6	x	xx	<4.45	<0.98	...	...	...
65%	Chemical	L	R.T.	...	x	..	<0.0001	0.00013	<0.0001	...	...
65%	Chemical	L	175	...	x	..	<0.0001	0.00068	<0.0001	...	...
60%	Research	L	175	...	..	..	C0.005 C0.02	...	...	...	...
60%	Research	L	200	...	..	..	...	0.003	...	...	...
60%	Research	L	245	...	..	..	C0.05 C0.2	...	...	...	...
60%	Research	L	245	...	..	..	...	C0.005 C0.02	...	...	...
60%	Research	L	B.P.	1	..	xx	0.012	0.022	...	...	...
60% plant phosphoric acid	Research	L	200	...	xx	..	...	0.003	...	...	...
60% plant phosphoric acid	Research	L	200	...	—	..	...	0.001	...	...	...
50%	Research	L	R.T.	...	x	..	<0.0001	<0.0001	<0.0001	...	...
50%	Research	L	175	...	x	..	<0.0001	0.00041	0.00044	...	...
50%	Research	L	240	...	..	..	C0.02 C0.05	...	...	...	...
50%	Research	L	B.P.	1	..	xx	0.0071	0.0071	...	...	...
50-10%	Research	L	125- 210	...	..	..	C0.005 C0.02	...	...	...	...
50-5%	Research	L	75	...	..	..	C0.005 C0.02	...	...	...	...
45%	Agriculture (fertilizer)	F	170	46	x	xx	...	0.0027ad	...	0.0009	0.0007
40%	Research	L	200	...	xx	..	...	0.006	...	...	...
40%	Research	L	200	...	—	..	...	0.001	...	...	...
40%	Research	L	B.P.	1	..	..	0.0031	0.0051	...	...	...
40% plant phosphoric acid	Research	L	200	...	xx	..	...	0.0004	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Phosphoric acid											
40% plant phosphoric acid	Research	L	200	...	—	..	...	0.002	...	...	...
35%	Research	L	R.T.	...	x	..	<0.0001	<0.0001	<0.0001	...	...
35%	Research	L	175	...	x	..	<0.0001	0.0008	0.0002	...	...
30%	Research	L	217	...	..	..	CS0.008	CS0.003	...	...	...
30%, pressure	Research	L	230-390	...	..	..	C0.2 C>0.2	...	...	...	...
30%, pressure	Research	L	235	...	..	..	...	C0.02 C0.05	...	...	...
30%, pressure	Research	L	280	...	..	..	...	C0.05 C0.2	...	...	...
30%, pressure	Research	L	300	...	..	..	...	C>0.2	...	...	...
30%, pressure	Research	L	B.P.	1	..	..	0.0019	0.001	...	...	...
22%, pickling solution	Metal (cleaning)	F	190	12	—	..	0.0001	0.0001 W0.0001	0.00013	0.0004	...
20%	Research	L	200	...	xx	..	...	0.0002	...	...	...
20%	Research	L	200	...	—	..	...	0.001	...	...	...
20%	Research	L	B.P.	1	..	xx	0.0004	0.0004	...	...	...
20% plant phosphoric acid	Research	L	200	...	xx	..	...	0.0002	...	...	...
20% plant phosphoric acid	Research	L	200	...	—	..	...	0.002	...	...	...
10%	Chemical	L	R.T.	...	x	..	<0.0001	<0.0001	nil	...	...
10%	Research	L	125-210	...	..	..	...	C0.005 C0.02	...	...	...
10%	Research	L	175	...	x	..	0.00012	<0.0001	0.00012	...	...
10%	Research	L	B.P.	1	..	xx	<0.0004	<0.0004	...	...	...
3.3%	Research	L	77	1	..	..	0.0002	...	...	...	...
3.3%	Research	L	77	70	..	..	<0.0001	...	...	...	...
<1%	Research	L	80-100	...	..	..	0.001* 0.0002	nil	...	...	...
PHOSPHORIC-ACID MIXTURES											
95-85%, small amounts of fluorine compounds	Research	L	212-239	...	..	..	0.045*	0.036	...	...	...
95-85%, small amounts of fluorine compounds	Research	L	165-185	...	..	..	0.0028*	0.0032	...	...	...
81%, water 16%, nitric acid 3%	Metal	F	190	89	x	—	0.0041 S>0.063	0.003 S>0.099 L0.0041	0.0024	0.0011	0.0032 S0.027
80-70%, small amounts of fluorine compounds	Research	L	203-230	...	..	..	0.0096	0.007	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Phosphoric acid mixtures											
70%, electric-furnace technical grade	Chemical	F	75	310	x	x	<0.0001 S0.015 L<0.0001	<0.0001	...	...	...
56.2%, non-ionic detergent 10%, amine-type inhibitor 2%, water, pH 0.2	Soap	F	72	90	—	xx	<0.0001	<0.0001	...	0.0002	<0.0001
50-45%, fluosilicic acid 2-4%, some suspended gypsum (rotating filter drum)	Chemical	F	176	...	xx	..	0.0001	0.0004	0.0002	...	...
43%, "Phoscaloid," vegetable protein material 8-10%	Water Treatment	L	130	1	—	xx	0.837	0.0018	...	...	...
43%, "Phoscaloid," vegetable material 8-10%	Water Treatment	L	130	1	xx	xx	0.0017	0.0004	...	...	...
43%, "Phoscaloid," vegetable material 8-10%	Water Treatment	L	130	2.8	—	xx	0.291	0.001	...	...	...
40%, sulfuric acid 5%, "Acitrol" inhibitor 0.05%, "Santomerse" wetting agent 0.25% (top of Permutit "Q" regenerating column)	Metal (cleaning)	F	120	62	—	x	<0.0001	<0.0001	<0.0001	<0.0001	...
40%, sulfuric acid 5%, "Acitrol" inhibitor 0.05%, "Santomerse" wetting agent 0.25%	Metal (cleaning)	F	200	62	—	xx	<0.0001	0.0001	0.0002	0.0004	...
33.5-33%, fluosilicic acid 3-3.5% (thickener)	Chemical	F	170	33	—	xx	0.0068cd	0.0016	0.0009	...	...
31.41%, calcium sulfate hydrate and silica 30%, sulfuric acid 1.64%, fluosilicic acid 1.46%, hydrofluoric acid 0.12% (filter)	Chemical	F	127	8.4	..	—	<0.0001 0.0001 S0.0386	<0.0001 L0.0001 LS0.0325	...	...	...
30.75%, water 25%, iodine 3.85%, non-ionic detergent remainder	Soap	F	72	90	—	xx	<0.0001	<0.0001	...	<0.0001	<0.0001
22%, and back wash and regeneration with sulfuric acid 30% (Permutit unit)	Metal (cleaning)	F	190-210	63	xx	..	<0.0001	<0.0001 W0.0001	<0.0001	0.0001	...
22%, pickling solution	Metal (pickling)	F	195	61	—	x	<0.0001	<0.0001	0.00013	0.0002	...
18%, "Deoxidrine No. 171" solution	Metal (treating)	F	75-150	60	—	—	<0.0001	<0.0001	...	...	...
16%, water 66.6%, non-ionic detergent 15.75%, iodine 1.75%	Soap	F	73	90	—	—	<0.0001	<0.0001	...	<0.0001	<0.0001
15-10%, 4-hydroxy 3-methyl 2-butanone 15%, polymer 5%, methyl-isopropyl ketone 3%, formaldehyde 1%, water remainder	Chemical	F	230	61	—	x	0.0004	0.0001	0.00012	0.0225	...
15-2%, water 65%, organics remainder	Chemical	..	200	...	—	..	...	0.001	0.0005	0.0009	0.0012
14.5%, nitric acid 0.381%, pH 0.62	Agriculture (fertilizer)	F	158	32	x	xx	0.0001	0.0001	0.0001	0.0001 C0.0001	0.0001
10%, water, mesityl oxide	Rayon	F	216	149	—	—	0.0001	0.0001	...	...	...
10%, water, mesityl oxide, diacetone alcohol	Rayon	F	221	149	—	—	...	0.012d	...	...	...
10%, water, mesityl oxide, diacetone alcohol	Rayon	F	216	181	—	xx	0.00022	0.00043	...	...	...
10%, water, mesityl oxide, diacetone alcohol	Rayon	F	216	149	—	—	0.003	0.0007	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Phosphoric-acid mixtures											
4-2%, solids 15%, gypsum slurry, sulfuric acid 1%, soluble fluorine compounds 0.2%, pH 1.9 (pump box)	Chemical	F	90	90	xx	xx	<0.0001	<0.0001	...	C<0.0001	...
3.86%, fluosilicic acid 0.15%, fluorine 0.38%, water, pH 1.2	Chemical	F	123-168	65	—	—	0.003*cd	0.002cd	...	...	...
2.9%, water containing a sludge	Chemical	F	133	13	—	x	0.0004	0.0002 W0.0001	...	...	...
1%, sugar 5%, pressure 160 psi	Research	L	363	...	—	..	0.0009	0.0003	...	...	...
1% approximately, "Granodine," small amount of oxidizing agent	Metal (treating)	F	165	60	—	—	<0.0001	<0.0001	...	...	...
<1%, small amount of phosphorous acid	Research	L	150	...	..	..	0.002 0.003*	0.0031	...	...	...
<1%, acid from weak acid sump, pH 1 approximately	Research	L	80-100	>6	—	xx	0.00015	nil	...	...	...
0.5%, phosphoric-acid-type catalyst, organics	Chemical	F	R.T.-600	14	—	xx	0.017	0.02 0.018	...	0.032	0.046
vapors containing phosphorus pentoxide 0.07% approximately, oxygen 7-15%, fluorine 264 ppm approximately	Research	L	129-237	...	..	xx	0.19	0.0037	...	0.006	...
PHOSPHOROUS ACID											
2.7% approximately	Research	L	78	70	..	..	<0.0001	...	...	...	...
PHOSPHORUS											
phosphorus	Research	L	149-158	...	..	..	0.0001*	0.0001	...	...	...
phosphorus	Chemical	F	140	185	x	—	<0.0001	<0.0001	...	...	...
phosphorus, water, hydrogen, phosphine, hydrocarbon, traces of carbon dioxide and carbon monoxide, pH 3-6 (vapors, liquid)	Chemical (distillation)	F	176	112	x	xx	0.0031	0.0029	0.0025	C0.0028	0.0024
buffered "phossy" water or tap water, small particles of phosphorus, adjusted with soda ash to pH 9	Chemical	F	140	185	x	—	<0.0001	<0.0001	...	...	...
gas stream of phosphorus condenser, carbon monoxide 90%, nitrogen 8%, carbon dioxide 2%, small amounts phosphoric acid, phosphine, hydrogen sulfide and fluosilicic acid	Chemical	F	150-175	56	—	xx	0.021	0.0023	...	...	...
PHOSPHORUS OXYCHLORIDE											
phosphorus oxychloride and triethyl phosphate to form tetraethyl pyrophosphate and ethyl-chloride gas	Chemical	F	300	2	xx	xx	0.0085 0.0085*	0.0081	...	...	...
PHOSPHOTUNGSTIC ACID											
phosphotungstic acid and hydrochloric acid, pH 1.5	Pharmaceutical	F	54	4.6	—	x	0.0005ad	0.0003d	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
phosphotungstic acid and phosphomolybdic acid used in precipitation of basic dyes	Pigment	F	55-205	60	..	x	0.0001ad	<0.0001	...	...	...
phosphotungstic acid, slurried with water, and adjusted with hot barium hydroxide to pH 8-12	Pharmaceutical	F	77	8	—	x	0.0002	<0.0001	...	...	...
PHOTOGRAPHIC SOLUTIONS											
photographic film dope, ethylene and propylene chlorides, acetone, alcohol	Photographic	F	...	37	..	..	0.0001	0.0001	...	...	...
film sensitizing solution, organic and inorganic acids, solvents, salts and dye components together 10%, pH 1	Chemical	F	85	16	—	—	0.162a	0.0021d	...	0.034cd	...
PHTHALIC ACID											
7% phthalic-acid vapor, water vapor	Chemical	F	356	40	..	xx	0.2843 S0.1523	nil S0.0004	...	0.0007 C0.0001	...
phthalic acid, xylene, phthalide, toluic acid <0.2%, water 98%	Rayon	F	200	44	—	xx	0.0005	0.0009	...	...	...
PHTHALIC ANHYDRIDE											
99%, benzoic and maleic acids impurities (vapors)	Chemical	F	536	25	x	xx	0.0001	<0.0001	0.0001	0.0002	0.0001
96-95%, benzoic and maleic acids impurities	Chemical	F	536	25	x	xx	0.0002	0.0002	0.0002	0.0002	0.0002
crude phthalic anhydride, small amounts of maleic acid and water (top of column, vapors)	Chemical (distillation)	F	410	45	—	xx	0.0393*	0.0007	0.0001	...	...
phthalic anyhdride (vapors)	Chemical	F	435-555	85	..	..	0.0092a	0.0006	<0.0001	...	...
crude phthalic anhydride (vapors)	Coal By-product	F	320 545	59	..	xx	0.0002	0.0002	0.0001	0.0001	...
phthalic anhydride, methyl "Cellosolve," dimethoxy ethyl phthalate	Chemical	F	284	221	x	x	0.0085	0.0054	0.0032	0.0028	0.0014
liquid phthalic anyhdride, phthalic acid, water, small amounts of maleic acid, maleic anhydride, benzoic acid, naphtha quinones	Chemical (distillation)	F	329-518	70	—	—	>0.25	0.25	0.002d	...	0.008a
POTASSIUM BROMIDE											
75%, potassium bromate 25%, potassium hydroxide 1.5%, bromine, iron trace	Chemical	F	65	3.4	x	xx	0.0078b	0.0057a	...	...	...
saturated potassium-bromide solution, dissolved ammonia, pH 8-9.5 (filter)	Chemical	F	185	20	x	x	<0.0001	<0.0001	...	<0.0001	<0.0001
POTASSIUM CARBONATE											
17%, potassium bicarbonate 13%, chromate ion 2000 ppm, pressure 270 psig (top of carbon-dioxide absorber)	Petroleum	F	240	74	—	xx	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Potassium carbonate											
16%, potassium bicarbonate 14%, chromate ion 2000 ppm, pressure 8 psig (bottom of carbon-dioxide stripper)	Petroleum	F	240	74	—	xx	<0.0001	<0.0001	...	...	...
10%, potassium bicarbonate 14%, chromate 10 ppm (storage vessel feeding potassium hydroxide to absorber)	Chemical	F	230	120	—	xx	<0.0001	<0.0001	...	...	...
5%, potassium bicarbonate 21%, stripped carbon-dioxide gas, water remainder (venting off stripper)	Chemical	..	221	120	—	xx	<0.0001	<0.0001	...	...	...
4%, potassium bicarbonate 28%, chromate ion 2000 ppm, pressure 6 psig (top of carbon-dioxide stripper)	Petroleum	F	240	74	—	xx	0.0001	0.0001	...	...	...
POTASSIUM CHLORATE											
<30%, potassium-chlorate slurry, sodium chlorate 400-600 g/l, potassium chloride 20-500 g/l, sodium chloride 30-250 g/l, sodium bichromate 2-14 g/l, pH 5.3-8.7	Chemical	F	122	132	—	x	...	0.0001a	...	0.0001	0.0001
POTASSIUM CHLORIDE											
31.5%, sodium sulfate 0.5%, sodium chloride 0.05%, lead, copper, starch trace, pH 9-10 (Dorr clariflocculator, overflow weir)	Chemical	F	180	65	x	x	0.0002c	0.0002	...	...	...
28%, saturated solution, potassium hydroxide 2-7 g/l, potassium sulfate 2-3 g/l, potassium carbonate 1 g/l, calcium 3.5 ppm, specific gravity 1.18, pH 13.5	Chemical	F	150	215	x	x	<0.0001ad	<0.0001a	...	C<0.0001	...
25%, copper trace	Chemical	F	70	64	x	xx	0.0002b	<0.0001	...	...	...
25% approximately, potassium ion 13.95%, chloride ion 13.49%, sodium ion 0.59%, sulfate ion 0.5%, ferric oxide 0.29%, calcium ion 0.07%, copper powder trace, amine acetate 210 ppm	Chemical	F	122	29	xx	xx	0.0003d	<0.0001d	...	...	...
POTASSIUM CHROMIC SULFATE											
45% potassium-chrome-alum solution, free sulfuric acid 5% approximately	Chemical	F	50-122	46	—	—	0.057c	<0.0001	...	C<0.0001	...
POTASSIUM DICHROMATE											
9%, pH 5.8-6.1	Metal	F	190-212	45	—	x	<0.0001d	<0.0001	...	<0.0001 C<0.0001	...
POTASSIUM HYDROXIDE											
92-90%	Chemical	F	716	4	..	xx	0.35	0.25	...	C0.092	...
80% approximately	Chemical	F	B.P.	4	..	—	0.1	0.008	...	0.02	...
50% approximately	Chemical	F	B.P.	3	..	xx	0.13	0.12	...	0.15	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Potassium hydroxide											
50%, sodium hydroxide 50%	Chemical	F	<200	30	—	—	<0.0001	<0.0001	...	...	...
32.4%, sodium hydroxide 21.6%, ammonium hydroxide 3% approximately (evaporator)	Chemical	F	248	60	—	xx	0.0228 0.0222	0.0295 0.0292	...	...	...
25.2%, potassium isobutyrate 37.8%, potassium sulfide 5.5%, potassium carbonate 2.1%, potassium mercaptides 1.9% (reboiler)	Petroleum	F	282-290	140	—	xx	corr corr*	...	...	...	...
20%, isopropanol solution of hexachlorocyclopentadiene	Chemical	F	176	146	x	xx	0.0002*a	0.0002	...	...	...
20%, isopropanol solution of hexachlorocyclopentadiene	Chemical	F	176	90	x	x	0.0001	0.0001	...	...	...
20%, isopropanol solution of hexachloropentadiene (vapors)	Chemical	F	202	18	x	—	0.0004*a	0.0003a	...	...	...
20%, isopropanol solution of hexachloropentadiene	Chemical	F	202	19	x	xx	0.0009*a	0.0007a	...	...	...
11.2%, alkyl phenolate 28%, potassium isobutyrate 19%, sulfide 0.8%, mercaptans 0.4% (bottom of "solutizer" regenerator tower)	Petroleum	F	360-380	276	x	xx	0.0023ad 0.0024*ad	0.0041ad	...	...	...
POTASSIUM PERCHLORATE											
<30%, potassium-perchlorate slurry, sodium perchlorate 600-900 g/l, potassium chloride 0-500 g/l, sodium chloride 0-250 g/l, sodium chlorate 6-24 g/l, sodium dichromate 2-8 g/l, pH 8.7-5.3	Chemical	F	122	132	xx	xx	...	0.0001	...	0.0001	0.0001
POTASSIUM PERSULFATE											
8.7% approximately saturated solution, pH 1.9 initially, 2.1-2.3 finally	Rubber	L	100	1	—	xx	0.0015	nil	...	...	...
5.1%, pH 3	Synthetic Rubber	L	R.T.	5	x	x	0.00035	0.0001	...	...	...
5%	Rubber	L	76	25	—	xx	<0.0001	<0.0001	...	...	...
5%	Synthetic Rubber	L	85-100	2	—	—	nil nil*	<0.0001	...	...	...
4.8%, pH 3	Synthetic Rubber	F	90	13	—	—	nil nil*	nil	...	...	...
4%	Synthetic Rubber	F	R.T.	42	—	x	<0.0001	<0.0001	...	...	...
4%	Chemical	F	80	61	x	x	<0.0001	<0.0001	...	...	...
PROPANE											
propane, fatty acids	Soap	F	R.T.	365	—	—	0.0001	...	...	...	...
propane, free sulfur dioxide, sulfurous acid (vapors)	Petroleum	F	110	262	—	xx	0.0001	0.0001	...	0.0001	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
PROPIOLACTONE											
100% β-propiolactone	Rayon	F	176	200	—	xx	L0.0003	0.0001 L0.0001	...	...	...
85% β-propiolactone, acetic anhydride 13%, dioxymethylene diacetate 2.3%, aluminum chloride and zinc chloride together 0.2%, formaldehyde trace	Rayon	F	95	200	—	x	L.0002	0.0001 L0.0002	...	...	...
PROPIONIC ACID											
100%	Rayon	F	293	200	—	xx	0.038	0.012	...	...	...
99.5%, butyric acid 0.3%, acetic acid 0.2% during 219 days; and propionic acid 0.5%, butyric acid 99.5% during 31 days	Chemical	F	120	250	—	—	0.0005	<0.0001	<0.0001	...	...
99%, sulfuric acid 1%	Chemical	F	280	10	x	x	0.02	0.0043	0.005	...	...
99%, sulfuric acid 1%	Chemical	F	282	12	..	x	0.073a	0.011	0.014	...	...
98%, sulfuric acid 1%, butyric acid 0.5%, decomposition products 0.5%, during 12 days; and diversified operation during 613 days	Chemical	F	302	625	..	x	0.0078c	0.0013	0.0004	...	...
96.2%, acetic acid 3.4%, water 0.1%, iron ion 35-2500 ppm, copper ion 5-30 ppm	Chemical	F	291	50	..	..	0.0034	0.0016	...	...	...
96.2%, water 0.1%, manganous acetate 10 lb/24 hours, iron ion 35-2500 ppm, copper ion 5-30 ppm	Chemical	F	291	34	..	x	0.0011ar	0.0006	...	...	...
95%, acetic acid 5% during 200 days; 100% propionic acid during 46 days	Rayon	F	292	246	—	xx	...	0.0014	0.0003	C0.003	...
95%, butyric acid 2%, remainder unknown	Chemical	F	284-329	125	..	xx	0.047	0.0024	0.0012	...	...
94%, sulfuric acid 5%, butyric acid 0.5%, decomposition products 0.5%	Chemical	F	302	12	..	x	0.0007	0.00027	0.00019	...	...
93%, acetic acid 5%, esters 2% during 155 days; and acetic acid 97%, water 2%, formic acid 1% during 38 days	Chemical	F	233-284	193	..	xx	0.006	0.0007	<0.0001	...	...
89-86.5, acetic acid 11-14%, water, traces of copper and iron ions	Chemical	F	288	47	..	xx	0.01 0.003	0.006 0.0001	... nil	...	...
86%, domestic water 10%, butyric acid 3%, higher esters 1% during 213 days; propionic acid 75%, butyric acid 15%, acetic acid 5%, higher esters 5% during 127 days; and propionic acid 85%, acetic acid 6%, higher esters 6% during 85 days	Chemical	F	212-340	425	—	x	0.0086b	0.0013	0.0008	...	...
83%, butyric acid 12%, sulfuric acid 5%	Chemical	F	280	10	x	x	0.045	0.003	0.0035	...	...
83%, butyric acid 12%, sulfuric acid 5% during 7.4 days; butyric acid 83%, propionic acid 12%, sulfuric acid 5% during 7.4 days; propionic acid 80%, acetic acid 10%, nitric acid 10% during 3.2 days	Chemical	F	252-286	18	..	x	0.16	0.011	0.0047	...	...
80%, butyric acid 10%, sulfuric acid 10% during 7.4 days; butyric acid 80%, propionic acid 10%, sulfuric acid 10% during 7.4 days; and propionic acid 70%, acetic acid 10%, nitric acid 10%, unknown 10% during 3.2 days	Chemical	F	228-275	18	..	x	0.16	0.021	0.0045	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Propionic acid											
80%, sulfuric acid 10%, decomposition products 10% during 7.4 days; butyric acid 80%, sulfuric acid 10%, decomposition products 10% during 7.4 days; and propionic acid 80%, sulfuric acid 10%, nitric acid 5%, unknown 5% during 3.2 days	Chemical	F	310-320	18	..	x	0.12	0.012	0.005	...	...
75%, propionic anhydride 13%, acetic acid 12%, and propionic anhydride 98%, acetic anhydride and impurities together 2%	Chemical	F	275-338	36	..	..	0.025r	0.005r	0.004	...	...
70%, glycol esters 16.5%, butyric acid 12%, acetic acid 1.5%	Chemical	F	314	566	—	x	0.017	0.0046a	0.003	...	...
66%, isobutyric acid 17%, *n*-butyric acid 17%, small amounts of acetic acid, non-volatile 300-400 mg/l	Chemical	F	300	21	—	xx	0.012	0.007	0.005	0.0035	...
65-60%, butyric acid 10-12%, acetic acid 4-7%, unknown remainder	Chemical		311	466	..	xx	0.027c	0.0061b	0.0039	...	...
50%, acetic acid 50%; propionic acid 54%, acetic acid 25%, water 20%, unknown 1%; and propionic acid 97%, acetic acid 3%	Chemical	F	212-284	125	..	xx	0.018a	0.0025	0.0009	...	...
50%, butyric acid 45%, heavy esters 5% during 155 days; and acetic acid 96%, non-volatiles 2%, propionic acid 1%, water 1% during 38 days	Chemical	F	251	193		xx	0.002	0.0007	0.0004	...	...
48%, butyric acid 13%, acetic acid 8%, nitric acid 2%, other higher acids remainder	Chemical	F	176-284	250	..	xx	0.006	0.001	...	...	...
9%, ethyl acetate 63%, benzene 21%, water 6%, acetic acid <1%	Chemical	F	199	25	..	xx	0.15	0.01	0.003	...	...
PROPIONIC ANHYDRIDE											
99.9%, impurities	Chemical	F	324	167	..	..	0.004r 0.006r	0.002r	0.001	...	...
99.8%	Chemical	F	347	50	..	..	0.002	0.0003	0.0002	...	...
99.8%	Chemical	F	347	93	..	..	0.003	0.0007	0.006	...	...
(ISO) PROPYL ALCOHOL											
25% isopropanol, water 57%, sodium chloride 18%, isopropyl chloride bubbled through solution, sodium hydroxide adjusted pH 10	Research	L	140	4.2	..	..	nil	nil	...	...	...
spent isopropanol, sugar solids 3%, small amounts of sulfur dioxide, hydrochloric acid, sodium tetraphosphate, pH 3.45	Food	F	100	37	x	—	0.0001	0.0001	...	...	...
(ISO) PROPYL CHLORIDE											
50% isopropyl chloride, water 50% (vapors)	Research	L	97	4.2	..	..	nil	nil	...	...	...
PROPYLENE GLYCOL											
100%	Chemical	F	260-270	51	—	xx	0.0004	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Propylene glycol											
90%, dipropylene glycol 8%, water 1%, sodium hydroxide 0.04%	Rayon	F	385	461	—	xx	0.0001	0.0001	...	...	...
85-80%, dipropylene glycol 15%, salts as sodium hydroxide and sodium formate 0-1%	Chemical	F	360	123	—	xx	<0.0001	<0.0001	...	...	...
66%, water 15%, unidentified organics remainder	Chemical	F	194-196	48	—	xx	0.0002	0.0001	...	...	...
30-20%, water 60-70%, methanol and methyl aldehyde 3%, formic acid 0-1%, pH 3-3.5	Chemical	F	300	51	—	xx	<0.0001	<0.0001	...	...	...
15%, dipropylene glycol 80%, solids as sodium formate, resins 5%	Chemical	F	360	51	—	xx	<0.0001	<0.0001	...	...	...
propylene glycol, formic acid, formic esters of propylene glycol, traces of acetals and water	Chemical	F	275	3.5	—	xx	0.023	0.02	...	...	...
PROPYLENE OXIDE											
90-85%, sodium hydroxide 3-6%, methanol and methyl aldehyde together 3-5%	Chemical	F	110-140	51	—	—	<0.0001	<0.0001	...	...	...
20-15%, water 75-80%, propylene glycol 0-10%, traces of formic acid and carbon dioxide	Chemical	F	360	51	—	xx	<0.0001	<0.0001	...	...	...
0.1%, formic acid 1%, propylene glycol 0.2%, water remainder, sodium hydroxide added	Rayon	F	218	462	—	x	0.0001	<0.0001	...	...	...
PRUNE PROCESSING WATER											
prune processing water, pH 3.8	Food	F	210	60	x	x	0.0001	0.0001	...	...	...
PYRIDINE											
50%, water 50%, traces of hydrochloric acid, methylene chloride and acetone (vapors)	Plastic (distillation)	F	200	61	—	xx	<0.0001	<0.0001	...	<0.0001	<0.0001
6%, sodium chloride 4-5%, methylene chloride 2%, water remainder (top of column)	Plastic (distillation)	F	100	52	—	xx	<0.0001	<0.0001	...	...	<0.0001
pyridine, water, acetone, methylene chloride (bottom of reboiler)	Plastic (distillation)	F	230	56	—	xx	0.0001	0.0001	...	<0.0001	<0.0001
PYRIDINE BASES											
pyridine bases from tar and carbolic oil (vapors, liquid)	Coal By-product (distillation)	L	176-212	...	...	...	0.025 0.079 L0.024 L0.072	0.008 0.05	...	...	...
PYRIDINE SULFATE											
pyridine sulfate, unrectified pyridine sulfate, condensate liquor, sulfuric acid, water	Coal By-product	F	123	197	x	xx	...	0.037	...	...	...
rectified pyridine sulfate, unrectified pyridine sulfate	Coal By-product	F	215	197	xx	xx	0.017c	0.014cd	...	...	...
unwashed pyridine sulfate, carbolic oil and sulfuric acid 15% (condensate)	Coal By-product	F	123	197	x	xx	0.0007cd	0.0003	...	0.0003	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
PYROLIGNEOUS ACID											
pyroligneous liquor vapors, pressure 125 psi	Turpentine (distillation)	F	<353	53	—	xx	<0.0001ad	<0.0001a	...	...	...
wood-distillation products, acetic acid, methanol, formic acid etc, pressure 100 psi	Chemical (distillation)	F	<335	27	—	x	0.00107	0.00029	...	...	...
12% **approximately** pyroligneous liquor, sulfuric acid 2%, pressure 30 psi	Chemical	F	275	14	—	—	0.00071	0.00063	...	...	...
pyroligneous liquor, sulfuric acid 10% approximately, pressure 100 psi	Chemical	F	<335	8	—	xx	0.0098	0.00558	...	...	...
pyroligneous liquor, sulfuric acid 10% approximately, pressure 100 psi	Chemical	F	<335	18	—	xx	0.045	0.0304	...	...	...
QUATERNARY AMMONIUM COMPOUND											
organic quaternary ammonium compound in methanol solution, possibly product of isonicotinate and carboxylic acid, pH 2-3	Chemical	F	195	4.2	—	xx	0.012	0.005	...	0.0015	...
QUEBRACHO EXTRACT											
condensate formed when mixing or bisulfiting quebracho extract with sodium bisulfite 3%; reaction frees sulfur dioxide and forms sulfurous acid with water vapors	Tanning	F	70-206	50	—	x	<0.0001	<0.0001	...	...	...
QUINOLINE											
coal tar base of quinoline type, carbon and diacradine impurities, pH 8-9	Chemical	F	110	185	..	..	0.0001	0.0001	...	...	...
RARE-EARTH CHLORIDE											
rare-earth-chloride solution, residue composed of sand, rare earth and thorium, free hydrochloric acid 0.04-0.2N	Chemical	F	105-122	15.6	x	xx	0.046*cd 0.087cd	0.04cd	...	C0.03cd	...
RARE-EARTH SULFATES											
rare-earth sulfate solution, sulfuric acid, phosphoric acid, acidity 0.9-1.1N, specific gravity 1.14-1.15	Chemical	F	R.T.	69	—	xx	<0.0001d	<0.0001d	...	C<0.0001	...
rare-earth sulfate crystals, sulfuric acid 25%, phosphoric acid 17%, considerable copper in solution	Chemical	F	50-70	4	—	xx	0.0002* 0.0004	0.0004	...	0.0004	...
rare earths, ceric, cerium, and sulfuric acids 0.5-0.8N, slurry containing sand and barium sulfate	Chemical	F	159	2.5	—	xx	0.29*d 0.19cd	0.31d	...	C0.2d	...
rare earths, ceric, cerium and sulfuric acids 0.5-0.8N, slurry containing sand and barium sulfate	Chemical	F	159	65	—	xx	0.012* 0.008	0.012	...	C0.008	...
rare-earth sulfate slurry, sulfuric acid 18-20%, phosphoric acid 16-17%	Chemical	F	55	23	x	xx	<0.0001	0.0001	...	C0.0003	...
rare-earth double-sulfate salts, sodium sulfate, phosphoric and sulfuric acids, acidity 1.4-2N	Chemical	F	113	7.5	—	xx	nil* 0.0004	0.0002	...	C0.0003	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
RAYON HARDENING BATH											
sulfuric acid 15-5% coagulating bath, sodium sulfate 15-25%, other inorganic salts 1-5%	Rayon	F	112-130	30	—	—	0.056c 0.037*c	0.016cd	...	...	...
sulfuric acid 13%, rayon mixed acid, sodium sulfate 24%, zinc sulfate 1.5%, small amount of hydrogen sulfide, water remainder	Rayon	F	112	149	—	—	0.0122*c	0.0106	0.0111	...	...
sulfuric acid 0.001-10%, dilute coagulating bath, carbon disulfide and hydrogen sulfide 0-500 ppm	Rayon	F	...	30	..	..	0.027 0.004* 0.041 0.02* 0.017 <0.0001*	0.0001 0.009 <0.0001d	...	...	...
sulfuric acid 0.002-0.005%, staple fiber drainage liquors, sodium sulfate 0.006-0.015%	Rayon	F	132-138	60	xx	x	<0.0001ad	<0.0001	<0.0001	...	...
sulfuric-acid vapors, water 93%, carbon disulfide 5%, air 2%, hydrogen sulfide 0.2%	Rayon	F	200	39	—	xx	0.0012cd	0.00014	<0.0001	...	...
acid vapors from hardening bath evaporator	Rayon	F	120	425	—	x	0.0029c 0.0033*c	0.004c	...	...	...
RAYON SIZING BATH											
rayon sizing bath, gelatine, vegetable oil, softeners, penetrants, glycerine	Rayon	F	155-160	68	—	x	<0.0001*ad <0.0001cd	<0.0001	...	...	...
rayon sizing bath, gelatine, vegetable oil, softeners, penetrants, glycerine	Rayon	F	160	208	—	x	<0.0001*d <0.0001ad	<0.0001	...	..	...
RAYON SPIN BATH											
viscose rayon spin bath (evaporator)	Rayon	F	170	78	xx	xx	...	...	0.084	0.027	0.03
sulfuric acid 10-12%, rayon spin bath, sodium sulfate 10-12%	Rayon	F	98	111	xx	xx	0.0002c 0.0001*	0.0011c	...	...	...
sulfuric acid 10-12%, rayon spin bath, sodium sulfate 20-22%, some zinc sulfate, some organics	Rayon	F	<120	30	x	x	0.0107cd 0.059*cd	0.0061ad	0.0061ad	...	...
sulfuric acid 11%, rayon spin bath, sodium sulfate 20.5%, zinc sulfate 0.8%, hydrogen sulfide 20 ppm approximately	Rayon	F	119	60	—	—	0.0131c 0.0001	0.0001 0.02	...	C0.0002c C0.0002	...
sulfuric acid 8.7%, rayon spin bath	Rayon	L	78	26	..	—	0.00035a	<0.0001	...	...	...
sulfuric acid 8%, rayon spin bath, water 71%, sodium sulfate 14%, glucose 6%, zinc sulfate 1%, traces of hydrogen sulfide and carbon disulfide	Rayon	F	105	35	xx	x	0.011cd	0.009d	...	...	...
sulfuric acid 7-8%, rayon spin bath, sodium sulfate 13-15%, some zinc sulfate and organics	Rayon	F	<112	30	x	x	0.0062*cd 0.0062cd	0.0035ad	0.0035d	...	...
sulfuric acid 7.25%, backchannel liquor, sodium sulfate 18-19%, zinc sulfate 0.75%, specific gravity 1.22 at 30 C	Rayon	F	104-113	60	x	—	0.0076*cd	0.0005	...	...	...
sulfuric acid 1-3% approximately, stretch water from rayon spinning machine	Rayon	F	167-194	20	—	—	0.05cd	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Rayon spin bath											
sulfuric acid 0.25%, spent rayon spin bath, sodium sulfate 0.25%	Rayon	F	180	102	xx	xx	. . .d	<0.0001d	. . .	. . .	. . .
sulfuric acid 0.25%, spent rayon spin bath, sodium sulfate	Rayon	F	200	111	xx	xx	0.0001 0.0001*	0.0001	. . .	. . .	. . .
rayon spin-bath drippings	Rayon	F	119	40	xx	—	0.0238*cd 0.0320*bd	0.0168 0.0025 0.0195 0.0026 0.0176 0.0023	0.0004 <0.0001	0.0028 0.0191	. . .
rayon spin-bath drippings	Rayon	F	105	78	xx	. .	0.0201*	. . .	0.00025a	. . .	. . .
spin-bath atmosphere, hydrogen sulfide, and spin-bath drippings	Rayon	F	117	40	. .	xx	0.0363d	. . .	0.0136a	. . .	. . .
fumes from rayon spin bath, sulfuric acid, carbon disulfide, hydrogen sulfide	Rayon	F	R.T.	30	. .	. .	0.001a 0.005*c 0.005*b	0.001 0.0014	. . .	C0.0001 C0.0003	. . .
acid bath fumes, carbon disulfide and hydrogen sulfide	Rayon	F	R.T.	30	xx	. .	0.005 0.005*	0.0006	. . .	. . .	. . .
rayon spin bath fumes	Rayon	F	160	111	xx	xx	0.0001c 0.0001*	0.0001	. . .	. . .	. . .
acid fumes and water vapor from rayon spin bath	Rayon	F	176-195	20	xx	xx	<0.0001	<0.0001	. . .	. . .	. . .
exhaust gases above spinning liquors, free chlorine and other gases from sodium-hypochlorite bleaching, sulfur, other vapors	Rayon	F	84	60	x)	xx	0.035c 0.042c	0.011b	0.01	. . .	. . .
atmosphere, on roof in vicinity of rayon bath fume stack	Rayon	F	57	30	xx	—	<0.0001	<0.0001	. . .	. . .	. . .
RESIN											
"Dowex 50" resin, saturated with nitric acid 6M	Atomic Energy	L	85	130	—	—	<0.0001	<0.0001	. . .	. . .	. . .
"Dowex 50" resin, saturated with oxalic acid 5%	Atomic Energy	L	85	125	—	—	<0.0001	<0.0001	. . .	. . .	. . .
"Dowex 50" resin, in distilled water, slurry	Atomic Energy	L	85	125	—	—	<0.0001	<0.0001	. . .	. . .	. . .
65% approximately urea-formaldehyde resins, free formic acid, pH 4.5-5.2 (vapors)	Plastic	F	212	5.8	x	xx	<0.0001d 0.0001*d	<0.0001	0.00012	. . .	. . .
urea-formaldehyde and zinc-chloride condensation product, solids 62%	Synthetic Resin	F	75	42	—	—	<0.0001 W<0.0001	<0.0001	. . .	. . .	. . .
urea-formaldehyde resin	Plastic	F	77	31	—	—	<0.0001	<0.0001	. . .	. . .	. . .
31% synthetic resin, acetic acid 41.5%, formaldehyde 7.5%, sulfuric acid 2%, water remainder	Synthetic Resin	F	158-180	179	—	x	0.00011*d	0.00016d W0.00011	. . .	. . .	. . .
23.5% vinyl-resin solids suspended by agitation in calcium chloride 0.33%, sodium thiosulfate 0.052%, sodium hydroxide 0.026% solution	Plastic	F	185	23	x	x	0.0003cd	<0.0001	<0.0001	. . .	. . .

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS–CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Resin											
synthetic-resin varnish base, phthalic anhydride and glycerine, vegetable oils and sodium hydroxide 10% cleaning solution	Paint and Varnish	F	100-500	40	—	xx	0.0002	0.0001	...	...	...
fumes from synthetic-resin varnish manufacture, phthalic anhydride, glycerine, vegetable oils and sodium hydroxide 10% cleaning solution	Paint and Varnish	F	100-500	40	—	x	<0.0001	<0.0001	...	...	...
formaldehyde resin, water 98%, methyl alcohol 2%	Chemical	F	220	130	..	x	0.0013	0.0005	0.0006	...	...
phenolic-resin slurry, sulfate 0.19%, chlorine 0.01%, nitrate and nitrite 12.5 ppm, nitrates 3 ppm, no sulfite, pH 3.5-7	Plastic	F	40-160	45	—	xx	<0.0001	<0.0001	...	C<0.0001	<0.0001
vapors from a phenol-formaldehyde resin reaction kettle, containing phenol 6000 lb, formaldehyde 3000 lb, and sulfuric acid 95% 120 lb	Synthetic Resin	F	212	63	—	x	0.0006bd	<0.0001	...	...	...
phenol-formaldehyde resin, obtained from phenol 6000 lb, formaldehyde 37% 3000 lb, and sulfuric acid 95% 120 lb	Synthetic Resin	F	212	51	—	xx	0.0551ad 0.0845a	0.0535ad	...	...	...
phenol-formaldehyde resin, obtained from phenol 6000 lb, formaldehyde 37% 3000 lb, sulfuric acid 95% 120 lb (vapors)	Synthetic Resin	F	212	51	—	xx	0.0063a	0.0039ad	...	...	...
ROSIN											
rosin, organic acids, phenols, aldehydes, various non-aqueous resin media (autoclave)	Chemical	F	525	610	..	xx	<0.0001 0.0003	L<0.0001 L 0.0002	<0.0001 0.0002	C<0.0001 C0.0002	...
60% rosin acids, oleic-linoleic acids 20%, tall-oil pitch 20% (bottom of tower)	Research (fractionation)	L	509	54	..	..	0.185	0.0001a	nil	C nil	...
tall oil, principally tall-oil rosin (above reboiler outlet)	.... (fractionation)	F	527	69	—	xx	...	0.0002	0.0001	0.0002	0.0002
RUBBER											
rubber reclaiming, alkaline, neutral and slightly acid conditions (digester, vapors, liquid)	Rubber	F	387	10	x	xx	0.0003 0.0002	0.0004 0.0002	...	...	...
rubber reclaiming, alkaline, neutral and slightly acid conditions (digester, vapors, liquid)	Rubber	F	387	13	..	xx	nil 0.0003	nil 0.0001	...	...	...
latex coagulation, calcium chloride 1%, pH 9 during 18 days; and acetic acid, pH 3 during 89 days	Synthetic Rubber	F	200	107	x	xx	0.0001d	nil d	...	...	...
latex, calcium chloride 2%, pH 9 during 34 days; and acetic acid 1%, pH 3 during 19 days	Synthetic Rubber	F	200	53	x	xx	<0.0001d	nil d	...	...	...
mother liquor from Oliver filters, sodium chloride 3% approximately, sulfuric acid 0.1% approximately, small amounts of hydroquinone and carbonates	Synthetic Rubber	F	90	12	—	—	nil nil*	<0.0001	...	...	...
treated water used in "Buna S" synthetic-rubber production, small amounts of styrene, pH 7-10	Synthetic Rubber	F	75	35	—	—	<0.0001*	<0.0001	...	...	...
treated water for making up synthetic-rubber emulsion, hardness 0, turbidity 3, pH 6-8 (tank bottom)	Synthetic Rubber	F	135	26	—	x	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Rubber											
synthetic-rubber crumb, water 30%, salt 0.5%, traces of coagulation liquor chemicals, combined sodium sulfide, blended triphenyl phosphite (drier)	Synthetic Rubber	F	180	15	xx	xx	<0.0001	<0.0001	...	<0.0001	...
"activator" solution used in cold rubber production, glucose 18.4%, sodium pyrophosphate 4.4%, ferrous sulfate 0.7%	Rubber	F	80-212	30	x	x	<0.0001	<0.0001	...	nil	...
synthetic rubber latex	Synthetic Rubber	F	<140	5	—	xx	<0.0001 <0.0001*	<0.0001	...	...	...
RUBBER COAGULATING BATH											
mixed-acid serum from synthetic-rubber coagulation, sodium chloride 20% average, sulfuric acid 0.08% average, acetic acid 0.08% average, pH 3	Synthetic Rubber	F	90	42	xx	—	0.0002ad	<0.0001ad	...	...	...
concentrated coagulating serum, sodium chloride 10%, pH 4-6 (serum evaporator)	Synthetic Rubber	F	185	13	xx	xx	0.0035cd	0.0017ad	...	...	...
coagulating serum, strong sodium-chloride concentration, dilute sulfuric acid, rubber fines and soap, traces of auxiliary solution; rubber contains carbon black 30%; some carbon black suspended in solution, pH 3.5 average	Synthetic Rubber	F	115	34	xx	xx	0.0025cd	0.00064bd	...	...	...
dilute acid solution for coagulating serum make-up, sodium chloride 4%, sulfuric acid 0.35%	Synthetic Rubber	F	100	41	xx	xx	0.0168cd 0.01115cd	0.0004d	...	...	...
recycle coagulating serum, sodium chloride 4%, dilute sulfuric acid, water, pH 4	Synthetic Rubber	F	100	64	—	x	0.00012ad <0.0001ad	<0.0001	...	...	...
dilute mother liquor used to coagulate synthetic rubber, sodium chloride 4% approximately, sodium sulfate 0.3% approximately, pH 3.5 (tank bottom)	Synthetic Rubber	F	120	21	x	—	nil a	nil	...	...	...
dilute creaming and coagulating solution for "GR S" synthetic rubber latex, sodium chloride 3.9%, sodium sulfate 0.27%, pH 3.55 (alternately immersed)	Synthetic Rubber	L	120	5	x	x	nil	nil	...	...	...
sodium chloride 3.3%, sulfuric acid 0.01% solution (Dorr dewatering skimmer)	Synthetic Rubber	F	90	30	xx	x	0.0007d	<0.0001	...	...	...
sodium chloride 3.06%, sodium sulfate 0.33% solution, dilute sulfuric acid, pH 4.3	Rubber	L	86	12	..	xx	0.0002c nil	<0.0001 nil	...	...	...
sodium chloride 3.06%, sodium sulfate 0.33% solution, dilute sulfuric acid, pH 4.3	Rubber	L	120	9	..	xx	0.0011c	<0.0001	...	...	...
sodium chloride 3.06%, sodium sulfate 0.33% solution, dilute sulfuric acid, pH 4.3	Rubber	L	120	12	..	xx	<0.0001	<0.0001	...	...	...
sodium chloride 2.68%, sodium sulfate 0.3% solution, dilute sulfuric acid, pH 1.5	Rubber	F	86	7	..	xx	0.0001	0.0072	...	...	...
sodium chloride 2.68%, sodium sulfate 0.3% solution, dilute sulfuric acid, pH 1.5	Rubber	F	86	12	..	xx	0.0324c	nil	...	...	...
sodium chloride 2.68%, sodium sulfate 0.3% solution, dilute sulfuric acid, pH 1.5	Rubber	F	120	12	..	xx	0.0427c 0.096	0.008 0.0005	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
SELENIOUS ACID											
selenious acid, sulfuric and nitric acids (gas scrubber)	Precious Metal	F	200	22	x	xx	0.28	0.135c	0.058c	0.083c	0.17c
fumes of selenious acid, sulfuric and nitric acids	Precious Metal	F	130	29	xx	..	0.0411c 0.1189c	0.0611c	0.0564c	0.1211c	0.0506c
fumes of selenious acid, sulfuric and nitric acids (box scrubber)	Precious Metal	F	650	29	xx	..	0.029c	0.027c	0.022c	0.024c	0.029c
SELENIUM											
selenium charge, sulfates 0.78%, sulfur 0.34%, chlorides 0.16%, iron 0.13%, tellurium 0.11%, copper 0.094%	Metal	L	1280	2	..	..	4.8 8.48*	7.02	...	3.19	...
SEWAGE											
moisture-laden sewage gas from anaerobic digestion of packing-house waste, carbon dioxide 63%, methane 36%, hydrogen sulfide 1%, pH 7.4 approximately (Nash vacuum pump)	Food (meat)	F	90	90	—	x	<0.0001 0.0003	<0.0001 0.0002	...	<0.0001 0.0001	<0.0001 0.0001
settled sewage, hydrogen sulfide 14-20 ppm, pH 6-7	Sewage (treatment)	F	75-80	34	—	xx	<0.0001	<0.0001	...	...	...
filtrate from dewatered elutriated sewage sludge, contains ferric chloride, pH 6 (vacuum filtration)	Sewage (disposal)	F	70	110	xx	xx	<0.0001d	<0.0001	...	...	...
filtrate from dewatered elutriated sewage sludge, contains ferric chloride, pH 5.5-6 (vacuum filtration)	Sewage (disposal)	F	70	139	xx	xx	0.0002cd	<0.0001d	...	...	...
SILICA											
siliceous ore pulp, solids 50%, sulfuric acid and ferric sulfate added, ferric ion 2 g/l, initial pH 0.5	Chemical	F	R.T.	3	—	xx	0.001 0.001*	0.0006	...	...	...
SILICON TETRAIODIDE											
silicon tetraiodide, free iodine 2% (half immersed)	Research	L	293	7	—	—	0.0032	0.0031a	...	0.0035	0.0029
SOAP											
>40% potash soap, derived from edible coconut oil, hand-washing soap, fatty acids <0.5%, pH 9.5-9.8	Soap	F	72	96	—	—	<0.0001	<0.0001	...	...	...
35% soap made up from coconut fatty acids 50% and soya fatty acids 50%, glycol 5%, hand-washing soap, fatty acids <0.4%, pH 9.2-9.5	Soap	F	72	96	—	—	<0.0001	<0.0001	...	...	...
15% soap, made up from soya fatty acids 50%, tall oil 50%, with sodium sulfate 1% and pine oil 1.5%, floor cleaner, pH 10.6	Soap	F	72	80	—	—	<0.0001	<0.0001	...	...	...
12.5% soap made up from soya fatty acids 50% and tall oil 50%, with free trisodium phosphate 1%, floor cleaner, pH 11-11.5	Soap	F	72	96	—	—	<0.0001	<0.0001	...	...	...
soap solution, pH 10.3	Synthetic Rubber	F	135	12	x	x	nil	nil	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions						Average corrosion rates (ipy)				
	INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
Soap											
soap and wash-liquor mixture, sodium hydroxide 15%, sodium chloride 10%	Soap	F	200	102	x	xx	<0.0001	<0.0001	. . .	. . .	. . .
soap lye, sodium chloride 11%, sodium hydroxide 2%	Soap	F	200	102	x	x	<0.0001	<0.0001	. . .	. . .	. . .
fats, fatty acids, caustic soda (bottom of kettle)	Soap	F	90-217	35	x	x	<0.0001	. . .	<0.0001	. . .	. . .
soap, salts of aluminum, calcium, magnesium and zinc, pH 4-11	Soap	F	100-190	35	x	x	<0.0001	. . .	<0.0001	. . .	. . .
precipitated soap and salt	Soap	F	100-125	35	x	x	<0.0001	. . .	<0.0001	. . .	. . .
tallow, acidulated cottonseed and soybean oil soap stocks (tank bottom)	Chemical	F	138	11	—	xx	<0.0001	<0.0001	. . .	<0.0001	<0.0001
acidulated cotton-seed oil soap stock and mixed vegetable oil soap stock	Chemical	F	147	62	xx	—	<0.0001	<0.0001	. . .	0.0004	0.0003
dilute soap solution of sodium salt of sulfonated oil of indefinite composition, sodium oleates, paraffin oils	Rayon	F	86	56	—	x	<0.0001	<0.0001	. . .	. . .	. . .
SODIUM ACETATE											
10%, organics, butyl alcohols 5-10%, formaldehyde 1%, water remainder, pH 4.5	Chemical	F	230	38	—	xx	<0.0001	<0.0001	. . .	. . .	. . .
5%, water remainder, pH 4-10	Chemical	F	80-130	157	—	xx	0.0001	0.0001	. . .	. . .	. . .
5-2%, water 93%, sodium formate 0.5-1%, butane 0.1%, pH 8.5-9.5	Chemical	F	300	61	xx	xx	<0.0001	. . .	. . .	. . .	. . .
SODIUM BICARBONATE											
98% crystalline sodium bicarbonate and ammonium chloride, remainder sodium chloride, ammonium bicarbonate, hydrogen sulfide, water (liquid); and air, sodium-carbonate dust, ammonia, hydrogen sulfide, water (vapors)	Chemical	F	82	36	xx	—	<0.0001	<0.0001 W0.0001	. . .	. . .	. . .
20%, soda-ash draw liquor, ammonium chloride 15%, sodium chloride 5%, dissolved carbon dioxide 2%, free ammonia 1.2%, solid ammonium bicarbonate 1%, sodium sulfide trace (carbonating tower)	Chemical	F	85	280	xx	xx	. . .	0.0001	0.0001	0.0001	. . .
condensate from sodium-bicarbonate mother liquor	Chemical	F	135	14-28	. .	. .	L nil	0.00037	. . .	. . .	. . .
sodium-bicarbonate slurry in solution of ammonium chloride, sodium chloride, and free ammonia 35 titer (carbonating tower)	Chemical	F	84	3102	—	xx	0.0001	0.0001	. . .	. . .	. . .
slurry saturated with sodium chloride, sodium bicarbonate, ammonium chloride, ammonium bicarbonate, free ammonia and free carbon dioxide (bicarbonating tower)	Chemical	F	81	90	xx	xx	0.0003ad	0.0004d	. . .	. . .	. . .

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sodium bicarbonate											
wet gas containing carbon dioxide and ammonia, water 0.32 g/l ammonia 0.23 g/l, carbon dioxide 0.135 g/l in vapors; ammonium carbonate 1M, ammonium hydroxide 1.3M in condensate, some hydrogen sulfide in vapors (heat exchanger)	Chemical (ammonia-soda)	F	185	70	—	x	0.0001b	0.0001	...	...	...
feeder liquor, sodium chloride 230 g/l, fixed ammonia 65 g/l, free ammonia 15 g/l, sulfide 0.04 g/l, iron 0.006 g/l (coke-packed section of stripper still)	Chemical	F	185	105	x	xx	0.0016c 0.0003*c S0.0014c LS0.0028c S0.001*c	0.0001c S0.0002c	0.0001c S0.0001a	...	...
bicarbonate tower slurry saturated with sodium bicarbonate, ammonium bicarbonate, sodium chloride, ammonium chloride, free ammonia, free carbon dioxide, some crystals of sodium bicarbonate	Chemical	F	75-160	77	x	xx	0.0021ad 0.0015*ad	0.0015a	...	...	...
SODIUM CARBONATE											
25.4%, sodium chloride 8%, sodium borate 8%, sodium sulfate 2.5%	Chemical	F	150	60	xx	xx	0.016c	...	..	...	...
SODIUM CHLORATE											
55%, sodium chloride 7%, solid salt in suspension 5%, pH 9-10 (vacuum evaporator)	Chemical	F	230	174	—	xx	0.0001	0.0001	...	C0.0001	...
saturated solution of sodium chlorate and sodium chloride from which the chlorate is crystallized, no hypochlorites, pH 6-7	Chemical	F	100	62	—	x	0.0001bd	...	0.0001bd	...	...
saturated solution of sodium chlorate and sodium chloride, sodium hypochlorite 2-5 g/l, chlorine vapors, pH 6-7	Chemical (evaporation)	F	165	13	—	xx	0.0003ad	...	0.0005ad	...	...
sodium chlorate, sulfuric acid, chlorine dioxide, water	Research	L	127-131	...	..	..	...	L0.0045 L0.009 L0.0156	L0.0063 L0.0086	0.002	...
SODIUM CHLORIDE											
purified sodium-chloride slurry from vacuum pans, brine 75% approximately, salt crystals 25% approximately	Chemical	F	90-100	90	xx	x	<0.0001ad	<0.0001	...	...	...
saturated sodium-chloride brine	Chemical	F	160	204	x	x	...	...	...	<0.0001d C<0.0001d	<0.0001d
saturated sodium-chloride brine, some oxidizing materials from products of combustion of gas flame	Chemical	F	180	52	x	x	0.0004*cd 0.0007cd	0.0022cd	...	...	...
saturated sodium-chloride solution (Oliver vacuum filter)	Chemical	F	90	90	x	xx	0.0012cd	0.0001a	...	...	...
saturated to 15.3% sodium-chloride solution (alternate immersion)	Metal	F	60-80	160	x	x	0.0002d	0.0001d	...	...	<0.0001
vapors from boiling saturated sodium-chloride solution (evaporator)	Chemical	F	210	210	—	xx	0.0001*cd	<0.0001bd	...	...	...
25%, water remainder	Research	L	140	4	..	..	nil a	nil	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions						Average corrosion rates (ipy)				
	INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
Sodium chloride											
25%, water remainder (vapors, liquid)	Chemical	L	140	4.5	. .	. .	nil a	nil a	. . .	. . .	. . .
20%, sodium-chloride spray	Research	L	95	84	. .	. .	0.00036c	<0.0001a	. . .	. . .	. . .
10%	Textile	L	150	4	. .	xx	0.0007	<0.0001	. . .	. . .	. . .
sodium-chloride solution, pH 8.5	Air Conditioning	F	17	90	—	—	0.00015cd L0.0001cd	<0.0001cd	. . .	. . .	. . .
sodium-chloride spray, pH 8.5	Refrigeration	F	17	90	x	xx	0.00013cd L0.00011cd	<0.0001d	. . .	. . .	. . .
4%	Research	L	195	1	xx	—	0.0146b	<0.0001	. . .	. . .	. . .
SODIUM-CHLORIDE MIXTURES											
saturated salt brine, hydrogen sulfide 0.15 g/l, pH 6.7	Chemical	F	100	393	xx	xx	. . .	0.0001c	. . .	. . .	. . .
50% sodium chloride, sodium hydroxide 8%, sodium chlorate 1%, ammonia 1%, water remainder (ammonia still)	Chemical	F	400	27	—	xx	0.004	0.0023	. . .	. . .	. . .
<50% sodium-chloride brine, oxidizing materials from combustion products of gas flame (open evaporator)	Chemical	F	200	14	x	xx	0.009*bd L .0215bd	0.0418bd	. . .	. . .	. . .
45.6% sodium-chloride slurry, calcium chloride 17.8%, magnesium chloride 3.2%, solid salt in suspension, pH 6.3 (limed); pH 5.3 (unlimed)	Chemical	F	129	215	x	x	. . .	0.0011cd	. . .	. . .	. . .
26% saturated sodium-chloride solution, calcium chloride 10 g/l, calcium sulfate 2 g/l, pH 6.5	Chemical	F	50	180	xx	x	. . .	0.0003	. . .	. . .	. . .
23.6% approximately sodium-chloride brine, calcium sulfate 3 g/l, sodium chlorate 0.5 g/l, traces of sodium hypochlorite and mercury	Chemical	F	149	31	xx	—	. . .	0.002	0.0007	. . .	. . .
23.5% approximately sodium-chloride brine, sodium sulfate 18 g/l, sodium carbonate 18 g/l, sodium hydroxide 1 g/l	Brine Production	F	R.T.-160	225	xx	x	. . .	nil	. . .	. . .	nil
22% approximately sodium-chloride solution, sodium sulfate 60 g/l, sodium hydroxide 7 g/l (crystallizer tank)	Chemical	F	48	119	—	xx	<0.0001	<0.0001	. . .	. . .	. . .
21.2% approximately sodium-chloride solution, free ammonia 39 g/l, fixed ammonia as ammonium chloride 1.5 g/l, carbon dioxide 19 g/l, hydrogen sulfide 0.5 g/l (piping)	Chemical	F	145	174	xx	xx	<0.0001c	<0.0001c	. . .	0.0001	. . .
19% approximately sodium-chloride brine, sodium chlorate 30-50 g/l, iron 1-1.5 ppm, mercury 1-1.5 ppm, sodium hypochlorite as chlorine 0.2%	Chemical	F	50	90	—	xx	. . .	0.003cd	. . .	0.0006cd	. . .
18%, residual soap, aluminum chloride hydrate 0.25% (filter)	Soap	F	160	65	xx	xx	0.0007c	0.0004c	. . .	. . .	. . .
18%, residual soap, aluminum chloride hydrate 0.25%	Soap	F	165	65	xx	xx	<0.0001	<0.0001	. . .	. . .	. . .
18%, residual soap, total sodium oxide 0.03% approximately, free sodium oxide 0.0003% approximately	Soap	F	165	65	xx	xx	0.0002d	0.0001	. . .	. . .	. . .

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sodium-chloride mixtures											
18%, residual soap, total sodium oxide 0.03% approximately, free sodium oxide 0.0003% approximately	Soap	F	140	65	xx	xx	0.0004d	0.0002	...	...	...
18%, aluminum chloride hydrate 0.25% approximately, pressure 110 psi	Soap	F	165	65	xx	xx	<0.0001	<0.0001	...	...	...
18%, aluminum chloride hydrate 0.25% approximately	Soap	F	160	65	xx	xx	0.00064c	0.00036cd	...	...	...
18%, total sodium oxide 0.03% approximately, free sodium oxide 0.003% approximately, pressure 110 psi	Soap	F	160	46	xx	xx	0.0004ad	0.00014	...	...	...
18%, total sodium oxide 0.03% approximately, free sodium oxide 0.003% approximately, pressure 110 psi	Soap	F	140	46	xx	xx	0.00084d	0.00038	...	...	...
15.3% approximately, ammonium perchlorate 240 g/l, sodium perchlorate 78 g/l, sodium chlorate 2 g/l, ammonium chloride trace, pH 4.8	Chemical	F	155-170	98	x	x	...	0.0002cd	...	0.0001a	0.0001a
14% **approximately** sodium-chloride slurry, potassium chloride 12% approximately (Dorr thickener, center well)	Chemical	F	77	38	x	x	0.0003a	0.0003	...	...	...
14% approximately sodium-chloride bittern, chloride ion 5N, sulfate ion 55 g/l, magnesium ion 41 g/l, sodium and potassium ions balance of cations, pH 2-5 (heat exchanger)	Chemical	F	170	90	—	xx	0.0036r	0.006c	...	0.0038cd	...
12%, acidified with sulfuric acid, petroleum solvent added, pH 2.5 (sheepskin degreasing drum)	Tanning	F	...	180	..	x	0.0001	0.0001	...	...	...
12% approximately waste brine, calcium chloride 1 g/l, hydrogen sulfide 250 ppm (line)	Mining (sulfur)	F	112	17	xx	xx	0.156cd	0.047cd	...	...	...
sodium chloride and sodium sulfate 13-16%, glycerine 10-12%, spent soap lye treated with ferric chloride and sulfuric acid to pH 4.5, mud and water	Soap	F	85	105	xx	x	W0.001cd	W0.001cd	...	...	...
sodium chloride and sodium sulfate 13-16%, acid lye treated with alkali to pH 9, glycerine 10-12%, mud and water	Soap	F	85	105	x	x	W0.006cd W0.004c W0.0001bd	W0.003cd W0.003 W<0.0001d	...	...	...
10.5%, acidic salt stripping solution, chloride 70 g/l, sulfate 50 g/l, nitrate 20-25 g/l, thorium 4-5 g/l, ferric ion 1 g/l, sulfuric acid 0.1N, pH 0.5 approximately	Mining	F	86	21	—	—	0.018a	0.016cd	0.0051ad	0.0074ad	0.006cd
7% approximately, pickle liquor, sulfuric acid 0.25-0.5%	Tanning	F	60-70	180	..	..	0.0022	0.0012	...	...	...
7% approximately, pickle liquor, sulfuric acid 0.25-0.5% (above liquor level)	Tanning	F	60-70	180	..	..	<0.0001	<0.0001	...	...	...
5%, potassium chloride 4.5%	Chemical	F	67	35	xx	xx	<0.0001	<0.0001	...	...	...
5-4%, sodium hydroxide 1% (bottom of column)	Chemical (distillation)	F	220	58	—	xx	<0.0001d	<0.0001d	...	<0.0001d	<0.0001d
4.7%, hydrofluosilicic acid 3.5%	Agriculture (fertilizer)	F	80	35	—	x	0.0026cd	0.0007ad	...	...	...
2%, plant-waste effluent, solids 4-5%, chlorides, carbonates, sulfates, sulfides and organic salts, water remainder, pH 10	Chemical	F	60	105	x	—	<0.0001	<0.0001	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sodium-chloride mixtures											
1.6% approximately, spent brine mine water from Frasch process, calcium carbonate 500-1000 ppm, hydrogen sulfide 150-200 ppm, polysulfides 75-100 ppm, thiosulfates as hydrogen sulfide 4-10 ppm, pH 6-6.8	Mining	F	120	67	xx	x	0.0001c	0.0001c	...	...	...
0.15%, oil-field brine, calcium and magnesium chlorides 10%, bromine 0.4%, pH 6	Chemical	F	149	144	xx	xx	...	0.016c	...	...	0.012c
sodium chloride, potassium chloride	Chemical	F	130	45	xx	xx	0.0022*d	0.0022d	...	...	...
purified sodium-chloride brine, acidified with hydrochloric acid to pH 3.5-4.5	Salt	F	228	18	—	xx	...	0.263	0.189	...	...
sodium chloride, water 3%, ferrous chloride 0.7%	Chemical	..	...	147	..	..	0.0002ad	0.0001ad	...	...	...
sodium-chloride bittern (heat-exchanger head)	Chemical	F	169	168	xx	..	0.0006cr	0.0006c	...	0.0002c	...
sodium chloride, sodium sulfate	Tanning	F	...	180	..	..	0.0002	0.0001	...	...	...
sodium chloride, sodium sulfate, glycerine, pH 6-10 (vertical tube evaporator)	Soap	F	140-150	1235	x	xx	<0.0001cd	<0.0001	...	<0.0001	...
saturated salt solution of glycerine and water, glycerine 15-80% (Wooster-Sanger evaporator, vapors)	Soap	F	140-220	91	—	—	0.0003cd	<0.0001ad	...	<0.0001d	<0.0001d
salt and crude glycerine, solids 7-25%, water vapor, pH 7-9	Soap	F	190	24	..		nil	nil	...	...	...
salt and crude glycerine, solids 7-25%, water vapor, pH 5.5-9	Soap	F	190	26	..	..	0.00012	<0.0001	...	...	...
organic material containing unstated amounts of sodium chloride and hydrochloric acid	Chemical	F	212	14	..	xx	0.0047cd	0.0043cd	...	...	...
air, saturated with sodium chloride	Mining	F	77	84	xx	xx	0.0003ad	<0.0001	...	<0.0001	<0.0001
SODIUM CHLORITE											
5%, pH 3.5-5	Chemical	L	68-158	8	..	—	0.004c 0.006*cd	0.0001	...	...	...
0.5%, during 34 hours, aeration during 138 hours, calcium hypochlorite direct chlorination with added sulfuric acid to pH 4.5 during 572 hours (horizontal Bellmer bleach beater)	Pulp and Paper	F	95	31	x	xx	0.0002cd	0.0001ad	...	...	...
0.2-0.1%, "Textone" cotton dyeing and bleaching, oxalic acid 1-2 g/l	Textile	F	160-170	194	x	xx	0.0006*c	0.0003c	0.0001c	0.0001a	...
0.1%, "CF" rayon bleach, 53% acetic acid 0.18%, synthetic detergent 0.1%, 0.035% hydrogen peroxide 100 vol, sodium carbonate 0.03%	Chemical	L	210	0.5	x	xx	0.003	0.003	...	...	...
0.04%, "CF" textile bleach, synthetic detergent 0.2%, sodium bicarbonate 0.15%, free chlorine as sodium hypochlorite 0.15%, soda ash 0.07%	Chemical	L	130	0.5	x	xx	0.001	0.002	...	...	...
0.02%, "Textone," caustic soda 1% (bleaching kier)	Textile	F	<215	23	—	x	0.0001	<0.0001	...	...	...
SODIUM CYANIDE											
sodium-cyanide solution	Mining	F	80	60	x	x	<0.0001	<0.0001	<0.0001	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Sodium cyanide											
sodium-cyanide solution	Mining	F	85	111	xx	xx	<0.0001	<0.0001	...	...	...
sodium-cyanide solution	Mining	F	75	98	—	x	0.0001	0.0001	...	...	...
sodium cyanide, water (vapors)	Mining	F	70	111	—	—	0.0001	0.0001	...	...	...
sodium cyanide, water (vapors)	Mining	F	74	98	—	—	0.0001	0.0001	...	...	...
sodium cyanide fused	Chemical	F	1292	10	...	...	0.0377d 0.0464d	0.0279ad 0.043d	...	...	...
SODIUM FLUORIDE											
sodium fluoride, aluminum fluoride, sodium sulfate, sodium carbonate, sodium bicarbonate, air, water, aluminum oxide, pH 9	Metal	F	87	69	...	...	...	...	<0.0001	<0.0001	0.00011 0.00017
SODIUM (ACID) FLUORIDE											
8.1% approximately saturated sodium acid fluoride solution, crystals 30 g/l, hydrogen fluoride 30 g/l	Chemical	F	175	30	x	xx	0.051c 0.07c	0.043	...	C0.032	...
8% (top trough of crystallizer)	Chemical	F	140-180	10	xx	xx	0.135	0.0562a	...	...	...
3.7% approximately saturated sodium-acid-fluoride solution, some free crystals	Chemical	F	50	30	xx	xx	0.0023	0.0013	...		...
SODIUM FLUOSILICATE											
sodium-fluosilicate slurry, hydrochloric acid 5%	Chemical	F	130	8	—	x	0.153ad 0.116*ad	0.055d	...	...	...
SODIUM FORMALDEHYDE SULFOXYLATE											
60-25% sodium-formaldehyde-sulfoxylate liquor (vacuum evaporator)	Chemical	F	167	310	—	x	<0.0001ad	<0.0001	...	...	...
SODIUM GLUTAMATE											
monosodium glutamate, saturated sodium chloride solution (crystallizer)	Food	F	86	28	xx	xx	0.00015*ad 0.0014bd	<0.0001a	...	...	...
SODIUM HYDROSULFIDE											
48-38%, sodium sulfide 1%	Chemical	F	176	84	x	xx	<0.0001	<0.0001	...	...	...
12-5%, sodium sulfide and polysulfides as impurities	Chemical	F	230	50	x	xx	<0.0001 <0.0001* L<0.0001	<0.0001	...	<0.0001	<0.0001
SODIUM HYDROSULFITE											
40%, some sulfur dioxide, zinc suspension in water	Textile	F	85-125	42	...	...	<0.0001	<0.0001	...	...	...
17.75% approximately	Chemical	F	110	57	x	x	0.002*a	0.0001	0.0001	C0.0001	...
12.65% approximately	Chemical	F	90	58	x	x	0.0001cd	0.0001	0.0001	C0.0001	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sodium hydrosulfite											
1%	Textile	L	150	4.1	—	x	nil	nil	...	...	...
SODIUM HYDROXIDE											
75%	Chemical	F	275	35	—	—	0.005a 0.007*a	0.007a	...	...	...
74% (tank car)	Chemical	F	265	88	..	xx	...	0.0084	...	0.0009	0.0003
73%	Chemical	F	248-320	34	—	—	0.113	0.105	...	...	...
73%	Chemical	F	230	88	—	x	0.045 0.038*	...	...	...	...
73%	Chemical	F	230	52	—	x	0.0093 0.0039*	...	...	...	...
72%	Chemical	F	250	119	x	x	0.0037	0.0031	...	...	...
70%	Chemical	F	194-239	90	—	—	0.0268	...	...	...	...
51-49%	Chemical	F	150	30	—	—	0.0001	...	...	...	...
50%	Chemical	F	136	167	x	x	<0.0001	...	...	...	...
30%	Petroleum	F	68	30	..	..	<0.0001	...	...	...	...
22%	Chemical	F	131	133	—	x	<0.0001 <0.0001*	...	...	...	...
14% (multiple-effect evaporator)	Chemical	F	190	90	—	—	<0.0001	...	...	...	...
SODIUM-HYDROXIDE MIXTURES											
50%, sodium chloride 10-15%	Chemical	F	200	119	x	x	0.0002	0.0002	...	...	...
40-35% approximately, salt 6-7% approximately (salt settler)	Chemical	F	240	24	x	x	0.001	0.0015	...	...	...
35%, chloride ion 3 ppm (vapors)	Atomic Energy	L	500	21	—	—	...	...	...	...	...
23% approximately, salt 7-8%	Chemical	F	200	48	x	x	0.0004	0.0023	...	...	...
23% caustic soda lye, sodium chloride 10-15%, tallow, coconut oil, glycerine removed with sodium chloride, sodium hydrosulfite 0.05-0.15% added in alkaline solution	Soap	F	190	64	..	xx	<0.0001cd <0.0001*cd 0.0001b 0.0001*a	<0.0001a 0.0003	...	...	...
22-18%, mercaptans, cresolates	Petroleum	F	100-220	30	x	xx	0.0001 0.0001*	0.0004	...	...	...
20%, potassium hydroxide 2-7%, (still pot in cracking column)	Plastic (distillation)	F	305	60	—	xx	<0.0001	<0.0001	...	...	...
20% approximately, suspended crystalline salt (evaporator)	....	F	140	196	—	xx	0.0014	0.0036	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Sodium hydroxide mixtures											
18%, naphthenic acid, cresols, phenols (resulting gravity 22-28°Bé), mercaptan sulfur 0.04% (tower)	Petroleum	F	225	660	—	x	0.0001	0.0002	...	...	...
18%, naphthenic acid, cresols, phenols (resulting gravity 22-28°Bé), mercaptan sulfur 0.04% (tower)	Petroleum	F	225	564	—	x	0.0001	0.0001	...	...	...
17-2%, organic salt 12%, methanol 8%, sodium chloride 7% (liquid line)	Chemical	F	85	37	x	xx	<0.0001 S0.0001	<0.0001 S0.0001	...	<0.0001	<0.0001
17-2%, organic salt 12%, methanol 8%, sodium chloride 7%	Chemical	F	85	37	—	xx	<0.0001 S0.0001	<0.0001 S0.0002	...	<0.0001	<0.0001
15%, monochlorotoluene saturated with chlorine 2% and hydrochloric acid 2% approximately (batch still)	Chemical (distillation)	F	212	33	—	x	...	0.023cd	...	0.022cd	0.018cd
15-1.5%, amine salt 12%, methanol 8%, sodium chloride 7%	Chemical	F	85	20	x	xx	0.0001	L0.0002	...	...	...
10% caustic cell liquor, salt 12%	Chemical	F	190	279	x	x	0.0002	<0.0001	...	...	...
10-3%, occasionally some sulfuric acid	Research	L	190	300	..	xx	0.03a	0.0083	...	C0.0006	0.0001
6%, sodium hypochlorite <1% (gas scrubber)	Petro-chemical	F	80-90	138	—	—	0.024*cd	0.022cd	...	...	...
2%, sulfuric acid 10%, sulfur dioxide 0.1%, pH 4.3	Chemical	F	125	104	—	x	<0.0001	<0.0001	...	...	...
sodium hydroxide, sulfur dioxide, normally acid solution	Chemical	F	130-140	99	x	xx	<0.0001	<0.0001	...	...	...
sodium hydroxide, sulfur dioxide, normally alkaline solution	Chemical	F	130-140	99	x	xx	<0.0001	<0.0001	...	...	...
sodium hydroxide, sodium hydrosulfide, sodium sulfide, intermittent exposure to air, steam and hydrogen sulfide (gas absorption column)	Chemical	F	167	15	x	xx	0.00015	0.0004	...	...	...
sodium hydroxide, organic material, sulfuric acid and arsenious acid (in resin of ion exchanger)	Chemical	F	167	30	x	x	0.0001	0.0001	...	...	...
0.5%, water 99.5%, traces of butane and kerosene	Chemical	F	320	275	x	x	nil	nil	...	...	...
dilute caustic soda, sodium formate, methanol, nitrogen compounds	Chemical	F	86-248	75	x	xx	<0.0001 0.0003	<0.0001 0.0003	...	<0.0001	<0.0001
SODIUM HYPOCHLORITE											
6.3%, sulfuric acid 45%, sulfate turpentine oil	Chemical	F	100	103	—	xx	...	0.0003d	0.0002d	0.0002d	0.0003d
5% (tank bottom)	Cellophane	F	65	39	—	x	...	0.0005bd	<0.0001	...	...
2.94%	Textile	F	70	25	—	—	0.029cd 0.0011cd	0.0006d	...	...	...
0.52%-0%, free sodium hydroxide 4-35 g/l, sodium chloride 2-25 g/l, sodium silicate 1 g/l, acid oils 0-2 ml/l	Petroleum	F	R.T.	37	..	..	0.0001a	nil	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sodium hypochlorite											
0.11%, sodium aluminate 1200 ppm approximately	Beverage	F	70	94	x	—	<0.0001d	<0.0001cd	...	...	...
0.1%	Chemical	F	140	1.3	—	—	0.0009d	0.00015d	...	...	...
0.042%-0%, sodium chloride 3-21 g/l, free sodium hydroxide 6-13 g/l, acid oils 0-2 ml/l during 13 days; and sodium chloride 7-15 g/l, free sodium hydroxide 5-8 g/l during 42 days	Petroleum	F	R.T.	55	..	..	0.0018c	nil	...	...	...
sodium hypochlorite traces, sodium chloride <1%, sulfur base dye	Cellophane	F	212	69	x	xx	<0.0001ad	<0.0001ad	...	...	<0.0001ad
SODIUM NITRATE											
68-12% approximately, crude sodium-nitrate solution (evaporator)	Chemical	F	232	30	—	xx	0.0007c	0.0006	...	0.0006	...
SODIUM NITRITE											
0.4-0.3%, sodium chloride 0.9%, diazoting bath	Textile	L	180	0.2	—	xx	0.0056 L0.0058	0.0044	...	...	...
SODIUM PHENOLATE											
sodium phenolate, tar acids 20 vol% approximately, total alkalinity 20% as sodium hydroxide (tower)	Coal By-product	F	248	329	—	..	<0.0001cd	<0.0001	...	...	...
SODIUM PHOSPHATE											
50% sodium tripolyphosphate and sodium tetrapolyphosphate solution (hydrator)	Chemical	F	165	2.5	xx	xx	0.0001	0.0004	...	...	...
sodium phosphate, salts 54-55%, hydrochloric-acid trace, pH 6.9-7 (gas scrubbing, vapors, liquid)	Chemical	F	185	16.5	xx	xx	nil	nil	...	...	nil
10% disodium phosphate and sodium carbonate, sodium-phosphate solution, pH 9 (bottom of tower)	Chemical	F	150	123	xx	xx	0.0001 0.0001*	0.0001	...	...	...
disodium pyrophosphate during 38.6 days, disodium phosphate during 7.3 days, monosodium phosphate during 5.7 days, potassium phosphate during 4.3 days, potassium pyrophosphate during 1.8 days, monopotassium phosphate during 1 day (rotary drier)	Food	F	60	59	xx	xx	0.0001	0.0001	0.0001	...	...
disodium pyrophosphate during 38.6 days, disodium phosphate during 7.3 days, monosodium phosphate during 5.7 days, potassium phosphate during 4.3 days, potassium pyrophosphate during 1.8 days, monopotassium phosphate during 1 day (rotary drier)	Food	F	70	59	—	xx	0.0001a	0.0001	0.0001	...	...
sodium phosphate, sodium chloride, pH 4	Research	F	230	55	—	—	...	0.0012cdr	...	0.0011c	0.0016cd
SODIUM PROPIONATE											
<0.2% sodium and calcium propionates and acetates, sodium salts, pH 8 approximately	Chemical	F	<160	45	xx	xx	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
SODIUM SULFATE											
saturated sodium-sulfate solution, crystals 20%	Rayon	F	170	48	x	xx	0.0001	0.0001	0.0001	...	...
sodium-sulfate saturated slurry, zinc sulfate 1%, sodium hydroxide, pH 8.5-9 (evaporator)	Chemical	F	230	193	—	xx	0.0001	0.0001 W0.0001	0.0001	...	...
25-20%, top waters from organic yellow pigment, sodium acetate 3%, sodium chloride 1.6%	Paper	F	158-176	7.5	xx	xx	0.0006ad	0.0003d	...	...	...
14.8%, chloride ion 4%, ferric ion 4%, phosphate ion 1%, pH 1-2.5	Pharmaceutical	F	125	20	x	xx	0.0028cd	0.001cd	...	...	...
6.5-4.7% approximately, sodium fluoride 5-20 g/l, sodium carbonate 2-10 g/l, traces of sulfur dioxide and hydrofluoric acid, water remainder (Söderberg gas scrubber)	Metal	F	68-104	55	xx	xx	0.0004c <0.0001	<0.0001	...	...	...
5-0.5%, sulfuric acid 0.5-3%, wash water from washing of silica gel	Chemical	F	150	28	x	xx	<0.0001d	<0.0001	...	...	...
1.5% sodium sulfate hydrate, sulfuric acid 0.5%	Textile	L	150	4.1	—	x	nil	nil	...	...	...
sodium sulfate, sodium carbonate, sodium sulfide, water, solids 55%	Pulp and Paper	F	190	179	x	xx	<0.0001	<0.0001	...	...	...
SODIUM (BI-) SULFATE											
13% approximately	Metal (pickling)	F	160	71	x	—	<0.0001a S<0.0001	<0.0001 S nil	...	...	...
SODIUM SULFIDE											
60%	Chemical	F	340	28	—	—	0.036	0.038	...	C0.081	...
60% (fusion pot)	Chemical	F	212-355	81	xx	xx	>0.073	>0.072	...	C0.11	...
60-30% (tube evaporator tray)	Chemical	F	300	30	—	xx	0.092 0.114*	...	0.207	...	...
60-25%	Chemical	F	300	19	—	xx	0.084 0.23*	>0.3	...	...	...
40% initially, sodium hydrosulfide 45% finally	Chemical	F	194	160	—	x	0.0026	0.0039	...	0.0015	0.0005
30% (evaporator, vapors)	Chemical	F	255	30	—	xx	0.0075 0.0118*	...	0.019	...	...
15% (evaporator, vapors)	Chemical	F	185	30	—	xx	0.0001 0.0001*	...	0.0001	...	...
10% (evaporator)	Chemical	F	185	21	—	xx	0.0005 0.0001*	0.0001	...	...	...
10%	Chemical	F	R.T.	81	xx	—	0.0001	0.0001	...	C0.0001	...
0.4%	Rayon	F	108	43	—	x	0.0002 <0.0001 0.0001* <0.0001*	<0.0001	...	...	...
sodium-sulfide solution, pH 6.5 (bottom of tank)	Pulp and Paper	F	65-100	163	—	—	<0.0001 <0.0001*	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sodium sulfide											
sodium-sulfide solution, sodium sulfhydrate	Tanning	F	...	180	..	..	0.0001	0.0001	...	...	...
sodium sulfide, sulfonic-acid derivatives, pH >8 if any liquid entrained in vapors and non-condensable gases (evaporator, vapors)	Pulp and Paper	F	140	84	x	xx	0.0001	0.0001	...	...	...
2% sodium trisulfide, sodium chloride 2%, sodium hydroxide 0.5%, traces of ethyl amine, thiosulfates and sodium mercapto-benzothiazole, water remainder	Chemical	F	105	70	xx	x	0.0001	<0.0001	...	...	...
SODIUM SULFITE											
6.84% approximately, sodium bicarbonate, pH 7.5	Pulp and Paper	F	75	28	—	—	<0.0001	<0.0001 nil	...	...	...
3%, organic acids, sulfurous acid, tannins (under false bottom of quebracho bisulfiting tank)	Tanning	F	...	180	..	xx	0.0001*	0.0001	...	...	...
sodium sulfite calculated as sodium hydroxide 0.12%, alkaline "Antichlor" solution	Rayon	F	108	56	—	x	<0.0001 <0.0001*	<0.0001	...	...	...
0.093%, sulfates as sulfur trioxide 232 ppm, chlorides as chlorine 210 ppm, iron 28 ppm, nitrates as nitrogen dioxide 15 ppm, free sulfur 2 ppm	....	..	150-200	55	..	..	0.2038	nil	...	C nil	...
SODIUM (BI-) SULFITE											
20%, vanillin, treated under vacuum with sulfuric acid to drive off sulfur dioxide, solution decomposed to sodium sulfate	Pulp and Paper	F	180	116	—	x	...	0.0002'	...	C0.0008	...
6%, organic acids, sulfurous acid, tannins	Tanning	F	...	180	..	xx	0.0001	0.0001	...	...	...
SODIUM VANADATE											
19.4% approximately, hydrochloric acid 5%, sodium chloride 3%	Metal	F	125	30	xx	..	corr	0.069cd	...	0.065cd 0.188cd	...
SOYBEAN											
air, steam, vapors from hot, moist soybean meal (expeller)	Agriculture	F	165	33	xx	xx	<0.0001d	<0.0001d	...	...	...
air, steam, vapors from hot, moist, raw extracted soybean meal	Agriculture	F	156	28	xx	xx	<0.0001	<0.0001	...	...	...
air, steam, vapors from moist, toasted extracted soybean meal	Agriculture	F	175	28	xx	xx	<0.0001d	<0.0001ad	...	...	...
steam, *n*-hexane vapors, some organic distillates from soybean extracted meal, no chlorides (half embedded in carbon, vapors inlet of absorption tower)	Chemical	F	80-250	55	x	x	0.0002	0.0004	...	...	...
vapors and condensate from soybean and flaxseed (linseed) cooking (vapors inlet of condenser)	Food	F	100-400	145	—	x	<0.0001cd <0.0001*	<0.0001	...	...	...
fumes from soybean and flaxseed (linseed) cooking (pressure cooker)	Food	F	450-500	145	—	x	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	■ Type of test	■ Average temperature (F)	■ Duration (days)	■ Aeration	■ Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Soybean											
fumes from the heating of crushed soybeans and flaxseed (expeller conditioner ventilator)	Food	F	230-240	39	—	x	<0.0001	<0.0001	...	...	...
STARCH											
wheat starch, water, sulfur dioxide and "Dowicide," pH 2.2-3.8 (drum drier, vapors during 35 days)	Food	F	320-340	68	x	x	0.0002c 0.0002*c	<0.0001	...	...	...
STEAM											
steam virtually devoid of all solutes (deaerating heater)	Power	F	220	244	—	—	<0.0001	<0.0001 S<0.0001 W<0.0001	...	...	...
steam, occasional traces of ammonia, sodium hydroxide, sodium chlorate and sodium chloride	....	..	430	129	..	..	...	0.0006	...	0.0003	...
92.2% approximately, hydrogen sulfide 7.63%, mercaptans 0.17% (overhead line from sour-water stripper)	Research	L	200-230	291	..	..	nil	...	...	C nil	nil
geothermal steam condensate, carbon dioxide, hydrogen sulfide, ammonia, pH 5.25	Power	F	240	55	—	x	<0.0001	<0.0001	...	...	...
geothermal steam and water, carbon dioxide, hydrogen sulfide, ammonia, pH 6.5 (steam and water separator)	Power	F	180	60	—	x	<0.0001	<0.0001	...	...	...
steam from Dallas city water, after zeolite softening, sodium chloride 292 ppm average, hydroxides 0-42 ppm, carbonates 10-38 ppm, bicarbonates 0-6 ppm	Chemical	F	225	30	xx	xx	...	0.0004c	...	...	<0.0001
steam, fumes from feedstuffs and molasses (top of cooler)	Agriculture	F	190	112	—	—	<0.0001	<0.0001	...	...	...
steam and water and other reagents picked up during vat aging of printed goods	Textile (printing)	F	<212	268	xx	—	0.00011ad	<0.0001	...	...	...
STRONTIUM CHLORIDE											
33%, small amounts of sodium chromate, pH 3-6 during 44 hours, pH 11 approximately during 35 hours, pH 1-2 during 9 hours	Chemical	F	180	3.7	—	x	0.219ad 0.217*bd	0.07bd	...	...	...
SUGAR, BEET											
"Steffen" filtrate, total dry substance 70%, (sucrose 10%, aminoacids 10%, potassium salts remainder), pH 8.5 (evaporator)	Sugar	F	178	127	—	x	<0.0001a <0.0001*	<0.0001	...	...	...
"Steffen" filtrate, total dry substance 40%, (sucrose 10%, aminoacids 10%, potassium salts remainder), pH 8.5 (evaporator)	Food	F	178	127	—	x	0.0001	0.0002	...	...	...
"Steffen" filtrate, total dry substance 4%, (sucrose 10%, aminoacids 10%, potassium salts remainder), pH 8.5 (evaporator)	Sugar	F	214	111	—	xx	0.0001*a	0.0001	...	...	...
carbonated "Steffen" filtrate sludge, total solids 23%, (calcium carbonate 87%, sucrose 4%, aminoacids 4%, mostly potassium salts remainder), pH 8.5 (Dorr thickener)	Food	F	125	59	x	xx	0.0001a	0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sugar, beet											
carbonated "Steffen" filtrate, total solids 3%, (sucrose 10%, aminoacids 10%, calcium carbonate 6%, mostly potassium salts remainder), pH 8.5 (Dorr thickener)	Food	F	125	59	x	x	0.0001	0.0001	...	...	...
SUGAR, CANE											
sugar, hydrochloric acid, ammonium sulfate, ammonium chloride, pH 0.5, pressure	Chemical	F	260	5	—	xx	...	0.037c	0.0059	0.0015	0.0013
97-80% sucrose, sugar syrups and liquors, dissolved solids 60%, pH 3.5-5	Sugar	F	160	133	xx	xx	<0.0001c	<0.0001c	...	...	...
60% sugar syrup, caustic soda 3%, muriatic acid 3%	Sugar	F	180	7	—	xx	0.014	0.006	0.0006	...	...
concentrated "Steffen" filtrate, solids in solution 60%, solids (mostly potassium salts) in suspension 5% (calandria evaporator)	Sugar	F	176	105	x	x	nil	nil	...	...	...
invert sucrose syrup, acidified with hydrochloric acid to pH 2.5-3, and neutralized with lime to pH 5-6	Sugar	F	140	116	—	—	0.0003	0.0001	...	...	...
cane-sugar liquors (bone char filtration)	Sugar	F	170	56	x	x	<0.0001	<0.0001	<0.0001	<0.0001	...
14-0.5% sugar, sweetwater from washing bone char after use as a filter aid for refined sugar liquor (evaporator charge tank)	Sugar	F	160	61	—	xx	<0.0001	<0.0001	...	...	...
11%, low-purity (75%) sweet water, final pH 7.6	Sugar	F	160	228	—	—	<0.0001	<0.0001	...	...	...
5%, sulfuric acid 0.5%, pressure 160 psi	Research	L	363	...	..	—	0.018	0.0033	...	...	...
sugar filter media, superheated steam, pH 6 (gravity filter vessel)	Sugar	F	200-1100	0.2	—	xx	0.001*	0.002	0.003	...	...
"Steffen" filtrate, solids in solution 2.5%, calcium carbonate precipitated 1%, solids in suspension (Kelly filter)	Sugar	F	185	105	x	x	<0.0001	<0.0001	...	...	...
waste water from bone-char filters, organic and inorganic impurities, pH 6.7-7.3	Sugar	F	170	74	x	—	<0.0001	<0.0001	<0.0001	<0.0001	...
steam, destructively distilled organics at 800 F, pH 6-7 (filter)	Sugar (refining)	F	200-700	50	—	xx	<0.0001	<0.0001	<0.0001	...	...
vapors from low-grade sugar massecuite, vacuum 27 in. of mercury (condenser)	Sugar	F	160	59	xx	xx	<0.0001	<0.0001	...	...	...
vapors from hot sugar liquor (char filter trough)	Sugar	F	145	56	—	—	<0.0001	<0.0001	<0.0001	<0.0001	...
SUGAR, CORN, CONVERSION											
dextrose solution formed by washing dextrose dust with recirculated water, pH initially 7, finally 3.7 each day (sugar scrubber)	Food	F	78-88	16	xx	xx	<0.0001	<0.0001	...	...	...
dextrose, dilute hydrochloric acid, pH 1.33	Food	F	214	8	—	xx	0.016d	0.0002	...	...	...
corn syrup being concentrated from 51% solids to 80% solids (vacuum evaporator)	Corn Products	F	90-190	108	—	xx	<0.0001d	<0.0001d	...	<0.0001 C<0.0001	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Sugar, corn, conversion											
corn syrup	Corn Products (refining)	F	...	280	xx	xx	<0.0001ad	<0.0001ad	...	...	...
85-50% approximately, second sugar liquor, sodium chloride 4.2%, pH 4.2 (final evaporator)	Sugar	F	135	33	—	xx	0.0006 0.0005*	0.0003	...	...	...
60% approximately, second sugar char liquor, pH 4-5 (under surface of carbon in column)	Sugar	F	70	42	—	xx	0.0002bd	<0.0001	...	...	...
50% approximately, second sugar liquor, sodium chloride 2.7%, hydrochloric acid to pH 4.4-4.6	Sugar	F	135	30	x	—	<0.0001	<0.0001	...	...	...
45% approximately, glucose liquor from corn, pH 4-4.5 (filter)	Food	F	170	100	x	xx	0.0003cd	<0.0001	...	...	...
22% approximately, refined dextrose solution, activated carbon suspension, sulfuric acid, pH 4	Corn Products	F	145	52	x	x	<0.0001 W<0.0001	<0.0001 W<0.0001	...	...	...
96.9% starch, hydrochloric acid 10°Bé remainder	Chemical	F	425	15	—	x	0.0015*a	0.0005a	...	...	...
93.8% starch, 10°Bé hydrochloric acid 3.11%, glacial acetic acid 3.05%	Chemical	F	140	15	—	x	0.0003*a	0.0002	...	...	...
aerated cornstarch fermentation liquor, pH >3.2, pressure 15-18 psi	Food	F	77-96	6	xx	xx	<0.0001 <0.0001*	<0.0001	...	...	...
starch slurry, hydrochloric acid to 0.02N, specific gravity 1.075, pH 1.8 (dextrose converter, vapors, liquid)	Corn Products (refining)	F	275	134-217	..	xx	...	0.0002 0.0004d	...	<0.0001d 0.0008d	...
starch slurry, sulfuric acid to 0.04N, chlorides 0.0022%, pH 1.8-2	Corn Products	F	120	57	xx	xx	0.0001 W<0.0001	W<0.0001	...	...	...
starch wash filtrates, sulfur dioxide, pH 3.5	Corn Products (refining)	L	125	44	xx	xx	0.001d	<0.0001	<0.0001	...	...
flashed steam, hydrochloric acid, sulfur dioxide, various volatile decomposition products from acid hydrolysis of corn starch, pH of liquor 1.5 (vapor line)	Food	F	60-212	79	x	xx	<0.0001cd	<0.0001	...	<0.0001	<0.0001
SULFONATED COMPOUNDS											
91.3% benzene sulfonic acid, sulfuric acid 3.8%	Chemical	F	284	8	—	—	...	0.66		0.07	0.12
90% benzene sulfonic acid, sulfuric acid 4% finally; sulfuric acid 66°Bé, benzene initially	Chemical	F	329	15	—	x	...	0.095	...	0.046	0.036
86.7% benzene sulfonic acid, sulfuric acid 3.7%, some water	Chemical	F	284	11	—	—	...	0.53	...	0.7	>0.65
60-40% benzene sulfonic acid, sulfuric acid 30-50%, benzene *m*-disulfonic acid 0-15%, sulfur dioxide in vapors	Chemical	F	98-275	31	xx	xx	0.0017d	0.0011	...	...	...
50% oil-soluble sulfonic acid, solvent naphtha 45%, water 5%, sulfuric acid trace (bottom of still)	Chemical (distillation)	F	60-250	3.8	—	x	...	1.451	0.83	0.346	0.316
50% oil-soluble sulfonic acid, solvent naphtha 45%, water 5%, sulfuric acid trace (vapors)	Chemical (distillation)	F	60-250	3.8	—	x	...	0.061	0.06	0.063	0.058

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfonated compounds											
liquor saturated with organic sulfonic acids, sodium sulfate and sulfur dioxide, hydrochloric acid 2%, some sulfuric acid, acetic acid trace, pH 1.5-2 (vacuum filter, alternately immersed)	Chemical	F	98	40	x	x	corr	0.0002a	...	0.002	...
liquor saturated with organic sulfonic acids, sodium sulfate and sulfur dioxide, hydrochloric acid 2%, some sulfuric acid, acetic acid trace, pH 1.5-2 (vacuum filter)	Chemical	F	78-98	80	—	x	corr	0.0001	...	0.0001	...
66% approximately dodecylbenzene sulfonic acid, spent sulfuric acid 33% approximately, sulfur dioxide and trioxide (bottom of sulfonator)	Petroleum	F	155	22	x	xx	0.071d	0.055d	0.049d	0.0102	0.02
66% approximately dodecylbenzene sulfonic acid, spent sulfuric acid 33% approximately, sulfur dioxide and trioxide (sulfonator, vapors)	Petroleum	F	155	22	x	xx	0.043d	0.04d	0.03d	0.0036	0.007
33% approximately dodecylbenzene sulfonic acid, hexane 64%, spent sulfuric acid 2-3% (bottom of tank)	Petroleum	F	80	22	x	x	0.0003	0.0009	0.0011	0.0008	0.0018
33% approximately dodecylbenzene sulfonic acid, hexane 64%, spent sulfuric acid 2-3% (vapors)	Petroleum	F	80	22	x	x	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
dodecylbenzene sulfonic acid, from reaction of 20% oleum 1.32 parts and dodecylbenzene 1 part	Detergent	L	125	16	—	xx	0.01d 0.003d	0.0023d	...	0.0009	...
dodecylbenzene sulfonic acid, from reaction of 20% oleum 1.32 parts and dodecylbenzene 1 part, water 0.139 parts	Detergent	L	125	16	—	xx	0.0015d	0.0021d	...	0.0011	...
dodecylbenzene sulfonate paste, neutralized with mixture of alkali and alkaline metal hydroxides	Detergent	L	125	16	—	xx	nil	nil	...	...	...
sulfonated kerosene, settling out of sulfuric acid 85%	Detergent	F	135	111	xx	—	0.005*d	0.004	...	...	...
sulfonated kerosene, in sulfuric acid 85% which during washing ranges from 85% to neutral	Detergent	F	60-150	111	xx	xx	0.002ad	0.003ad	...	...	...
naphthalene sulfonic acid, solids 50%, pH 1	Chemical	F	122	3.3	—	xx	0.0395	0.0107	...	...	...
naphthalene sulfonic acid, phenol condensates, pH 1-7 (bottom of tank)	Chemical	F	104-284	100	x	xx	>0.056c	>0.061c	0.039c 0.073c	...	0.013
30% phenol sulfonic acid, from reaction of phenol and 98% sulfuric acid (248 F during 12 hours), formaldehyde and water added, borax and ammonia to pH 3	Chemical	F	158	40	—	..	...	0.142	0.136	C0.0084	...
22% p-chlorobenzene sulfonic acid, sulfuric acid 74%, "DDT" 4%	Chemical	F	65	11	—	—	0.0003	0.001	0.002	...	...
chlorosulfonic acid, alkyl aryl organic, hydrochloric acid, sulfur dioxide	Chemical	F	140	4.2	x	xx	0.0087	0.008	0.0068	0.0068	...
20%, pyridine sulfonic acid, sulfuric acid 1-5%, calcium sulfate, mercury sulfate suspension trace (alternately immersed)	Chemical	F	75	37	xx	x	<0.0001	<0.0001	...	...	...
15-10% calcium pyridine sulfonate, pyridine 1% approximately, calcium hydroxide 0.1%, pH 8 approximately (alternately immersed)	Chemical	F	R.T.	4.7	xx	x	0.0012*	0.0014	...	...	...
calcium pyridine sulfonate slurry, sulfuric acid 1-5%, small amount of mercury sulfate probably in mercuric form (vacuum filter)	Chemical	F	100-150	16	xx	x	<0.0001*	<0.0001	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	Average corrosion rates (ipy): TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
Sulfonated compounds											
aconitic acid, sodium hydroxide, sulfuric acid, sodium m-bisulfite (half immersed)	Chemical	F	188-195	0.4	xx	..	0.113ad	0.121	...	...	...
sulfonated turpentine, from reaction of sulfuric acid 60% and turpentine in molar ratio 2/1	Chemical	F	32-42	1	..	..	0.001	0.001	0.001	0.005	...
sulfonated alkylated aromatics, sulfuric acid 98% at 145-170 F, and 63% at 195-222 F	Chemical	F	145-222	14	..	xx	0.21	...	0.122	0.048	...
sulfonated alkylated aromatics, sulfuric acid 98% at 145-170 F, and 63% at 195-222 F (vapors)	Chemical	F	145-222	14	..	xx	0.0017	0.0013	0.0013	0.001	...
sulfonated waxes, sodium chloride, water solution, pH 5-8	Rayon	F	132	162	..	xx	0.0001cd 0.0001*ad	0.0001	...	...	...
unspecified green sulfonic acids, unspecified carboxylic acids, medium viscosity lube oil stock, in sulfuric acid 3% solution, neutralized with sodium hydroxide to sodium hydroxide $<6\%$ concentration (below steam coil, bottom of tank)	Petroleum	F	150-180	60	x	x	0.045c	0.027c	...	0.0027	...
SULFUR											
liquid sulfur, selenium	Metal (distillation)	F	850	7.8	—	..	0.015	0.008	...	0.028	...
liquid sulfur, iron and aluminium chlorides 600 ppm approximately, hydrochloric acid trace possible (filter)	Chemical	F	275	83	—	xx	0.0037*cd 0.0035cd	0.0024	0.0033	C0.004	...
liquid sulfur, small amounts of sulfuric acid and iron sulfate (air-sulfur interface)	Mining	F	280	13	xx	xx	0.015 0.015*	0.018	0.017	0.015	...
liquid sulfur, traces of moisture and hydrochloric acid	Chemical	F	302	105	—	—	0.0048cd	0.0033cd	...	...	...
liquid sulfur, air, small amounts of water, pH 1.5-3.5	Mining (sulfur)	F	305	11	xx	xx	0.037 0.035*	0.021a	0.019bd	...	...
liquid sulfur, water saturated, pressure 25 psig	Chemical	F	248	8.5	—	—	0.088c	0.058c	...	...	...
liquid sulfur, moisture during 10 days, and water during 51 days	Mining (sulfur)	F	330	61	xx	xx	0.005*cd	...	0.0015bd	...	...
liquid sulfur, nitrogen 55%, water vapor 27%, carbon dioxide 9%, hydrogen sulfide 4%, sulfur dioxide 2% of gas (bottom of tower packing support, scrubbing of sulfur vapors)	Chemical	F	290	135	—	xx	0.0003cd	0.0001	...	...	...
sulfur, sulfuric acid, hydrogen sulfide, sulfur dioxide, sulfurous acid trace, water vapor	Chemical	F	73-284	81	..	xx	0.0048*cd	0.0018bd	...	...	...
sulfur (vapors)	Metal (distillation)	F	850	7.8	—	..	0.02	0.023	...	...	...
sulfur (vapors)	Chemical	F	1060	54	..	xx	0.027	0.0311	...	...	...
sulfur, stagnant (vapors)	Research	F	1020	27	..	—	0.03 0.032*	0.0022	...	0.02	...
sulfur, stagnant (vapors)	Research	F	1100	36	..	—	0.031 0.051*	...	...	...	...
sulfur, stagnant (vapors)	Research	F	1250	28	..	—	0.047 0.014*	0.084	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfur											
sulfur, stagnant (vapors)	Research	F	1400	28	..	—	0.11 0.18*	0.12	...	...	...
sulfur, traces of moisture and hydrochloric acid (vapors)	Chemical	F	305	105	—	—	0.004cd	0.0023cd	...	...	...
6% sulfur, in acid gases, nitrogen 55%, water vapor 16%, carbon dioxide 15%, hydrogen sulfide 6%, sulfur dioxide 3%	Chemical	F	500-600	163	..	..	0.0002	0.0001	...	...	...
3% sulfur vapors, in acid gases, nitrogen 55%, water vapor 27%, carbon dioxide 9%, hydrogen sulfide 4%, sulfur dioxide 2% (bottom of catalyst support grid in converter)	Chemical	F	800	135	—	xx	0.002	0.002	...	...	...
2.5% sulfur vapors, in acid gases, nitrogen 59%, water vapor 22%, carbon dioxide 15%, hydrogen sulfide 1%, sulfur dioxide 0.5%	Chemical	F	500	276	..	..	<0.0001	0.0001	...	...	...
sulfur vapors in steam (vulcanization autoclave, half immersed in water)	Rubber	F	290	4.5	..	..	<0.0001 <0.0001*	<0.0001	...	...	...
sulfur compounds leached from rubber, hot water and steam or steam alone	Rubber	F	212	69	—	—	L<0.0001	<0.0001	...	...	...
sulfur compounds in reduced crude vapors, pressure 75-mm mercury (tar pocket, vacuum tower)	Petroleum	F	750	369	—	xx	0.0002	L0.0001	...	...	...
SULFUR CHLORIDE											
98.3%, carbon tetrachloride 0.13%, iron as ferric chloride 0.01% (reboiler for bubble cap column)	Chemical (rectification)	F	280	133	—	xx	0.00078	0.0004	...	...	...
98% approximately (below bottom plate of bubble cap column, vapors)	Chemical (rectification)	F	257	133	—	xx	0.00035	0.00035	...	...	...
SULFUR DIOXIDE											
80%, nitrogen 20%, water vapor saturated	Chemical	F	60	94	—	xx	0.0001 0.00025*	0.00025	...	...	...
18%, small amount of sulfur trioxide and moisture (sulfur burner, discharge line)	Chemical	F	500-700	90	xx	xx	...	0.0002	0.0003	0.0002	0.0001
17-13%, moisture, small amount of sulfur trioxide (tower)	Pulp and Paper	F	100	37	..	..	<0.0001a 0.0003*a	<0.0001	<0.0001	...	...
10% approximately, saturated with water, recycle liquor contains sulfuric acid 0.3-0.75% (Peabody scrubber)	Sulfuric Acid	F	85-95	20	xx	xx	0.0001*	0.0001	0.0001	0.0001	<0.0001
10% approximately, saturated with water, recycle liquor contains sulfuric acid 0.7-2.5%	Sulfuric Acid	F	125-135	20	xx	xx	0.002a 0.254a	0.052	0.006	0.003	0.002
10-7%, water 30-80%, sulfur trioxide 5-7%	Chemical	F	180-200	4.5	..	xx	0.02 0.037	0.021 L0.041	...	...	0.02
5%, nickel-converter gas	Metal	F	400	39	..	..	0.0056ad 0.0008a	0.0046a 0.0007	...	...	0.0041 0.0008ad
5%, saturated fumes from calcining process, oxygen 11%, carbon dioxide 8%, sulfur trioxide mist 1 cu ft	Metal	F	40-130	34	xx	xx	...	<0.0001	<0.0001	<0.0001 C0.0001	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfur dioxide											
5% approximately, air, moisture 6%, sulfur trioxide 1%	....	..	425	68	..	..	0.002	0.002	...	...	...
<5%, oxygen 15%, nitrogen remainder, dew point 125F	Mining	F	200-500	79	xx	xx	0.0042b 0.0015*cd	0.0007	...	...	...
4-2%, water-vapor saturated gases	Mining	F	170-550	180	x	x	<0.0001	<0.0001	...	<0.0001	<0.0001
2-1.5%, oxygen and nitrogen remainder	Mining	F	300-500	103	xx	xx	<0.0001a 0.0002a	<0.0001cd	...	...	...
0.25%, moisture	Food	F	31	62	x	x	<0.0001	<0.0001	<0.0001	<0.0001	...
sulfur-dioxide-containing gas (spray tower)	Mining	F	185	13	xx	xx	0.2	0.184	0.161	...	...
sulfur dioxide, sulfuric-acid mist, selenious acid, nitrogen oxides from decomposition of sodium nitrate, water vapor, gases of varying composition (Cottrell exit gases)	Metal	F	90-100	15	..	xx	0.085cd	0.035cd	...	0.032bd	...
sulfur dioxide, sulfuric-acid mist, selenious acid, nitrogen oxides from decomposition of sodium nitrate, water vapor, gases of varying composition (Cottrell exit gases)	Chemical	F	90-100	8.8	..	xx	0.15bd	0.007bd	...	0.009bd	0.01bd
sulfur dioxide, moisture, carbon dioxide, lactic acid, organic-acid vapors	Corn Products (refining)	F	200-400	271	—	—	0.021c	0.0002c L0.0001c	...	...	...
sulfur dioxide, sulfur mist, small amounts of oxygen, water vapor and sulfuric acid (Cottrell precipitator)	Mining	F	250-450	2	x	xx	0.094 0.035*	0.051	0.047	...	...
sulfur dioxide, sulfur flowers added to burning coke, sulfur trioxide, carbon monoxide and dioxide, uncertain concentrations, possibly sulfuric and sulfurous acids	Brewing (beer)	F	60-140	277	xx	xx	0.0004d 0.0003*d	0.0001	...	...	...
sulfur dioxide, trioxide, carbon dioxide (locomotive smoke)	Railroad	F	R.T.	365-620	xx	xx	0.001a	0.0001a	...	...	...
SULFURIC ACID											
oleum (25%)	Soap	F	50-90	55	xx	—	...	0.0007	...	...	0.0002
95%	Research	L	60	1	xx	—	0.013	nil	...	...	...
95%	Research	L	100	0.08	x	—	0.0042	nil	nil	...	...
95%	Research	L	104	1	xx	—	0.022	nil	...	...	...
95%	Research	L	150	0.08	x	—	0.15	0.059	0.084	...	...
95%	Research	L	175	0.08	x	—	0.138	0.0825	0.26	...	...
95%	Research	L	200	0.08	x	—	0.177	0.338	0.551	...	...
93.5%	Plastic	F	49-77	102	—	—	<0.0001	nil	<0.0001	...	...
90%	Research	L	104	1	xx	—	0.017	nil	...	...	...
80%	Research	L	60	1	xx	—	0.002	nil	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfuric acid											
80%	Research	L	100	0.08	x	—	0.736	0.282	0.579	...	...
80%	Research	L	104	1	xx	—	0.022	nil	...	...	...
80%	Research	L	150	0.08	x	—	1.26	0.572	1.12	...	...
80%	Research	L	175	0.08	x	—	2.1	1.2	3.35	...	...
80%	Research	L	200	0.08	x	—	7.05	4.0	6.05	...	...
77.6%	Research	L	90	...	—	..	0.0001	0.0007	...	0.0001	...
70%	Research	L	60	1	xx	—	0.039	0.05	...	...	...
70%	Research	L	104	1	xx	—	0.0875	0.54	...	...	...
66%	Research	L	90	...	—	..	0.204	0.144	...	0.0003	...
60%	Research	L	60	1	xx	—	0.306	0.43	...	...	...
60%	Research	L	104	1	xx	—	0.346	1.08	...	...	...
50%	Research	L	60	1	xx	—	0.15	0.258	...	...	...
50%	Research	L	90	...	—	..	0.217	corr	...	0.0038	...
50%	Research	L	104	1	xx	—	4.4	6.5	...	...	...
40%	Research	L	60	1	xx	—	0.048	0.18	...	...	...
40%	Research	L	100	0.08	x	—	0.85	0.825	0.22	...	...
40%	Research	L	104	1	xx	—	0.9	6.5	...	...	...
40%	Research	L	150	0.08	x	—	13.0	6.4	2.64	...	...
35%	....	..	R.T.	1	..	..	0.6	0.072	...	...	...
30%	Research	L	60	1	xx	—	0.035	0.065	...	...	...
30%	Research	L	104	1	xx	—	0.474	0.665	...	...	...
30%	Metal (cleaning)	F	130	62	xx	xx	0.0001	<0.0003	0.0004	0.0002 0.0012	...
25%	Research	L	60	1	xx	—	0.053	nil	...	...	...
25%	Research	L	104	1	xx	—	0.41	0.47	...	...	...
20%	....	..	R.T.	1	..	..	0.13	0.009	...	...	...
20%	Research	L	60	1	xx	—	0.44	nil	...	...	...
20%	Research	L	100	0.08	x	—	1.01	0.0745	0.024	...	...
20%	Research	L	104	1	xx	—	0.437	0.11	...	...	...
20%	....	..	104	1	..	..	0.68	0.027	...	...	...
20%	Research	L	150	0.08	x	—	5.75	0.191	0.198	...	...
20%	Research	L	175	0.08	x	—	10.7	0.84	0.576	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfuric acid											
20%	Research	L	200	0.08	x	—	21.0	1.77	1.06	...	...
20% approximately	Chemical	F	<104	8.5	xx	—	0.0002 0.0238 L0.0001	0.0001	...	...	...
15%	Research	L	60	1	xx	—	0.03	niL	...	...	...
15%	Coal By-product	F	59-86	212	x	xx	0.024c	0.0014	...	0.0012	...
15%	Research	L	104	1	xx	—	0.292	nil	...	...	...
12% approximately	Metal (pickling)	F	185-195	14	xx	xx	0.0126a	0.0027	...	...	...
10%	....	..	R.T.	1	..	..	0.065	nil	...	...	...
10%	Research	L	60	1	xx	—	0.0175	nil	...	...	...
10%	Research	L	100	0.08	x	—	0.39	0.0096	nil	...	...
10%	Research	L	104	1	xx	—	0.193	nil	...	...	...
10%	....	..	104	1	..	..	0.17	0.0036	...	...	...
10%	Research	L	140	1	..	..	...	0.09	...	...	...
10%	Metal (pickling)	F	120-160	23	..	..	...	L nil	nil	nil	0.013
10%	Research	L	150	0.08	x	—	1.83	0.081	0.078	...	...
10%	Research	L	175	0.08	x	—	4.5	0.15	0.197	...	...
10%	....	..	176	1	..	..	...	0.18	...	...	...
10%	Research	L	200	0.08	x	—	7.0	0.207	0.55	...	...
10%	Research	L	B.P.	...	—	—	16.5	0.86	...	...	...
10% approximately	Sugar	F	68-152	97	..	..	<0.0001* <0.0001 0.0007	0.0001	...	<0.0001 0.025	...
8.7%	Research	L	176	9-10	..	..	0.460	0.0001	0.0252	...	...
8%	Metal (pickling)	F	130	47	—	—	0.0108 0.0504	0.0014	...	C0.0059	...
5%	....	..	R.T.	1	..	..	0.047	nil	...	...	...
5%	Textile	F	R.T.	104	xx	—	<0.0001	<0.0001	...	...	...
5%	Research	L	60	1	xx	—	0.013	nil	...	...	...
5%	Textile	F	80	106	x	x	nil	nil	...	...	...
5%	Research	L	100	0.08	x	—	0.222	nil	nil	...	...
5%	....	..	104	1	..	..	0.058	nil	...	...	...
5%	Research	L	104	1	xx	—	0.0875	nil	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfuric acid											
5%	Research	L	150	0.08	x	—	1.1	0.036	0.0038	...	...
5%	Research	L	175	0.08	x	—	1.63	0.74	0.09	...	...
5%	Research	L	200	0.08	x	—	5.4	0.14	0.23	...	...
3%	Research	L	100	0.08	x	—	0.067	nil	nil	...	...
3%	Research	L	150	0.08	x	—	0.388	0.0082	nil	...	...
3%	Research	L	175	0.08	x	—	0.528	0.04	0.058	...	...
3%	Research	L	200	0.08	x	—	1.3	0.094	0.12	...	...
2.5%	....	..	R.T.	1	..	..	0.031	nil	...	...	...
2.5%	....	..	104	1	..	..	0.036	nil	...	...	...
2.5%	....	..	140	1	..	..	0.16	0.0036	...	...	...
2.5%	....	..	176	1	..	..	...	0.036	...	...	...
2% approximately	Pulp and Paper	F	...	90	..	..	nil	nil	...	...	...
1%	....	..	R.T.	1	..	..	0.025	nil	...	...	...
1%	Research	L	100	0.08	x	—	0.0575	nil	nil	...	...
1%	....	..	104	1	..	..	0.028	nil	...	...	...
1%	....	..	140	1	..	..	0.074	nil	...	...	...
1%	Research	L	150	0.08	x	—	0.22	nil	nil	...	...
1%	Research	L	175	0.08	x	—	0.38	nil	nil	...	...
1%	....	..	176	1	..	..	...	nil	...	...	...
1%	Research	L	200	0.08	x	—	0.79	nil	nil	...	...
1%	....	..	B.P.	1	..	..	...	0.14	...	...	...
1%	Research	L	B.P.	0.5	..	xx	0.3161	0.0489	...	...	...
0.5%	Research	L	100	0.08	x	—	0.037	nil	nil	...	...
0.5%	....	..	104	1	..	..	0.025	nil	...	...	...
0.5%	Synthetic Rubber	F	80-110	9	xx	x	0.021 0.0056*	0.0011	...	...	...
0.5%	....	..	140	1	..	..	0.047	nil	...	...	...
0.5%	Research	L	150	0.08	x	—	0.0225	nil	nil	...	...
0.5%	Research	L	175	0.08	x	—	0.445	nil	nil	...	...
0.5%	....	..	176	1	..	..	...	nil	...	...	...
0.5%	Research	L	200	0.08	x	—	0.79	0.0038	nil	...	...
0.5%	....	..	B.P.	1	..	..	...	0.054	...	...	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfuric acid											
0.25%	....	..	140	1	..	..	0.036	nil	...	...	...
0.25%	....	..	176	1	..	..	...	nil	...	...	...
0.25%	....	..	B.P.	1	..	..	...	0.0027	...	...	...
SULFURIC-ACID MIXTURES—see also MIXED ACIDS											
83.9% oleum (18%), pyridine 16.1%	Chemical	F	125-152	6	—	x	0.0013	0.0016	0.0014	C<0.0001	...
66% oleum (65%), pyridine 33% (bottom of sulfonation kettle)	Chemical	F	329-347	2	—	x	0.123 0.111*	0.07	...	C0.053	...
oleum (40%), nitric acid 4%	Chemical	F	110	110	—	x	0.00018	0.0001	0.00012	...	...
vapors over oleum (20%) and pyridine	Chemical	F	125-152	6	x	x	0.0001	0.0001	0.0001	C nil	...
99-96%, ferric sulfate, ferric chloride, hydrochloric-acid saturated (pipe)	Chemical	F	75-82	167	x	xx	0.00027	0.00015	...	...	0.00015
98%, sodium naphthanate 2-3°Bé	Petro-chemical	F	60-215	80	—	xx	0.0185d 0.017*cd	0.013d	...	0.0059d	0.0063d
98-80% sulfuric-acid sludge, pressure 15-18 psi (settling drum)	Petroleum	F	160	25	—	x	corr*	corr	...	...	...
93-0%, aluminium sulfate 30-90%, hydrated aluminum oxide (underside of tank cover, vapors and splash)	Chemical	F	40-270	165	..	—	0.0008	0.0002	...	<0.0001	<0.0001
89%, acetic anhydride 9.1%, water remainder	Petroleum	F	65-105	42	—	x	<0.0001	<0.0001	...	C0.00011	...
89%, acetic anhydride 9.1%, water remainder (vapors)	Petroleum	F	65-105	42	—	xx	...	<0.0001	...	C<0.0001	...
80-20%, tallow fat	Soap and Fatty Acid	F	150-200	110	..	xx	corr	0.072	...	0.012	...
79%, nitrogen oxides	Chemical	F	95	73	..	..	nil	nil	...	C nil	...
78%, hydrogen peroxide 3.5%, various iron, manganese, chromium and nickel salts	Soap	F	100-130	8	xx	xx	0.0047	0.0082	0.014	0.0022	0.005
69%, reclaimed sulfuric acid, sodium sulfate 40-50 g/l, nickel 3-5 g/l, arsenic 1-1.5 g/l, copper trace	Metal	F	100	33	..	—	0.14	0.0005	...	0.0009	...
67%, propane, propylene partially combined with the acid	Chemical	F	104-167	113	xx	xx	0.075c	0.08c	...	0.012a	0.0059
67%, minor hydrocarbon contaminants	Chemical	F	77-122	113	xx	xx	0.015	0.0015	...	0.0013a	0.0014
63-41%, propylene	Chemical	F	68-203	63	xx	xx	...	0.01	0.099	0.099	0.033
60% sulfuric-acid emulsion, manganese dioxide precipitated 40%	Pharma-ceutical	F	145	12	x	xx	0.0094	0.0094	...	...	...
60-20%, copper 45 g/l, nickel 20 g/l, arsenic 11.7 g/l	Metal (electro-refining)	F	B.P.	101	x	xx	...	0.0002	0.0002	0.0002	0.0001

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions						Average corrosion rates (ipy)				
	INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
Sulfuric-acid mixtures											
56.5%, selenious acid 80 g/l, sodium sulfate saturated	Chemical	F	50-190	13	x	x	0.007a	<0.0001	...	...	...
56% sulfuric-acid sludge from light-oil washing, coal tar, saturated and unsaturated hydrocarbons, sulfur trioxide fumes, steam	Coal By-product	F	285	87	—	xx	0.005	0.002	...	0.0003	...
56% sulfuric-acid sludge from light-oil washing, coal tar, saturated and unsaturated hydrocarbons, sulfur trioxide fumes, steam	Coal By-product	F	285	2	—	xx	0.2	0.06	...	0.011	...
56% sulfuric-acid sludge from light-oil washing, coal tar, saturated and unsaturated hydrocarbons, sulfur trioxide fumes, steam	Coal By-product	F	256-285	77	..	..	0.006c	0.003c	...	0.0013c	...
56% sulfuric-acid sludge from light-oil washing, coal tar, saturated and unsaturated hydrocarbons, sulfur trioxide fumes, steam	Coal By-product	F	256-285	3	..	..	0.15	0.08	...	0.033	...
50%, caustic soda 20°Bé (neutralizer)	Petroleum	F	200-250	48	—	—	0.065cd	0.02cd	...	...	...
50-5%, fats and oils (top of tank)	Soap and Fatty Acid	F	160-200	40	x	xx	0.0056	0.0047	...	0.0028	0.0027
45%, sodium bichromate 8%, sodium sulfate 8%, chromic sulfate 3%	....	..	105	7	..	..	0.05	0.041	...	...	...
35.6%, phosphoric acid 13.3%, aluminum and ferric oxides 3.4%, hydrofluoric acid 1.3%, copper 0.3%, rare-earth oxide 0.02%, thorium oxide 0.01% (transport truck)	Chemical	F	R.T.	7	x	xx	0.0012 0.0004	0.001	...	0.0034	...
35-15% sulfuric-acid sludge, tar, oil	Petroleum	F	120-200	19	—	xx	0.121	0.059c	0.045	C0.017	...
35-15% sulfuric-acid sludge, large volumes of tar and oil	Petroleum	F	120-200	29	—	xx	...	...	0.482	C0.157	...
35-10%, ammonia, nitrous oxide	Chemical	F	40-110	53	—	xx	<0.0001	<0.0001	...	...	...
30%, clay	Research	L	212	>6	—	xx	0.0001*	0.0008	...	...	...
30% approximately, sodium-sulfate solution (sulfonator)	Chemical	F	175-202	5.1	x	—	0.34	0.39	0.46	...	...
30-20%, copper sulfate 0.5-3.5%, abrasive anode mud from electrolytic copper-refining process	Metal	F	170-180	4	xx	xx	0.131	0.096	0.072	...	...
25%, phosphoric acid 15%, sodium sulfate 3%, hydrofluoric acid 0.3%, rare-earth fluorides	Chemical	F	R.T.-212	4	xx	xx	corr	corr	...	C0.01	...
25-22%, sodium dichromate 5-6%	Aircraft	F	150-160	70	xx	xx	0.021cr	0.011	0.013	0.005	0.009
24%, titanium dioxide as titanium sulfate 12%, ferrous sulfate 9.6%, titanium (3) 2 g/l, specific gravity 1.485	Metal	F	66-70	5	—	xx	0.03*	0.0024	...	...	...
22-19%, copper sulfate 35-45 g/l, nickel sulfate 20-30 g/l, chlorides as sodium chloride 0.5 g/l	....	..	130-150	30	..	x	<0.0001	<0.0001 L<0.0001	...	<0.0001	<0.0001
20%, sodium dichromate 4% (stripping tank)	Metal	F	150-160	77	—	xx	0.014	0.023	0.011	0.0064	0.019

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfuric acid mixtures											
20%, copper sulfate <5% (continuous pickler)	Metal (pickling)	F	140	25	x	x	0.188*	0.014 W0.013	0.015	C0.0056	...
20%, ferrous and ferric iron 2% (continuous pickler, bottom of sump tank)	Metal (pickling)	F	170-180	8	xx	x	<0.0001	<0.0001	...	...	...
18.5%, chromic acid 3% (bottom of tank)	Metal	F	180	86	—	x	0.0091 S0.031a L0.012	0.016 S0.04 L0.027a	0.021a	0.0081	0.0038 S0.072
18.5%, chromic acid 3% (bottom of tank)	Metal	F	180-185	23	—	x	0.0051 S0.024	0.007 S0.014	...	...	...
18%, sodium chloride 3%	Metal (pickling)	F	170-190	7	—	xx	0.53	0.21	0.17	0.11 C0.096	...
18%, iron 1% approximately, "Rodine 67" inhibitor added (continuous pickler)	Metal (pickling)	F	190-210	19	—	xx	0.0004	0.0003	0.0004	0.0006 C0.0003	...
17.5%, chromic acid 3.5%	Electronic	F	160-200	30	—	—	0.003a 0.002d	0.0015	...	0.0008	...
15.6-8.5%, selenious acid 40-100 g/l, some selenium suspension, small amounts of sulfurous acid	Research	L	70-80	90	..	..	0.0324c	0.0004d	...	C0.0003d	nil d
15%, anneal and spray pickle cycle (conveyor racks)	Metal	F	R.T.-1300	8	xx	xx	0.012 L0.014	0.007	...	0.005	...
15-10%, copper sulfate	Metal (cleaning)	F	B.P.	720	—	xx	0.0001 S corr L NG	0.00014	...	0.0001	...
15-10% sulfuric-acid sludge, large amounts of sludge oil	Petroleum	F	150-200	22	—	xx	0.095 0.077*	0.072	0.077	C0.046	...
13%, manganese sulfate, manganic oxide, water	Chemical	F	80-210	30	x	xx	0.034	0.031	...	0.03	...
10%, manganese dioxide 9-10 g/l, some permanganic acid	Metal (plating)	F	131-208	76	—	—	0.0045	0.0047	0.0053	0.005	0.004
10%, manganous acid 8%, slurry	Chemical (filtration)	F	65-70	3.8	—	x	<0.0001	<0.0001	...	...	...
10%, manganese-dioxide sludge (electrolytic zinc cell)	Metal (plating)	F	95-122	60	—	x	0.0078	0.0083	0.0087	0.0069	0.0051
10%, copper sulfate 2% (spray pickling machine)	Metal (pickling)	F	90	7.3	xx	xx	<0.0001 <0.0001*a	<0.0001	...	...	...
10-5%, copper sulfate 0.25%	Metal	F	100-200	162	x	xx	<0.0001 S NG	<0.0001 S NG	...	...	0.0001 S N G
10-5%, sodium sulfate 25%, hydrogen sulfide trace	Petroleum	F	100-140	42	—	x	0.053cd	0.025cd	0.004cd	...	...
10-5%, sodium sulfate 25%, hydrogen sulfide trace	Petroleum	F	100-140	23	—	x	0.062cd	0.018cd	0.0033cd	...	...
9%, water 85.5%, sodium sulfate 3%, hydrofluoric acid 1%, orthosilicic acid 1%, sodium fluosilicate 0.5%	Chemical	F	80-120	62	—	—	0.015	0.007	...	...	0.001

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfuric-acid mixtures											
8%, oxidizing constituent, "Ferroclean" pickling solution	Metal	F	...	1	—	..	0.0004 0.0005*	nil	...	...	...
8-7.5%, aluminum sulfate 3%, ferric sulfate 1%, small amounts of calcium and magnesium sulfates	Chemical	F	200-210	7.5	xx	xx	0.025	0.006a	...	...	...
8-7%, sodium nitrate 0.8-0.9 oz/gal	Metal (pickling)	F	155-165	13	—	xx	0.036d 0.053d	0.0001 0.0031	nil 0.0022	...	...
6%, alum solution 11%	Pulp and Paper	F	78	90	..	xx	<0.0001	0.0007	...	<0.0001	...
5.5%, roaster-scrubber solution, selenium as selenious acid 89.7 g/l, tellurium as tellurous acid 0.8 g/l	Chemical	F	150-160	30	..	x	0.08cd	0.025cd	...	0.02cd	0.002cd
5%, zirconyl sulfate 0.3-0.4 lb/gal	....	F	80-100	15	xx	xx	...	0.001	...	0.001	nil
5%, zirconyl sulfate 3-4%	....	F	90	15	xx	..	nil	0.001	...	0.001	nil
5%, "Acitrol" inhibitor	Metal (cleaning)	F	...	57	—	xx	0.077	0.0048	...	0.0008	...
5%, sodium dichromate 1.11 lb/gal	Metal (pickling)	F	70-85	30	—	—	0.0003d	<0.0001d	...	C<0.0001	...
5%, copper 0.5-0.56 oz/gal	Metal (pickling)	F	175-185	30	..	xx	0.0003d	0.0001d	...	C0.0005	...
5-4% sulfuric-acid solution settled from the acid washing of oleic acid, during settling periods only (bottom of tank)	Chemical	F	180-212	6	xx	—	0.00016a	<0.0001	...	...	...
4%, large amounts of sodium chloride	....	F	70-82	30	—	xx	0.0318*cd	0.0246ad	...	...	...
4-1%, ammonium sulfate 20-25%, sodium sulfate 10-15%	Chemical	F	95-104	970	x	x	...	0.0001	0.0001	0.0001 C0.0001	0.0001
3%, "Cuprodine" powder 5 oz/gal	Metal (pickling)	L	150	2.7	—	—	0.0057c	0.0011	...	...	...
3%, "Cuprodine" powder 5 oz/gal	Metal (pickling)	L	150	2.7	xx	xx	0.071c	0.0021c	...	...	...
2.5%, copper sulfate 0.1%, alcohols (tower)	Chemical	F	200-250	11	..	..	0.0725*	0.02	0.0188	...	...
2%, sodium chloride saturated	....	F	120-128	30	—	xx	0.0072*ad	0.0059a	...	...	...
1.87-0.027%, chlorides as chlorine ion 0.001-0.015%, pH 1.1-8.1	Chemical	F	120-180	259	x	xx	<0.0001 0.0001	<0.0001 0.0002	...	<0.0001 0.0001	<0.0001 0.0001
<1%, ferrous and ferric sulfates, pH 1.8-4.5 (pressure vessel, liquid interface)	Paint and Varnish (crystallization)	F	430-470	5	—	x	0.0163	0.0427	...	0.0301	0.026
0.38%, some chlorides from acid brine mother liquor used to dilute concentrated sulfuric acid (bottom of tank)	Synthetic Rubber	F	70-110	11	x	—	0.0088d 0.0040d	<0.0001d	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Sulfuric-acid mixtures											
0.2-0.02%, "Retrol" clay, amylene, phenol, traces of diamylene, amyl chloride, ferric and ferrous chlorides (vapors)	Chemical	F	125-305	52	—	xx	0.01cdr	0.0055c	...	0.005c	...
0.1%, sulfur dioxide 0.04%, varying amounts of carbon, pH 2 (Peabody scrubber, bottom tray stripper section)	Chemical	F	164-177	58	xx	xx	0.0023c	<0.0001d	<0.0001	<0.0001d	...
0.1% approximately, tungsten and molybdenum salts, pH 2-3.5	Chemical	F	170-185	14	—	xx	0.147c	0.0004	...	...	...
0.05-0.03%, glycol 15%, water remainder (bottom side of hydrator tank)	Petro-chemical	F	210	57	—	x	<0.0001ad	<0.0001ad	<0.0001	0.0001	<0.0001
0.05-0.03%, glycol 15%, water remainder (top dome of hydrator tank)	Petro-chemical	F	130-150	57	—	x	<0.0001d	<0.0001d	<0.0001	0.0003	<0.0001
sulfuric acid concentrated to very dilute, hydrochloric acid, caustic soda, inorganic chlorides, miscellaneous anthraquinone derivatives, various solvents, pH 1-12	Sewage (treatment)	F	60-100	35	x	xx	<0.0001 0.0006	<0.0001 0.0003	...	...	0.0001
sulfuric acid, phosphoric acid, hydrofluoric acid and fluosilicic acid mixture, concentration 20% in water (scrubber)	Chemical	F	225	30	xx	xx	0.0016cd	0.001ad 0.001cd	0.0005d	<0.0001	0.0001
sulfuric acid, ammonium sulfate	Chemical	F	125-145	77	—	—	<0.0001 0.003	0.0003 W<0.0001	<0.0001	C<0.0001	...
sulfuric acid, ferrous sulfate, some sulfide ion, pH 1.5 (alternately immersed)	Metal (refining)	F	162-178	8	x	x	<0.0001d	<0.0001d	...	0.0001 C<0.0001	0.002ad
sulfuric and sulfurous acids, pH 2.5 approximately (clay dust washer)	....	F	660-690	8.2	xx	xx	0.24 S0.43	0.0012 S0.0025a S0.0011a	...	...	...
sulfuric and sulfurous acids, pH 2.5 approximately (clay dust washer)	....	F	660-690	8.3	xx	xx	S0.29cd 0.58cd	0.0014 S0.0018	...	...	...
sulfuric acid, sulfurous acid, sulfur dioxide, hydrocarbon alkylate, pH of water 3 approximately (rerun overhead column)	Petroleum	F	230	281	—	x	<0.0001b	<0.0001	...	<0.0001	...
dilute sulfuric acid in plant process water, acetic acid, sodium hydroxide, pH 3-14 (collector sewer sump)	Chemical	F	60-150	80	x	x	<0.0001a	<0.0001	...	...	...
dilute sulfuric acid, negligible amounts of sulfonic and organic acids (top of clay contact flash tower, vapors)	Petroleum	F	265	247	x	x	<0.0001	<0.0001	...	...	...
dilute sulfuric and acetic acids mixture neutralized with sodium hydroxide 50% (sump)	Plastic	F	60-160	216	x	x	<0.0001	<0.0001	...	...	...
dilute sulfuric acid, waste acid sewer from steel pickling	Metal (pickling)	F	60	164	x	x	<0.0001	<0.0001	<0.0001 0.0001	<0.0001 0.0002 C<0.0001	...
dilute sulfuric acid, sodium sulfate water solution (sulfonator)	Chemical	F	80-105	6.8	—	—	0.0001 W0.002	0.0001 W0.0025	0.0001	...	...
dilute sulfuric acid, pH 2-3 (vapors from fat splitting tank)	Soap	F	70-220	60	xx	..	0.002*ad	0.001a	...	0.001a	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
SULFUROUS ACID											
90.3% (sulfur-dioxide scrubber)	Synthetic Resin	F	189	41.5	..	..	0.00022*	<0.0001 W<0.0001	...	C0.0001	...
sulfurous and sulfuric acids, pH 2.5 approximately (clay dust washer)	....	F	660-690	8.3	x	xx	>1.0 S>1.0	0.0054 S0.0059	...	...	...
sulfurous and sulfuric acids, pH 2.5 approximately (clay dust washer)	....	F	660-690	8.1	x	xx	0.27d S0.43d	0.012d S0.011	...	...	...
2.6% (sulfur-dioxide scrubber)	Synthetic Resin	F	127	41.5	..	..	<0.0001	<0.0001 W<0.0001	...	C<0.0001	...
2.05% approximately, sea water, sodium chloride 1.7%	Chemical	F	55	30	xx	xx	0.0015ad	0.00013d	<0.0001d	C<0.0001d	...
dilute sulfurous acid, in propylene-glycol solution	Chemical	F	80	30	—	—	<0.0001	<0.0001	...	...	...
0.01% approximately	Synthetic Resin	F	219	41.5	..	..	<0.0001	<0.0001 W<0.0001	...	C<0.0001	...
sulfurous acid and caustic soda in varying concentrations, water effluent of air heater washing, pH 1.1-12.6	Power	F	150	2.4	x	xx	0.0001	<0.0001	0.0002	<0.0001	...
TALL OIL											
tall oil	Chemical (fractionation)	L	545	...	..	..	0.175*	0.001 0.004	0.0005	...	...
tall oil	Chemical (fractionation)	L	572	...	..	..	0.497*	0.003 0.004	0.0008	...	...
tall oil	Chemical (fractionation)	L	600	...	..	..	0.804*	0.027 0.072	0.021	...	...
tall-oil fatty acids from southern kraft-paper mills (high-vacuum fractionating still, bottom of tower)	Soap	F	500-550	195	—	x	corr	0.014	...	...	...
tall-oil fatty acids from southern kraft-paper mills (high-vacuum fractionating still, top of tower, vapors)	Soap	F	470-510	195	—	x	corr	<0.0001	...	...	...
crude tall-oil fatty acids from kraft-pulp manufacture, oleic, linoleic and abietic acids (high-vacuum fractionating still)	Soap	L	560-590	3	—	xx	0.048c	0.001	...	...	...
tall-oil fatty acids (reboiler)	Chemical (fractionation)	F	455-473	50	—	xx	...	0.0018	0.0001	0.0006	0.0007
tall oil and its glyceryl esters, tall-oil amides, sulfurized tall oil (bottom of tank)	Chemical	F	300-550	17.5	—	xx	0.009	0.0014	...	C0.0006	...
tall oil and its glyceryl esters, tall-oil amides, sulfurized tall oil (top of tank, vapors)	Chemical	F	300-550	17.5	—	..	<0.0001ad	<0.0001	...	C<0.0001	...
successive tall-oil esterifications, amidizations, sulfurizations	Research	L	300-550	18	..	..	0.009	0.0014	...	C0.0006	...
successive tall-oil esterifications, amidizations, sulfurizations (vapors)	Research	L	300-550	18	..	..	0.0001	0.0001	...	C0.0001	...

Average corrosion rates (ipy)

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Tall oil											
tall-oil methyl esters, rosin acids 46%, methyl oleate and linoleate 44%, sterols 10%	Oils and Fats	L	378	18	—	—	<0.0001	<0.0001	...	...	...
fatty acid, iodine, rosin (vapors)	Chemical	F	250-450	11	—	xx	0.008	0.0034	...	0.0038 C0.0025	...
TANNING LIQUOR											
tanning solution, small amounts of lactic, acetic and organic acids, pH initially 5.4, after 8 days 4.2, at end of 17-day cycle 3.7	Leather	F	80	113	—	xx	0.0001*	0.0001	...	...	...
chrome tanning liquor	Leather	F	80-220	123	xx	xx	0.0008cd	0.0008cd	0.001cd	...	...
chrome tanning liquor	Leather	F	60-90	123	—	—	0.0001	0.0001	0.0001	...	...
chrome-tanning solution, concentrated basic chromium sulfate	Tanning	F	200	30	—	x	0.185	0.089	...	C0.032	...
55% basic chrominum-sulfate solution (bottom of tank)	Chemical	F	200	20	—	x	corr	corr	...	0.026	...
50% basic chrominum-sulfate solution (bottom of tank)	Chemical	F	130	38	—	x	0.0001*	0.0008	...	0.0009	...
chrome-tanning solutions: sulfuric acid 16% at 150F during 16 hours; sulfonated naphthalene, pH 1.8, at 212F during 25 hours; chromic sulfate, pH 2.8, at 70F during 50 hours; sodium bicarbonate 5%, at 100F during 25 hours	Leather	F	70-212	4.8	x	x	<0.0001	<0.0001	...	<0.0001	<0.0001
vegetable tan liquor, organic acids, tannins	Tanning	F	140-160	180	..	xx	<0.0001	<0.0001	...	...	...
run-off liquor on leather wringer, tanning liquor 1.5%, sulfuric acid 0.013%, traces of sodium carbonate and animal grease	Tanning	F	114-126	21	xx	x	<0.0001	<0.0001	...	...	...
vegetable tan liquor, chestnut extract 40%, quebracho extract 30%, bisulfited previously with sodium bisulfite 3% and hemlock-bark liquor 30%	Leather	F	110	53	x	xx	<0.0001	<0.0001	...	...	...
TAR											
coal tar	Coal By-product (tar distillation)	F	...	116	—	xx	<0.0001	<0.0001	...	...	...
coal tar, some chlorides (column)	Coal By-product (distillation)	F	350-420	60	—	x	0.065	0.023 S0.025 L0.021	...	0.012	0.008
coal tar, some chlorides (column)	Coal By-product (distillation)	F	350-420	60	—	x	0.056	0.016 S0.022 L0.0145	...	0.0085	0.0063
coal tar, some chlorides (column)	Coal By-product (distillation)	F	350-420	60	—	x	0.025	0.009 S0.008 L0.007	...	0.0033	0.002
coal tar, some chlorides (column)	Coal By-product (distillation)	F	350-420	60	—	x	0.023	0.012 S0.01 L0.01	...	0.006	0.002

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
Tar											
coal tar (reflux condenser)	Coal By-product (distillation)	F	450	306	—	x	0.013r	0.0035r	...	...	...
coal tar, water washed to remove chlorides (top of column)	Coal Byproduct (tar fractionation)	F	390	66	—	xx	0.01cd	0.0002bd	...	...	...
coal tar, water washed to remove chlorides (top of column)	Coal Byproduct (tar fractionation)	F	390	59	—	xx	0.002bd 0.005cd	<0.0001d	...	...	...
coal tar, water washed to remove chlorides (column)	Coal Byproduct (tar fractionation)	F	515	66	—	xx	nil	nil	...	...	...
coal tar, water washed to remove chlorides (column)	Coal Byproduct (tar fractionation)	F	515	59	—	x	0.013c	<0.0001	...	...	...
coal tar, water washed to remove chlorides (column)	Coal Byproduct (tar fractionation)	F	500-600	59	—	x	<0.0001	<0.0001	...	...	...
coal tar, water washed to remove chlorides (bottom of column)	Coal Byproduct (tar fractionation)	F	640	59	—	x	<0.0001	<0.0001	...	...	...
coal tar (continuous still, flash box, above liquid level)	Coal By-product (tar distillation)	F	<650	360	—	xx	<0.0001* W<0.0001	<0.0001	...	...	...
coal tar, chlorides 0.08% (top of still)	Coal By-product (tar distillation)	F	390	81	—	xx	0.035	0.012 W0.008	...	...	...
coal tar, chlorides 0.08%	Coal By-product (tar distillation)	F	515	81	—	xx	0.0025	0.001 W0.00023	...	...	...
coal tar, chlorides 0.08% (bottom of column)	Coal By-product (tar distillation)	F	640	81	—	xx	0.00016	<0.0001 W<0.0001	...	...	...
coke-oven tar (vapors, liquid)	Coal By-product (tar distillation)	F	180-700	30 5	—	xx	<0.0001 0.0003	<0.0001 0.0003	...	...	...
coal-tar hydrocarbon mixture with steam (column, vapors, liquid)	Coal Byproduct (tar fractionation)	F	100-145	48	...	...	0.0001	<0.0001	<0.0001	C<0.0001	...
coal-tar oil, "Carbolic oil," tar acids, tar bases, naphthalene 40-50%, water 1-3%, neutral oils, chlorides as ammonium chloride 4.17 lb/1000 gal, pH of feed 6 (bottom of column)	Coal Byproduct (tar fractionation)	F	510	53	—	xx	0.0002c	0.0002	...	...	...
tar acids, tar bases, neutral coal-tar oil constituents, ammonium chloride, pH 5 approximately (vapors)	Chemical (distillation)	F	430-460	13.3	—	—	0.099c	0.052	...	...	0.02c 0.0095c
tar acids, tar bases, neutral coal-tar oil constituents, ammonium chloride, pH 6 approximately (top of column, vapors)	Coal By-product (distillation)	F	430-460	97	x	xx	...	0.0089c L0.0071c	0.0024	0.0015	0.001
high boiling tar acid (top of heating bundle in still)	Chemical (distillation)	F	356	188	—	xx	corr	0.0066	...	0.0002	0.0001

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Tar											
tar acids, phenols, cresols, xylenol, sulfur compounds (vacuum still, vapors outlet, liquid)	Coal By-product (distillation)	F	175-375	547	—	xx	0.0002	0.0002	...	...	...
tar acids, phenol, cresol, xylenol	Coal By-product (distillation)	F	374	32	—	xx	<0.0001	<0.0001	...	...	...
tar acids, sodium sulfate, sodium carbonate impurities, pH 6.8 (column)	Chemical (distillation)	F	212-392	38	x	xx	<0.0001	<0.0001	...	...	<0.0001
tar acids, benzoic acid, phosphoric acid, sodium sulfate, pH 4.5 (top of still pot)	Chemical (distillation)	F	212-392	11.5	x	xx	<0.0001	<0.0001	...	...	...
tar acids, benzoic acid, phosphoric acid, sodium sulfate impurities (bottom of still)	Chemical (distillation)	F	212-392	11.5	—	xx	0.0002	<0.0001	...	...	0.0001
tar acids, phenols, cresols, xylenols (vapors, some spray of liquid possible)	Coal Byproduct (fractionation)	F	350-380	140	—	xx	<0.0001	<0.0001	...	...	...
tar acids, phenol, cresol, xylenol (vapors)	Coal By-product (distillation)	F	320	27.4	—	xx	<0.0001	<0.0001	...	...	...
coal tar, vacuum (top of fractionating column, vapors)	Coal By-product (tar fractionation)	F	175	25	—	xx	0.0001	0.0001	...	...	...
coal-tar vapors (condenser)	Coal By-product (tar distillation)	F	400	306	..	..	0.018c	0.017cd	...	...	...
coal-tar vapors, phenol, naphthalene, tar bases, cresylic acids, some chlorides	Coal By-product	F	250-650	128	—	xx	<0.0001	<0.0001	...	...	...
coal-tar vapors, phenol, naphthalene, tar bases, cresylic acids, some chlorides (top of column)	Coal By-product (tar distillation)	F	190-375	128	—	xx	<0.0001	<0.0001	...	...	...
coal-tar vapors, light oil vapors, water	Coal By-product	F	230	24	—	..	<0.0001	<0.0001	...	...	...
gases containing constituents commonly found in coal-tar pitch, hydrofluoric acid, traces of sulfur and carbon dioxide, air	Metal (aluminum)	F	100	196	xx	xx	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
gases containing constituents commonly found in coal-tar pitch, hydrofluoric acid, traces of sulfur and carbon dioxide, air	Metal (aluminum)	F	100	196	xx	xx	0.0001cd 0.0007cd	<0.0001	<0.0001	<0.0001	<0.0001
TARTARIC ACID											
commercial-grade tartaric acid, decomposition products, formic and acetic acids, etc	Chemical	F	395	5	—	xx	0.002	0.0045	0.0063	...	...
vapors over tartaric acid, decomposition products, acetic and formic acids, etc	Chemical	F	395	5	—	xx	0.003	0.0006	0.001	...	...
THORIUM											
thorium traces, solvent extraction from ion-exchange "barren" solution: ferrous ion 2-20 g/l, sulfuric acid 2-3 g/l, ferric ion 1 g/l, nitrate ion 0.5 g/l, chloride ion 0.2 g/l, pH 1.7; solvent: amine 5% in kerosene, chlorine 2 g/l (extractor)	Metal	F	68-86	21	—	xx	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Type 304	Type 316	Type 317	"20"	Alloy 825
TIN CHLORIDE											
tin chloride, sodium chloride, zinc chloride, suspended solids, petroleum solvent containing small amounts of water (autoclave)	Chemical	F	80-370	16	—	x	0.067	0.013	...	...	...
TIN FLUOBORATE											
18% approximately stannous fluoborate, free fluoboric acid 200 g/l, gelatine 3 g/l, catechol 0.5 g/l, β-naphthol 0.5 g/l	Metal (plating)	F	125	365	—	xx	0.0056	0.0009	...	0.0003d	0.0003
TIN SULFATE											
stannous-sulfate saturated solution, sulfuric acid 4 oz/gal, hydrofluoric acid 1 oz/gal	Metal	L	...	14	—	—	0.00135 L0.00133 0.00037 L0.00038	0.00626 0.00143	...	...	...
11.7% stannous sulfate, sulfuric acid 9.4%, cresol sulfonic acid 3.9%	Metal	L	140	2	—	xx	0.0149	0.0002	...	...	...
TOLUIC ACID											
72.5% *m*-toluic acid, *p*-toluic acid 22.3%, *o*-toluic acid 2.6%, benzoic acid 2.6%	Petrochemical	F	R.T.-250	77	—	x	<0.0001	<0.0001	...	<0.0001	<0.0001
55%, phthalide 12%, esters 12%, water 10%, xylene 5%, phthalic acid and anhydride 5%	Rayon	F	330-380	22.5	..	..	0.0002	0.0003	...	...	...
50%, phthalide 15%, esters 15%, phthalic acid and anhydride 10%, xylene 10%	Rayon	F	350-370	22.5	..	..	0.0003	0.0005	...	...	...
40%, xylene 20%, phthalide 15%, esters 10%, phthalic acid 4%, water remainder	Rayon	F	290-320	22.5	..	..	0.0005	0.0006	...	...	...
40%, xylene 20%, phthalide 15%, esters 10%, phthalic acid 4%, cobalt acetate 1%, water remainder	Rayon	F	340-350	44	xx	xx	0.001	0.0006	...	...	...
30%, xylene 50%, phthalide 8%, water 5%, phthalic acid 3%, phthalic anhydride 3%	Rayon	F	220	44	..	xx	0.0005	0.0007	...	...	...
toluic acid, benzoic acid, acetophenone, tolualdehyde, undetermined organic materials (reboiler)	Petrochemical (distillation)	F	350-525	34	—	xx	0.029 0.033*	0.0002	...	0.0013	0.001
TURPENTINE											
turpentine from kraft pulping, small amounts of hydrogen sulfide, methyl mercaptan, dimethyl sulfide (decanter)	Pulp and Paper	F	150-200	97	x	xx	0.0001	0.0001	...	...	...
URANIUM CHLORIDE											
12% approximately, water solution	....	..	B.P.	6.8	..	..	L0.92	0.44	...	0.125	...
12% approximately, water solution (half immersed)	....	..	B.P.	6.8	..	..	L0.58	0.43	...	0.97	...
12% approximately, water solution (vapors)	....	..	B.P.	6.8	..	..	L0.012	0.018	...	0.0048	...

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TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
URANIUM ORE											
uranium ore pulp in sulfuric acid 8%	Mining	L	103-106	23	x	x	0.00015 <0.0001*	<0.0001	. . .	<0.0001	. . .
uranium ore, solids 70%, free sulfuric acid 50-60 g/l, iron ion 5-6 g/l, uranium oxide 1 g/l, chlorate 0.3 g/l	Mining	F	113-118	60	xx	xx	. . .	0.0019cd L0.002d	0.0009d	0.0013d	<0.0001d
pulped uranium ore, solids 60%, sulfuric acid 28-55 g/l, ferric ion 5-10 g/l, some ferrous ion, sodium chlorate 0.1% approximately	Mining	F	118	41	—	x	0.0002*d	0.0001	0.0002d	0.0002	0.0001
pulped uranium ore (silicate), sulfuric acid 5%, ferrous ion 6 g/l, ferric ion 0.5 g/l (Dorr agitator)	Mining	F	104-116	42	xx	xx	0.109c	0.066c	. . .	0.028	0.07
uranium-ore pulp, sulfuric acid 4%	Mining	L	103-106	23	x	x	0.0001 <0.0001*	<0.0001	. . .	<0.0001	. . .
uranium-ore pulp, sulfuric acid 2%	Mining	L	103-106	23	x	x	0.0003 <0.0001*	<0.0001	. . .	<0.0001	. . .
uranium-ore pulp, sulfuric acid 1% approximately	Mining	L	103-106	12	x	x	<0.0001 <0.0001*	<0.0001	. . .	<0.0001	. . .
uranium-ore pulp, sulfuric acid 0.5%	Mining	L	103-106	23	x	x	<0.0001 <0.0001*	<0.0001	. . .	<0.0001	. . .
uranium-ore leach pulp, solids 68% approximately, sulfur as sulfate ion 13.2 g/l, ferrous ion 6.6 g/l, ferric ion 2.7 g/l, fluoride ion 2.7 g/l, chloride ion 1.2 g/l, free sulfuric acid 0.1 g/l	Mining	F	75-90	38	. .	. .	0.0001*d	<0.0001	. . .	0.0001d	<0.0001d
uranium ore (granite rock), sodium-carbonate pulp, solids 50%, sodium sulfate 6%, sodium carbonate 5%, sodium bicarbonate 1.5%, pressure 85 psig (half immersed)	Mining	F	200-215	44	xx	xx	0.002* 0.001cd	<0.0001	. . .	. . .	. . .
uranium and other metal salts in sulfuric-acid solution, from leaching of uranium ores, pH 0.4-1	Mining	F	100-160	100	xx	xx	. . .	0.037 0.067	. . .	C0.0005	0.0002
uranium and other metal salts in sulfuric-acid solution, from leaching of uranium ores, pH 0.9-1.4	Mining	F	R.T.-100	100	x	x	. . .	<0.0001	. . .	C<0.0001	<0.0001
URANYL NITRATE											
uranyl-nitrate water solution, being concentrated to 100% uranyl nitrate hexahydrate (evaporator)	Mining	F	B.P.	120	. .	. .	0.0004 L0.0004	0.0003	.	. . .	. . .
80%, water solution, free nitric acid trace (bottom of tank)	Mining	F	160-215	36	—	x	0.0004ad	0.0005 0.0003	. . .	0.0009 0.0004	0.001 0.0002
uranyl-nitrate raffinate solution, nitric acid 30-40%, variable chlorides <2000 ppm (concentrator column, vapors, liquid)	Mining	F	175	92	—	x	0.0011 0.0016	0.0011 0.0007	. . .	0.00095a 0.0006	0.0011 0.0007
UREA											
44%, ammonia 31%, water 17%, carbon dioxide 8%	Chemical	F	90	42	x	xx	0.0001 0.0002	0.0002 0.0001	. . .	. . .	<0.0001 0.0002
43%, ammonia 32%, carbon dioxide 7%, water remainder (heat-exchanger head)	Chemical	F	90-250	100	—	x	<0.0001	<0.0001	. . .	. . .	<0.0001

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions						Average corrosion rates (ipy)				
	INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
Urea											
28%, ammonia 32.2%, water 20.5%, carbon dioxide 19%, inerts 0.3%	Petrochemical	F	355-360	150	x	. .	<0.0001 S<0.0001	<0.0001 S<0.0001	. . .	<0.0001	<0.0001
urea, ammonia carbamate, ammonia, carbon dioxide	Chemical	F	300	300	—	xx	. . .	corr	corr	. . .	corr
urea, ammonia, carbon dioxide, oil (urea stripper reboiler)	Chemical	F	250-310	56	—	xx	0.028	0.027	. . .	. . .	. . .
urea, liquid ammonia, carbon dioxide, ammonium carbonate	Chemical	F	365-375	125	x	xx	0.0015 S>0.068 L0.0016	0.0011 0.0089 S0.0041 L0.0013 L0.003	0.0013	0.0011	0.0011
VINYL CHLORIDE											
vinyl chloride, vinyl acetate, acetic acid, hydrogen peroxide, hydrochloric acid, pH 3.5-4.5 (polymerizer)	Chemical	F	R.T.-150	3	—	xx	0.0004	0.0004 0.0008 S0.0007	0.0006	0.0002 0.0009	0.0001
vinyl chloride, vinyl acetate, methyl acetate, dimethyl acetal, air and moisture (vapors and resin alternately)	Chemical	F	60-110	226	—	x	<0.0001	<0.0001	. . .	. . .	<0.0001
vinyl chloride, probably containing unsettled droplets of a sodium-metabisulfite solution <15% and 4-8% average	Chemical	F	60-80	135	—	—	0.0011cd	<0.0001d	<0.0001	<0.0001	<0.0001
vinyl chloride, probably containing unsettled droplets of a sodium-metabisulfite solution <15% and 4-8% average	Chemical	F	60-80	135	—	—	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
vinyl-chloride vapors and polyvinyl chloride entrained in water vapor, possibly traces of peroxides and phosphates, vacuum	Resin	F	110-150	67	—	—	<0.0001*	<0.0001	. . .	. . .	. . .
20% polyvinyl-chloride solution, peroxides, phosphates 0.05%, pH 4-6	Resin	F	80-150	117	xx	xx	<0.0001	nil	. . .	. . .	. . .
WATER, BOILER FEED											
boiler-feed water, oxygen 0.01 ml/l, pH 8.1 (economizer)	Pulp and Paper	F	188-190	56	x	xx	<0.0001	<0.0001	. . .	. . .	. . .
boiler-feed water, sprayed into deaerating heater, carbon dioxide 70 ppm, sulfuric acid 30 ppm, oxygen 10 ppm	Power	F	100-220	244	x	xx	<0.0001* <0.0001dr	<0.0001 S<0.0001 W<0.0001	. . .	. . .	. . .
vented gases from steam deaerating heater, carbon dioxide <400 ppm, oxygen <80 ppm, zeolite-softened water vapor, pH 4	Power	F	210-220	244	x	xx	<0.0001d	<0.0001 W<0.0001	. . .	. . .	. . .
WATER, BRACKISH											
brackish sea water, total solids 1.8%, sulfur dioxide 1-2.5% (specimen removed and allowed to dry in air during 10 seconds)	Chemical	F	60-95	158	xx	xx	corr	0.0003cd	0.0001ad	0.0002d	. . .
Galveston Bay water (condenser)	Chemical	F	112	130	xx	xx	0.0002*	<0.0001	. . .	. . .	. . .
brackish water, salt 200-15000 ppm, pH 6-8 (condenser box)	Petroleum (distillation)	F	90-115	181	. .	—	<0.0001	<0.0001	. . .	. . .	. . .
brackish water, chlorides 0-5000 ppm, sulfuric acid (condenser water box)	Power	F	32-85	400	x	xx	<0.0001	<0.0001	. . .	. . .	<0.0001

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
water, brackish											
cascading brackish water, Everett, Mass. (ammonia-liquor cooling coils)	Coal By-product	F	R.T.	63	xx	xx	0.0006cd	<0.0001bd	...	...	...
WATER, CONDENSATE											
water condensed from gas stream (nitrogen 88%, carbon dioxide 12% approximately), iron 40 ppm, sulfuric and sulfurous acids 10 ppm, nitric and nitrous acids 3 ppm, pH 6 approximately (alternately immersed)	Petroleum	F	70-90	36	—	xx	<0.0001	<0.0001	<0.0001	<0.0001	...
WATER, DISTILLED—see WATER, HIGH-PURITY											
WATER, FRESH, COLD											
cooling water (tower basin)	Pharmaceutical	F	62	112	xx	xx	<0.0001*	<0.0001	...	...	...
cooling water, pH 4-5	Soap	F	70-110	360	—	xx	<0.0001 W<0.0001	<0.0001	...	...	...
tap water, bicarbonates as calcium carbonate 20 ppm, sulfates 21 ppm, chlorides 11 ppm, iron and alumina 6 ppm, calcium oxide 5 ppm, silica 2 ppm, suspended matter, pH 5.6	Food	F	42	30	xx	xx	<0.0001	<0.0001	...	...	...
New York City water sprayed into atmosphere and then drawn through air washer; water replaced every 33 hours, pH initially 7, finally 4.5-4.8 during each replacement period (immersed and in spray)	Food	F	45-50	16	xx	xx	<0.0001	<0.0001	...	...	...
evaporator tailpipe water, pH 7.14	Rayon	F	120	29	x	xx	<0.0001* <0.0001	<0.0001	...	...	...
evaporator tailpipe water, pH 7.28	Rayon	F	120	36	x	xx	<0.0001*d <0.0001d	<0.0001d	...	...	...
fresh water, pH 7.3	Public Works	F	68-72	42	x	xx	<0.0001	<0.0001	...	...	...
well water, chlorides 40 ppm, carbon dioxide 30 ppm, iron 5 ppm, sulfur dioxide 2 ppm, total hardness 200 ppm, pH 7.48 (pump discharge)	Petroleum	F	71	63	—	xx	<0.0001	<0.0001	...	...	...
fresh-water supply to pulp grinders, pH 7.6	Pulp and Paper	F	95-99	140	x	..	<0.0001	<0.0001	...	C0.0001	...
WATER, FRESH, HOT											
well water, hydrogen sulfide 58 ppm approximately	Synthetic Resin	F	126	61	—	xx	0.0003ad	<0.0001ad	...	...	...
domestic hot-water supply	Water Heating	F	160	1555	x	x	<0.0001a	...	...	...	...
hot water	Chemical	F	<212	89	xx	—	<0.0001	<0.0001	...	...	...
untreated water, salts as chlorides 300-4000 ppm, pH 6.5-7.5	Petroleum	F	212	164	..	xx	<0.0001	<0.0001	...	...	...
WATER, HIGH-PURITY											
degassed distilled water, pH 6.5, pressure 1235 psi	Research	L	572	30	..	—	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
water, high-purity											
high-purity water, oxygen 20 ml/l, pressure 720 psi	Research	L	500	30	..	xx	nil $<$0.0001	nil $<$0.0001	...	...	...
cation-free water, pH 3.2	Research	L	78-82	200	..	..	nil	nil	...	C nil	...
deionized water and steam, pH 9 (deaerating feed-water heater)	Power	F	450	655	—	xx	L$<$0.0001	L$<$0.0001	...	...	...
WATER, MINE											
Frood mine water, pH 3-4, (water changed 3 times during test)	Mining	L	110-120	14	xx	—	$<$0.0001	nil	...	...	...
mine water, total solids 27.3 g/l total dissolved solids 26.6 g/l, chlorides 14.8 g/l, pH 6.8, specific gravity 1.017	Mining	L	86	9	—	xx	$<$0.0001 L$<$0.0001	$<$0.0001	...	...	...
mine water from sulfide ore, ferrous sulfate 2.567 g/l, total sulfate ion 1.621 g/l, sulfuric acid 0.265 g/l, free sulfate ion 0.259 g/l	Mining	F	47	56	—	—	$<$0.0001	$<$0.0001	...	...	...
coal-mine water, sulfate ion 513 ppm, ferric ion 0.4 ppm, pH 7.85	Mining	F	61	87	—	—	$<$0.0001 $<$0.0001*	$<$0.0001	...	...	...
mine water from sulfide ore, magnesium sulfate 5230 ppm, ferrous sulfate 2599 ppm, calcium bisulfate 2285 ppm, acidity 200 ppm	Mining	F	47	61	—	—	$<$0.0001 $<$0.0001*	$<$0.0001			
mine water from sulfide ore, calcium sulfate 1710 ppm, magnesium sulfate 663 ppm, ferrous sulfate 603 ppm, acidity 150 ppm	Mining	F	47	61	—	—	0.0171d 0.0108*d	$<$0.0001	...	...	...
mine water from sulfide ore, ferrous sulfate 2835 ppm, magnesium sulfate 2410 ppm, calcium sulfate 1408 ppm, acidity 82 ppm	Mining	F	47	61	—	xx	0.0095bd 0.0014d	$<$0.0001	...	...	...
mine water from sulfide ore, ferrous sulfate 1060 ppm, magnesium sulfate 1000 ppm, calcium sulfate 923 ppm, acidity 71 ppm	Mining	F	47	60	—	xx	$<$0.0001	$<$0.0001	...	...	...
mine water from sulfide ore, calcium sulfate 1361, ferrous sulfate 1310 ppm, magnesium sulfate 854 ppm, acidity 52 ppm	Mining	F	47	60	—	xx	$<$0.0001d 0.0006*d	$<$0.0001	...	...	...
mine water from sulfide ore, calcium sulfate 923 ppm, calcium chloride 638 ppm, magnesium chloride 239 ppm, ferrous sulfate 61 ppm, acidity 23.5 ppm	Mining	F	47	60	—	xx	0.0003d 0.0002*d	$<$0.0001	...	...	...
mine water, copper as sulfate 0.102%, available sulfuric acid as iron sulfate 0.67% (water flows from launder into sump, spools exposed to air during 5.15 minutes, in water during 26.5 minutes)	Mining (copper)	F	60-61	5.8	xx	xx	$<$0.0001	$<$0.0001	...	...	...
WATER, MINERAL											
mineral spring water, sodium chloride 11190.5 ppm, potassium chloride 2614.9 ppm, sodium sulfate 2584.4 ppm, calcium sulfate 1263.8 ppm, hydrogen sulfide 274.3 ppm, calcium carbonate 273.2 ppm, calcium bicarbonate 221.3 ppm, magnesium sulfate 113.2 ppm, alumina 101 ppm, ferric oxide 93 ppm, carbon dioxide 41.8 ppm, acid, specific gravity 1.0169	Sanitary	F	80-212	47	—	x	$<$0.0001a $<$0.0001b	$<$0.0001	...	...	...
hot sulfur-spring water, total solids 269 ppm, calcium carbonate 124 ppm, sulfates 23.8 ppm, chlorides 14 ppm, sulfides 12 ppm, pH 9.4 (Olympic National Park, Wash.)	Sanitary	F	120	120	—	xx	$<$0.0001	$<$0.0001	nil	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
WATER, OIL-WELL											
Arbuckle water, N. A. Hoffman "B" No. 6, Trapp Field, Barton County, Kansas, total dissolved solids 33640 ppm, chloride ion 20165 ppm, sodium ion 10930 ppm, calcium ion 2091 ppm, bicarbonate ion 476 ppm, total alkalinity 390 ppm, sulfate ion 24.19 ppm, large amount of hydrogen sulfide, pH 6.95, specific gravity 1.0267	Petroleum	F	50-70	90	..	xx	<0.0001c 0.0042c	<0.0001	...	...	...
salt water from crude oil, pH 7.5 approximately (salt settler vessel)	Petroleum	F	170-200	216	—	xx	<0.0001a	<0.0001	...	...	...
oil-field brine, chloride ion 16950 ppm, chlorine 2 ppm	Petroleum	F	95	83	xx	x	0.0001d	<0.0001	...	...	...
WATER, RIVER											
Neches River water, chlorine 0.2%, chlorides 3030 ppm, hardness 340 ppm, methyl-orange alkalinity 312 ppm, silica 50 ppm, pH 8.1 (cooling tower)	Power	F	86-92	74	xx	xx	0.0006d 0.0003d	0.0002d <0.0001d	...	0.0002d <0.0001d	0.0002d <0.0001d
Neches River water, chlorine 0.2%, chlorides 3030 ppm, hardness 340 ppm, methyl-orange alkalinity 312 ppm, silica 50 ppm, pH 8.1 (cooling tower)	Power	F	82-97	74	xx	xx	0.0001d	<0.0001d	...	<0.0001	<0.0001d
cooling water from Passaic River, chloride ion 834 ppm, calcium carbonate 328 ppm, sulfate ion 160 ppm, bicarbonate ion 46 ppm, sulfate/chloride ratio 0.19, dissolved oxygen trace, pH 8.5	Power	F	65-71	30	—	—	<0.0001a	<0.0001	...	...	...
river water, chlorides 1300 ppm, sulfates as sulfur 75 ppm, sulfides as sulfur 20 ppm, pH 6.3 (travelling bark screen)	Pulp and Paper	F	45-85	148	xx	xx	0.0001	0.0001	...	...	...
river water from jet condenser (Potomac)	Pulp and Paper	F	R.T.	224	..	..	<0.0001*	<0.0001	...	...	...
Mississippi River water	Chemical	F	R.T.	90	—	—	<0.0001	<0.0001	...	...	<0.0001
river water, chlorides, various organics, intermittent chlorine (barometric condenser tailpit)	...	..	90	169	..	..	nil	nil	...	...	...
Kelly Lake water	Mining	F	72	35	x	xx	<0.0001	nil	...	...	nil
Hudson River water contaminated with organic waste from Poughkeepsie City	Gas Manufacture	F	100	60	xx	xx	<0.0001	<0.0001	...	...	...
WATER, SEA (IMMERSED)											
sea water	..	F	70-82	212	xx	xx	...	<0.0001	...	...	...
sea water at Kure Beach, N. C.	...	F	R.T.	160	x	x	0.0015c 0.0011*c	<0.0001	<0.0001	...	...
sea water at Kure Beach, N. C.	Research	F	60	185	..	..	0.0005*c <0.0001	<0.0001	...	...	...
sea water at Kure Beach, N. C.	Research	F	R.T.	483	—	xx	0.0001*c	0.0002c	...	...	...
sea water at Kure Beach, N. C.	Research	F	R.T.	1645	—	xx	<0.0001*c	<0.0001c	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions						Average corrosion rates (ipy)				
	INDUSTRY (PROCESS)	TYPE OF TEST	AVERAGE TEMPERATURE (F)	DURATION (DAYS)	AERATION	AGITATION	TYPE 304	TYPE 316	TYPE 317	"20"	ALLOY 825
Water, sea (immersed)											
sea water at Kure Beach, N. C.	Research	F	R.T.	480	—	—	0.0002*c	...	...	...	...
sea water at Curacao, Netherlands West Indies, chlorides 20000 ppm, pH 6.6 (pressure end of pump casing)	Petroleum	F	79-88	122	xx	xx	0.0001	<0.0001	...	...	...
sea water at Curacao, Netherlands West Indies, chlorides 20000 ppm, pH 6.6 (suction end of pump casing)	Petroleum	F	79-88	44	xx	xx	0.0001ad	0.0001ad	...	...	...
sea water at Curacao, Netherlands West Indies, chlorides 20000 ppm, pH 6.6 (pressure end of pump casing)	Petroleum	F	79-88	12	xx	xx	0.0005ad	0.0004ad	...	...	...
artificial sea water, pH 7.7-8	Research	L	86	84	xx	xx	<0.0001a	<0.0001	...	...	...
WATER, SEA, AERATED (IN SPRAY OR TIDAL ZONE)											
sea water at Kure Beach, N. C. (half-tide)	Research	F	R.T.	359	xx	xx	<0.0001*	<0.0001	...	...	...
sea water at Kure Beach, N. C. (half-tide in basin)	Research	F	R.T.	193	xx	xx	<0.0001	nil	...	...	...
WATER, SEA, IN HARBORS (IMMERSED)											
sea water at Wilmington, N. C.	Research	F	R.T.	360	..	..	0.0007cd	<0.0001d <0.0001ad	...	...	...
sea water at Duxbury, Mass.	Research	F	R.T.	160	..	..	0.0001 0.0001*	0.0001	0.0001	...	...
6.5 Bé concentrated seawater brine, pH 2.8, specific gravity 1.0469 (evaporation pond)	Food	F	68	105	x	xx	0.003c	0.0009c	...	0.0004cd	0.0006cd
WATER, SEA, HEATED											
Los Angeles Harbor West Basin sea water, total solids in suspension 2.5%, organic matter in solution 2.0%, chloride ion 18800 ppm, sodium ion 10478 ppm, sulfate ion 2724 ppm, magnesium ion 1245 ppm, calcium ion 451 ppm, potassium ion 374 ppm, bicarbonate ion 165 ppm, bromine ion 12 ppm, silica 6 ppm, phosphate ion 5 ppm, borate ion 0.3 ppm, iron ion 0.2 ppm, pH 7.5 (18 in. below water level)	Petroleum	F	120-140	350	—	x	0.0005cr	0.0001a	...	...	...
heated sea water, oxygen 15 ppm, pH 6.2	Chemical	L	290	...	xx	xx	0.0124	0.0131	...	...	...
heated sea water, oxygen trace, pH 6.7	Chemical	L	180	...	x	xx	0.0091	0.0007	...	...	...
heated sea water, pH 7	Chemical	L	320	...	—	xx	0.0002	0.0002	...	...	...
sea water, salt 6.07%, pH 8.1 (first-stage evaporator)	....	L	187	6.2	x	..	0.00013	0.00011	...	...	0.0001
sea water, salt 6.07%, pH 8.1 (second-stage evaporator)	....	L	174	6.2	x	..	0.00018 <0.0001	0.00031	...	...	<0.0001 0.0001
sea water, salt 6.07%, pH 8.1 (third-stage evaporator)	....	L	174	6.2	x	..	<0.0001	0.00021	...	...	<0.0001

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Water, sea, heated											
sea water, salt 5.95-6.13%, magnesium hydroxide, pH 8.8 (evaporator)	....	L	250	66.5	..	..	<0.0001a	<0.0001ar	...	...	<0.0001
sea water, salt 5.95-6.13%, magnesium hydroxide, pH 8.8 (evaporator, vapors)	....	L	250	66.5	..	..	0.0005c	0.0003ar	...	...	<0.0001
sea-water brine, salt 1.3-1.4%, carbon dioxide 1 ppm, pH 8.1 (first effect, bottom of unit)	Marine (distillation)	F	267-270	4.2	—	xx	0.0003	...	...	...	0.0002
sea-water brine, salt 1.8-2.0%, pH 8.2 (second effect, bottom of unit)	Marine (distillation)	F	253-256	4.2	—	xx	0.0002	...	...	...	0.0001
sea-water bittern, "Pachuca" slurry, sodium chloride 100 g/l, magnesium chloride 75 g/l, calcium sulfate 50 g/l, calcium chloride 25 g/l, pH 6-7.5 (specimens covered with crystals)	Chemical	F	127	107	xx	xx	0.0001*	0.0001	...	...	...
sea-water bittern, sodium chloride 100 g/l, magnesium chloride 73 g/l, calcium chloride 25 g/l, calcium sulfate 2.5 g/l (heating tank)	Chemical	F	95-126	84	xx	—	0.0004*bd	0.0003ad	...	...	...
hot sea water, carbon dioxide 1 ppm, pH 6.2 (vapors mixture)	Marine	F	267-270	4.2	—	xx	0.0004a	...	...	...	0.0002
hot sea water, carbon dioxide 1 ppm, pH 6.3-6.7 (vapors mixture)	Marine	F	253-256	4.2	—	xx	0.0004	...	...	...	<0.0001
WATER, SOFTENED											
decationized water (top of cation exchanger, above mineral bed)	Water Treatment	F	65	210	—	xx	<0.0001*	<0.0001	...	...	...
demineralized water, effluent from anion and cation exchangers	Water Treatment	F	65	210	—	xx	<0.0001*	<0.0001	...	...	...
zeolite-softened water (screen, treated water line)	Synthetic Rubber	F	70	17	—	xx	<0.0001 nil*	<0.0001	...	...	...
zeolite-softened water, small amount of styrene, pH 7	Synthetic Rubber	F	150	5	—	—	nil nil*	<0.0001	...	...	...
zeolite softening of well water at Sioux Falls, S. D., total hardness 23.2 g/gal, calcium hardness 16.3 g/gal, methyl-orange alkalinity 11.6 g/gal, magnesium hardness 6.9 g/gal, chlorides 1.6 g/gal, sulfates 1.1 g/gal (all these expressed as calcium carbonate), silica 20 ppm, iron 0.4 ppm, pH 8.1	Water Treatment	F	50-60	365	..	xx	<0.0001*	<0.0001	...	...	...
zeolite softening of river water at Casper, Wyo., sulfates 40 g/gal, compensated hardness 29.1 g/gal, total hardness 26.4 g/gal, calcium hardness 21.6 g/gal, methyl-orange alkalinity 9.6 g/gal, magnesium hardness 4.8 g/gal, chlorides 2.8 g/gal (all these expressed as calcium carbonate), silica 15 ppm, iron 0.1 ppm, pH 7.6	Water Treatment	F	50-60	365	..	xx	<0.0001*	<0.0001	...	...	...
WATER, STEEP											
10-4° Bé steep water, pH 4 (evaporator)	Corn Products	F	150-190	242	—	xx	0.0005 <0.0001	<0.0001	<0.0001	...	...
corn steep acid, acidity at end of steeping cycle as hydrochloric acid 0.56%, sulfur dioxide initially 0.14%, finally 0.018%, pH 4 average (in liquor just above corn level)	Corn Products	F	127	44	xx	xx	<0.0001d W0.0003	<0.0001 W0.0006	<0.0001	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of Test	Average Temperature (F)	Duration (Days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Water, steep											
corn steep acid, acidity at end of steeping cycle as hydrochloric acid 0.56%, sulfur dioxide initially 0.12%, finally 0.012%, pH 4.1 average (below corn level)	Corn Products	F	130	31	xx	xx	<0.0001 W0.0013c	<0.0001 W0.0012	<0.0001	...	...
corn steep acid, acidity at end of steeping cycle as hydrochloric acid 0.52%, sulfur dioxide initially 0.11%, finally 0.011%, pH 3.8 average (below corn level)	Corn Products	F	130	39	xx	xx	<0.0001 W0.0007c W0.0022c	<0.0001 W0.001 W0.0014	<0.0001	...	...
steep water from corn starch (evaporator)	Corn Products	F	126-130	80	..	xx	<0.0001d 0.011	<0.0001 0.0019	...	...	...
steep water, lactic acid 0.5-1%, sulfur dioxide 0.05%, pH 3.5-4.5 (alternately vapors, liquid)	Food	F	150	40	x	xx	<0.0001	<0.0001	...	...	...
vapors above steep water, lactic acid 0.5-1%, sulfur dioxide 0.05%, pH 3.5-4.5 (evaporator)	Food	F	130-190	24	xx	xx	<0.0001	<0.0001	...	...	...
WATER, TAP											
tap water saturated with carbon dioxide containing sulfur dioxide 0.008% average and traces of dissolved air, pressure	Power	F	400-425	32	x	xx	0.006 0.0055*	0.0016	0.0018	0.0042	...
water saturated with synthesis gas, hydrogen 38%, carbon monoxide 32%, carbon dioxide 8%, oxygen 0.2%, nitrogen remainder, sulfur as hydrogen sulfide and organic sulfurs 300-500 grains/cu ft	Chemical	F	150	30	..	xx	0.0001	0.0002 0.0003	...	...	...
WATER, TREATED											
chlorinated water	Plastic	F	85-115	57	x	x	<0.0001	<0.0001	...	...	<0.0001
chlorinated fresh water, pH 7, raw water composition: methyl-orange alkalinity as calcium carbonate 212 ppm, total hardness as calcium carbonate 200 ppm, sulfate ion 32 ppm, chloride ion 24 ppm	Food (fruit)	F	70-90	32	—	x	<0.0001	<0.0001	...	<0.0001	<0.0001
chlorinated fresh water buffered with sodium hydroxide to pH 8, raw water composition: methyl-orange alkalinity as calcium carbonate 212 ppm, total hardness as calcium carbonate 200 ppm, sulfate ion 32 ppm, chloride ion 24 ppm (washer, in spray)	Food (fruit)	F	70-90	31	—	x	<0.0001	<0.0001	...	<0.0001	<0.0001
chlorinated fresh water acidified with hydrochloric acid to pH 6.9, raw water composition: methyl-orange alkalinity as calcium carbonate 212 ppm, total hardness as calcium carbonate 200 ppm, sulfate ion 32 ppm, chloride ion 24 ppm (washer, in spray)	Food (fruit)	F	70-90	32	—	x	<0.0001	<0.0001	...	<0.0001	<0.0001
water, small amounts of hydrochloric acid and chlorine, pH 2 (bottom of condenser)	Chemical	F	195	61	—	—	0.0005*bd	0.0002bd	...	...	...
tower water from Syracuse water supply, treated with algicide, "Oakite Sanitizer No. 1," pH 8-8.5 (tower sluice-way)	Pharmaceutical	F	45-88	227	xx	xx	<0.0001 <0.0001*	<0.0001	...	...	...
WATER, WASTE											
quench water, total solids 0.64%, insoluble solids 0.25%, ammonium chloride 0.1%, volatiles 0.098%, calcium chloride 0.066%, calcium sulfate 0.062%, pH 6.5 (coke quenching tower, below spray header)	Coal	F	...	11.2	—	—	0.0021c 0.004c 0.0005	0.0003 0.0002	...	0.0004 0.0003	0.0002

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Water, waste											
quench water, total solids 0.64%, insoluble solids 0.25%, ammonium chloride 0.1%, volatiles 0.098%, calcium chloride 0.066%, calcium sulfate 0.062%, "Nalco No. 161" inhibitor added to coke sump feeding at rate of 50 ppm/gal water returned to sump (coke quenching tower, below spray header)	Coal	F	...	11.2	—	—	0.0013c 0.0093c 0.021c 0.0084c	0.0002 0.0003	...	0.0002 0.0004	0.0001 0.0003 0.0002
waste-water effluent, hydrochloric acid, sulfuric acid, soda ash, caustic soda, chlorinated solvents, organics, zinc sulfate, pH 2-10, generally acid (sump pipe line)	Chemical	F	R.T.	68	x	xx	...	<0.0001	...	C<0.0001	<0.0001
waste water from fine-chemicals manufacture, hydrochloric acid, sulfuric acid, organics, pH 6.5	Chemical	F	80-100	30	..	xx	<0.0001	<0.0001	...	...	...
waste water from fine-chemicals manufacture, acetic acid, halogen acids, sulfuric acid, salts of these acids, traces of organic solvents and greases, pH 2-7.5, 6.5 average	Chemical	F	55-70	42	x	x	<0.0001	<0.0001	...	...	...
waste-process water, sodium sulfate, sodium chloride, sodium phosphate, ammonium sulfate, calcium sulfate, magnesium sulfate, pH 3.5-5 (vacuum evaporator, vapors)	Chemical	F	90-118	63	—	..	<0.0001	<0.0001	...	<0.0001	<0.0001
water, various organic esters and acids, hydrochloric acid trace, pH 2 (cooler)	Chemical	F	86-99	147	—	xx	0.0116	0.0111	...	...	...
ammonia-still waste water, for spray quenching of coke (tower, just above spray piping)	Coal	F	R.T.-212	180	xx	..	0.003c	0.0004c	...	...	...
wash water, dissolved acid gases and oxygen, regeneration gas, carbon dioxide, sulfur dioxide, chlorides	Petroleum	F	100-500	278	—	xx	L0.0003a WL0.0003a	L0.0002a WL0.0003a	...	...	0.0002a
wash water, dissolved acid gases and oxygen, carbon dioxide, sulfur dioxide trace, chlorides trace, pressure 300 psi (bottom of tower)	Petroleum	F	125	211	—	x	L<0.0001 WL<0.0001	L<0.0001 WL<0.0001	...	...	<0.0001
electroplating waste, nickel, chromium, sodium salts, phosphates, pH 2	Metal (plating)	F	70	105	x	xx	<0.0001	<0.0001	...	...	...
WAX											
wax, sulfuric acid 5% approximately, pressure 15-18 psi	Petroleum	F	160-190	25	—	x	0.02*	0.014	...	...	...
castor wax, sodium hydroxide 50%, sulfuric acid 25%	Chemical	F	180-212	33	x	xx	0.0008 <0.0001	<0.0001	...	...	...
castor wax, sodium hydroxide 50%, sulfuric acid 25%	Chemical	F	180-212	17	x	xx	...	...	...	...	0.0009
WHISKY											
thin stillage, solids 4-5%, acetic acid, lactic acid, succinic acid, pH 3.8	Brewing (whisky)	F	140-185	30	—	x	<0.0001	<0.0001	...	...	...
grain and water mixture, pH 5.8 (cooker)	Brewing	F	110-240	90	—	xx	<0.0001	<0.0001	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
whisky											
lactic acid, water, grain, impurities, total solids 14%, pH 3.7 average	Brewing	F	60-160	146	—	xx	<0.0001	<0.0001	...	...	...
mixture of distillers dried grains and evaporator syrup, solids 40% (30% in syrup)	Brewing	F	175-212	146	—	—	<0.0001	<0.0001	...	...	...
vapors of alcohol, organic acids, water, pH 5	Brewing (distillation)	F	208	87	xx	—	<0.0001	<0.0001	...	...	...
vapors from drying solid syrup 30%, moisture, air, traces of lactic, acetic, formic, propionic acids (dehydrator)	Brewing	F	140-180	151	x	—	0.0005cd	<0.0001cd <0.0001	...	...	...
vapors from evaporators to condensers, moisture, traces of lactic, formic, propionic acids (vapor line, evaporator)	Brewing	F	120-200	146	—	—	<0.0001	<0.0001	...	...	...
XYLENE											
liquid xylene, small amounts of water, acetic acid, ph 3 approximately	Lumber	F	100-212	150	x	xx	...	<0.0001	...	...	...
97.8% *o*-xylene, aromatics 1%	Rayon	F	350	44	xx	xx	0.0006	0.0003	...	0.0007	...
98% *o*-xylene, water	Rayon	F	350	34	xx	xx	0.001	0.0008 0.0018d	...	0.001	...
mixed condensate of xylene and water, small amount of acetic acid, pH of aqueous phase 3 approximately	Lumber	F	70-180	150	x	xx	<0.0001	<0.0001	...	...	...
75%, acetic acid 2%, formic acid 2%, water and toluic acid remainder	Rayon	F	60	22.5	..	..	<0.0001	0.001	...	...	...
75%, acetic acid, toluic acid, formic acid, formaldehyde together 25%	Rayon	F	350-370	22.5	..	..	0.0016	0.0014	...	...	...
50%, water 22%, toluic acid 15%, phthalide 5%, ester 5%, phthalic acid 4%	Rayon	F	200-220	22.5	..	..	0.0004	0.0002	...	...	...
xylene, maleic acid 1% as maleic anhydride, benzene, water trace (column)	Chemical (distillation)	F	194-302	14	x	—	0.104c	0.0031	0.0008	0.0074	0.0043
azeotropic mixture of xylene and water	Rayon	F	80	460	xx	xx	0.0006	0.00045	...	...	...
xylene topping of reactor effluent (effluent is mixture of water, acetic acid, benzoic acid, toluic acid, tolualdehyde, acetophenone, hydrocarbons), vacuum 25 in. (column, vapors)	Chemical (distillation)	F	325-350	8.7	..	..	0.148	0.00024	...	0.00043	0.0003
ZINC CARBONATE											
19.3% zinc-carbonate slurry, sodium carbonate 10%, sulfides, sulfuric acid, pH 9	Chemical	F	70-180	46	x	x	0.0001 <0.0001*	...	<0.0001	...	...
ZINC CHLORIDE											
50%	Chemical	F	160	27	—	—	0.032cd	0.032d	...	...	...
33%, ammonium chloride 33%, water remainder	Chemical	L	140	33	—	—	0.0013cd	<0.0001cd	...	...	...
5% approximately, sodium chromate	Lumber (wood preserving)	F	140	144	—	—	<0.0001ad	<0.0001ad	...	...	...

(continued)

TABLE 4.13: VARIOUS STAINLESS STEELS AND HIGH NICKEL ALLOYS—CLIMAX MOLYBDENUM (cont'd)

Corrosion mediums	Test conditions: Industry (Process)	Type of test	Average temperature (F)	Duration (days)	Aeration	Agitation	Average corrosion rates (ipy): Type 304	Type 316	Type 317	"20"	Alloy 825
Zinc chloride											
zinc and lead-chloride fumes, oil combustion gases (dust collector)	Paint and Varnish	F	210	4.5	xx	..	0.027a 0.027*a	0.013a	...	...	...
ZINC FLUOSILICATE											
36-30% approximately, free fluosilicic acid 1%	Chemical	F	60-80	70	..	xx	0.0024*a	0.0007	...	...	...
zinc fluosilicate concentrated solution, free fluosilicic acid 1%, hydrochloric acid 0.5-1%	Chemical	F	100-116	22.4	x	xx	...	0.009c	...	C0.012c 0.011c	...
zinc fluosilicate, varying concentration, hydrochloric acid 0.05-0.1%	Chemical	F	106	33	—	xx	...	0.0011	0.001	0.0015	...
ZINC FORMALDEHYDE SULFOXYLATE											
zinc formaldehyde sulfoxylate, zinc dust, sulfuric acid 1-15%	Textile	F	115	25	—	xx	0.002	0.0004	...	...	...
ZINC SULFATE											
saturated zinc-sulfate solution (evaporator)	Chemical	F	B.P.	34	—	xx	0.006	0.0011	...	...	...
44% approximately, saturated zinc-sulfate solution, crystals, sulfuric acid trace	Chemical	F	212-225	35	—	xx	corr*	0.026a	0.006	...	...
38-30% zinc-sulfate solution being concentrated, sodium bichromate, hydrogen peroxide and lead peroxide (flash evaporator)	Chemical	F	100-180	48	—	xx	...	<0.0001	...	<0.0001	...
36.5%, sulfuric acid 66° Bé (evaporator)	Chemical	F	220	60	—	xx	...	0.01	...	0.0045	0.0046
36%, iron, sodium, cadmium, and copper impurities, pH 5.2 (flash evaporator)	Chemical	F	...	20	xx	xx	0.0007*c	<0.0001	<0.0001	C<0.0001	...
25% acid zinc-sulfate solution, sulfuric acid 2-3 g/l, copper 2 g/l, ferrous ion 0.8 g/l	Mining	F	90-102	85	—	—	<0.0001*	<0.0001	...	<0.0001 C<0.0001	...
25% neutral zinc-sulfate solution, copper 0.4 g/l	Mining	F	90-103	72	—	—	<0.0001*d	<0.0001	...	<0.0001 C<0.0001	...
20%, zinc chloride 8.8%, ferrous sulfate 1%, water	Chemical	F	R.T.-232	8.3	—	—	0.0081cd 0.0081*cd	0.0047cd	...	...	...
20% approximately, zinc chloride 9% approximately, water	Chemical	F	219-232	7.5	—	xx	0.0026*cd 0.0026cd	0.0015bd	...	...	...
zinc-sulfate electrolyte, pH 3	Metal (plating)	F	125-150	31	x	x	<0.0001	<0.0001	...	...	...
slightly acid zinc-sulfate solution, copper	Metal	F	90-102	317	..	..	<0.0001	<0.0001	...	...	...
zinc sulfate, zinc chloride, ferrous sulfate, ferric sulfate, ferric chloride, chloride, water, in varying concentrations (chlorinator)	Chemical	F	R.T.-230	83	xx	xx	0.014cd	0.0033cd	...	...	...
zinc-sulfate solution, copper 10 mg/l, iron hydroxide, zinc ferrite, lead sulfate, solids grab samples showed pH 4.8 (Kelly filter)	Mining	F	113	48	xx	x	0.0001	0.0001	...	...	...
zinc-sulfate drier fumes	Chemical	F	110	31	xx	—	0.0076bd 0.0068cd	0.0023ad 0.0004ad	...	C0.005cd C0.0082cd	...
ZIRCONIUM TETRACHLORIDE											
atmospheric fumes of zirconium tetrachloride, hydrogen chloride, and chlorine gas	Chemical	F	60-110	60	xx	—	0.0011	0.001a	...	...	0.002

Nonferrous Metals and Alloys

TABLE 5.1: ALUMINUM ALLOY–ALCOA

Effect of Hydrogen Sulfide, Carbon Dioxide and Sulfur Dioxide on Aluminum Alloys and Mild Steel

ALLOY	Calculated Volume of Metal loss in.^{3}/in.^{2}/yr.[1] Aqueous Solutions	Moist Vapors
HYDROGEN SULFIDE—96 HOURS		
2S-H14 Aluminum	.0003	.0005
3S-H14 Aluminum	.0003	.0007
Mild Steel	.0117	.0204
CARBON DIOXIDE—96 HOURS		
2S-H14 Aluminum	.0009	.0007
3S-H14 Aluminum	.0003	.0010
Mild Steel	.0111	.0017
SULFUR DIOXIDE—32 HOURS		
2S-H14 Aluminum	.0332	.0337
3S-H14 Aluminum	.0385	.0511
Mild Steel	45.0000[2]	.5080

NOTES: [1] Specimens .064" x .36" x 1.2" exposed to distilled water saturated with gas and also the gas saturated with moisture at room temperature. Daily cycle involved bubbling gas into water at 3 liters per hour for 8 hours and sealing the system off for 16 hours.

[2] Test terminated after one hour because of rapid attack of metal.

Resistance of Aluminum Alloy 3S* to Solid Chemicals Under Conditions of High Humidity

Non-Corrosive		Border Line	Corrosive
Ammonium dichromate	Citric acid	Ammonium chloride	Aluminum chloride
Ammonium molybdate	Potassium thiocyanate	Ammonium fluoride	Calcium chloride
Ammonium nitrate	Sodium acetate	Copper sulfate	Ferric chloride
Ammonium sulfate	Sodium aluminum fluoride	Magnesium chloride	Potassium permanganate
Barium carbonate	Sodium bicarbonate	Oxalic acid	Sodium carbonate
Barium chloride	Sodium chlorate		Sodium fluoride
Barium nitrate	Sodium chloride		
Borax	Sodium nitrate		
Boric acid	Sodium sulfate		
Calcium oxide	Triphenyl phosphate		
Chromium trioxide			

*Aluminum with 1.2% Mn.

NOTES: [1] Shallow 2" diameter impact extruded containers of aluminum alloy 3S.
[2] Chemicals placed in containers as a thin ($\frac{1}{16}$") layer and as scattered small mounds.
[3] Containers exposed to an atmosphere having a relative humidity of approximately 100% at room temperature for one month.

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION

CORROSION RATE UNITS: The most commonly accepted unit for expressing the rate of corrosion of a metal is mils per year, abbreviated mpy. One mil is equal to 0.001".

Resistant = less than 1 mpy attack
Mild action = 1-5 mpy attack
Moderate action = 5-20 mpy attack
Corrosive or corroded by = greater than 20 mpy

A

ABIETIC ACID. $C_{20}H_{30}O_2$. Abietic acid has been handled extensively in aluminum alloy equipment. See also Ref: (1) p. 124, (2) p. 274, (3) p. 132, (7) p. 3.

ACETALDEHYDE. $CH_3 \cdot CHO$. In laboratory tests, 1100 alloy was resistant to aqueous solutions of 0.1% to 100% acetaldehyde. Acetaldehyde has been produced and handled in aluminum alloy tubing, heat exchangers, stills, tankage and shipping drums. See also Ref: (1) p. 124, (2) p. 1, (3) p. 120, (4) p. 73, (7) p. 3.

ACETANILIDE. $CH_3 \cdot CO \cdot NH \cdot C_6H_5$. Acetanilide has been produced in aluminum alloy equipment including tanks, pipes, valves, pumps, reflux condensers, vapor lines, heating coils, evaporators and reaction vessels. See also Ref: (1) p. 124, (3) p. 147, (7) p. 3.

ACETIC ACID. $CH_3 \cdot COOH$. The effect of acetic acid on aluminum changes markedly with acid concentration and temperature.

The rate of corrosion is low when exposed to acetic acid at all concentrations up to anhydrous glacial acetic acid below 50°C (122°F); at the boiling temperature of the acetic acid, aluminum is corroded in solutions up to about 90% concentration of the acid, when the attack falls off rapidly to less than 5 mils per year and the rate remains at that level until the anhydrous condition approaches. The corrosion rate of aluminum in glacial acetic acid, which normally contains 0.1 to 0.2% water, does not increase with temperature. Boiling anhydrous acetic acid is very corrosive to aluminum. Removal of the last trace of water increases the corrosion rate one hundred fold, while conversely the addition of 0.05% water stops the action. Aluminum has been used extensively in the manufacture of acetic acid, in its storage and handling, and in process equipment where acetic acid is one of the raw materials. In the manufacture of acetic acid from wood, the following aluminum alloys have been used: for storage tanks, alloys 1100, 3003, 5083, 5052; for stills, alloys 3003, 5052, 6061; for condensers, alloys 3003, 5052, 6061; for piping, alloys 1100, 3003, 6061; for valves and fittings, alloys 356.0, 514.0; and for manholes, etc., alloy 356.0. Alloys 1100, 3003, 5154, and 5052 have been the most commonly used for tanks and tank cars for storage of pure glacial acetic acid solutions at normal temperatures. Aluminum alloys have been used extensively in the textile industry for storage facilities for acetic acid solutions down to 80% concentrations, although they are not recommended to store acid of less than 90% concentration. Some tank failures have been reported by the textile industry in the storage of 80-84% acetic acid solutions. Susceptibility of aluminum alloys to corrosive attack in acetic acid solutions is increased greatly by inorganic halides or reducing acids and reducing organic acids, esters and aldehydes normally encountered in the production and use of acetic acid. The presence of formic acid should be avoided. Potassium sulfate and bromide have no influence at normal temperatures, but accelerate attack at elevated temperatures. Aluminum acetylation equipment has been used in the cellulose acetate industry. Many large storage tanks, tank cars and shipping drums have been used for handling acetic acid.

See also Ref: (1) p. 124, (2) pp. 3, 4, (3) pp. 21, 124, 126, 127, (4) pp. 22, 23, 24, 25, 27, 28, 29, 30, 31, 34, 61, 62, 84, 92, 111, (6) p. 20, (7) p. 3.

ACETIC ANHYDRIDE. $(CH_3 \cdot CO)_2O$. In limited laboratory tests, acetic anhydride caused moderate (13 mpy) attack of 3003 alloy at 100°C (212°F). In other tests, acetic anhydride caused mild attack of 1100 alloy at ambient temperature and at 50°C (122°F). Acetic anhydride had mild action (~5 mpy) at the boiling point. Aluminum and its alloys have been used for heat exchangers, reaction vessels, piping, storage tanks, drums and tank cars for handling acetic anhydride. Alloy A356.0 valves have been used for handling acetic anhydride. See also Ref: (1) p. 124, (2) p. 13, (3) p. 128, (7) p. 5.

ACETONE. $CH \cdot CO \cdot CH_3$. Aluminum and Al-Mg alloys are resistant to acetone in laboratory tests at all temperatures. Aluminum has been used with acetone for piping, stills, heat exchangers and storage. Mild corrosion has been reported in an aluminum storage tank for redistilled acetone. Alloy 356.0 valves have been used for handling acetone. See also Ref: (1) p. 124, (2) p. 17, (3) pp. 121, 242, (7) p. 5.

ACETONITRILE. $CH_3 \cdot CN$. Alloy 3003 was resistant to acetonitrile at 100°C (212°F) in laboratory beaker tests. See also Ref: (3) p. 142, (5) p. 9.

ACETOPHENONE, ORTHOHYDROXY. $CH_3COC_6H_4OH$. Limited laboratory tests indicated that acetophenone was mildly corrosive to 3003 alloy under refluxing or boiling and condensing conditions. See also Ref: (1) p. 124, (2) p. 20, (3) p. 121, (7) p. 7.

p-ACETOTOLUIDIDE. $CH_3CONHC_6H_4CH_3$. Acetotoluidide has been distilled and handled in aluminum alloy equipment. See also Ref: (3) p. 144, (7) p. 7.

ACETYLSALICYLIC ACID. $CH_3 \cdot CO \cdot O \cdot C_6H_4COOH$. In the production of acetylsalicylic acid, the raw materials, acetic anhydride and salicylic acid, and the final product have been handled in aluminum alloy storage tanks, piping and reaction vessels. See also Ref: (2) p. 26, (3) p. 130, (5) p. 9, (7) p. 7.

ACONITIC ACID. $C_3H_3(COOH)_3$. In limited laboratory tests, aqueous solutions of aconitic acid (0.25% to 50%) caused moderate attack (~6 mpy) of 3003 alloy at 100°C (212°F). See also Ref: (10) p. 77.

ACROLEIN. $CH_2{:}CHCHO$. Aluminum alloy equipment has been used in the manufacture and shipment of acrolein. See also Ref: (1) p. 124, (3) p. 120.

ACRYLIC ACID. $CH_2{:}CHCOOH$. Alloys 3003, 5052, and 5454 were resistant to glacial acrylic acid at ambient conditions. Glacial acrylic acid has been shipped in aluminum alloy drums. See also Ref: (1) p. 124, (3) p. 128, (5) p. 9, (7) p. 7.

ACRYLONITRILE. $CH_2{:}CHCN$. In laboratory tests, alloy 3003 was resistant to acrylonitrile, acrylonitrile saturated with water and water saturated with acrylonitrile at room temperature and when exposed to boiling acrylonitrile. Aluminum alloy industrial equipment has been used for the production and shipment of acrylonitrile and also in further transforming it into acrylonitrile fiber. See also Ref: (1) p. 124, (3) pp. 142, 233, (7) p. 7.

ADIPIC ACID. $HO_2C(CH_2)_4CO_2H$. In laboratory tests, adipic acid in 20% and 50% concentrations caused mild attack of alloy 3003. The acid and its salts have been piped, shipped and stored in aluminum. See also Ref: (3) p. 130, (7) p. 7.

AEROSOLS. A generic term applied to packs of various liquid products under pressure. Aluminum alloy cans have been used to package aerosol formulations. See also Ref: (3) pp. 110, 239.

ALDOL. $CH_3 \cdot CH(OH) \cdot CH_2 \cdot CHO$. In laboratory tests, 3003 and 1100 alloys were resistant to aldol at 100°C (212°F) but at the boiling point alloy 3003 was mildly attacked (4 mpy). Aldol has been handled and shipped in aluminum alloy containers. See also Ref: (3) p. 121.

ALKALINE SOLUTIONS. Alkaline solutions generally have some action on aluminum alloys. The pH of these solutions alone is not a reliable indicator of the performance of aluminum alloys. Usually, weak bases such as ammonium hydroxide, hexamine, alkanolamines and their aqueous solutions can be handled in aluminum because a protective film forms on aluminum after an initial period of reaction. Solutions made alkaline by hydrolysis of basic salts such as sodium carbonate form protective films on Al-Mg alloys containing 3.5% or more magnesium. Strong bases such as sodium hydroxide and potassium hydroxide dissolved in water are very corrosive and should not be handled in aluminum. See also Ref: (4) pp. 35, 37.

ALKYL SODIUM SULFATE. RSO_3Na. Alkyl sodium sulfates have been stored in aluminum alloy containers. See also Ref: (3) p. 246.

ALLYL ALCOHOL. $CH_2{:}CHCH_2OH$. In laboratory tests under refluxing conditions, 3003 alloy was resistant to allyl alcohol. See also Ref: (3) pp. 22, 114, (5) p. 10, (7) p. 9.

(continued)

TABLE 5.2: ALUMINUM ALLOYS–ALUMINUM ASSOCIATION (continued)

ALLYL ISOTHIOCYANATE. CH_2:$CHCH_2NCS$. Aluminum alloy columns and condensers have been used in the production of allyl isothiocyanate. See also Ref: (3) p. 138.

ALUMINA. Al_2O_3. Alumina has been stored in aluminum alloy containers and shipped in aluminum alloy railroad cars. See also Ref: (3) p. 77, (4) p. 5.

ALUMINUM ACETATE. $Al(C_2H_3O_2)_3$. In limited laboratory tests, aqueous solutions of aluminum acetate (0.25% to 25%) caused mild attack (~3 mpy) of alloy 3003 at ambient temperature. Aluminum alloy equipment has been used in the manufacture of aluminum acetate. See also Ref: (1) p. 124, (3) p. 78, (5) p. 10, (7) p. 9.

ALUMINUM AMMONIUM SULFATE. $AlNH_4(SO_4)_2 \cdot 12\ H_2O$. Laboratory tests showed that alloys 3003 and 5154 were resistant to solid aluminum ammonium sulfate under conditions of 100% relative humidity at ambient temperature.

ALUMINUM BORATE. $2\ Al_2O_3 \cdot B_2O_3 \cdot 3\ H_2O$. Laboratory tests showed that alloys 3003 and 5154 were resistant to solid aluminum borate under conditions of 100% relative humidity at ambient temperature.

ALUMINUM CHLORIDE. $AlCl_3$. Anhydrous aluminum chloride has been stored and transported in aluminum alloy containers. Moist aluminum chloride and aluminum chloride solutions are very corrosive to aluminum alloys. The severity of attack depends upon the quantity of free hydrochloric acid produced by hydrolysis and on the temperature. See also Ref: (1) p. 125, (2) p. 37, (3) p. 77, (7) p. 11.

ALUMINUM FLUORIDE. AlF_3. Laboratory tests showed that alloys 3003 and 5154 were resistant to solid aluminum fluoride under conditions of 100% relative humidity at ambient temperature. Aluminum fluoride solutions are corrosive to aluminum. See also Ref: (3) p. 77, (7) p. 11.

ALUMINUM FORMATE. $Al(HCO_2)_3$. Laboratory tests indicated that 1% and 10% solutions of aluminum formate caused highly localized attack of alloy 1100 at ambient temperature. However, aluminum equipment has been used successfully in the production of aluminum formate. See also Ref: (1) p. 125, (3) p. 78.

ALUMINUM NITRATE. $Al(NO_3)_3 \cdot 9\ H_2O$. Solid aluminum nitrate was corrosive (50 mpy) to 3003 and 5154 alloys in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Aluminum nitrate has been stored and shipped in aluminum alloy containers. See also Ref: (1) p. 125, (3) p. 78, (7) p. 11.

ALUMINUM OXALATE. $Al_2(C_2O_4)_3 \cdot H_2O$. Laboratory tests indicated that alloys 3003 and 5154 were resistant to solid aluminum oxalate under conditions of 100% relative humidity at ambient temperature.

ALUMINUM STEARATE. $Al(C_{18}H_{35} \cdot O_2)_3$. Laboratory tests indicated that alloys 3003 and 5154 were resistant to solid aluminum stearate under conditions of 100% relative humidity at ambient temperature.

ALUMINUM SULFATE. $Al_2(SO_4)_3 \cdot 18\ H_2O$. Laboratory tests showed that alloys 3003 and 5154 were resistant to solid aluminum sulfate under conditions of 100% relative humidity at ambient temperature. Laboratory tests made in aqueous solutions indicated mild action on alloy 1100 by solutions of .01% to 25% aluminum sulfate. Aluminum piping has been used for aluminum sulfate solutions in the paper industry. Alloy 356.0 valves have been used for handling aluminum sulfate solutions. See also Ref: (1) p. 125, (2) p. 42, (3) p. 77, (7) p. 11.

ALUMINUM TARTRATE. $Al_2(C_4H_4O_6)_3$. Laboratory tests indicated that alloys 3003 and 5154 were resistant to solid aluminum tartrate under conditions of 100% relative humidity at ambient temperature.

2-AMINOETHANOL. $NH_2CH_2CH_2OH$. See monoethanolamine. See also Ref: (3) p. 145.

AMINOETHYLETHANOLAMINE. $NH_2CH_2CH_2NHCH_2CH_2OH$. In laboratory tests, 3003 alloy was resistant to aminoethylethanolamine at temperatures from ambient to 204°C (400°F). In other laboratory tests under refluxing conditions, aminoethylethanolamine was very corrosive to alloy 3003. Aluminum alloy tanks have been used to store aminoethylethanolamine. See also Ref: (7) pp. 12, 13.

AMMONIA. NH_3. (See also ammonium hydroxide) In laboratory tests, 1100, 3003 and other copper free aluminum alloys have been found to be resistant to dry, gaseous ammonia even at elevated temperatures. Alloys 1100 and 3003 were also resistant to pure anhydrous liquid ammonia but contaminants can result in pitting of the metal. In dilute ammonia solutions (up to ~10%) the initial rate of attack is controlled by diffusion of OH^- ions to the aluminum surface and is a function of pH. Passivation of the aluminum surface occurs when a critical amount of corrosion product builds up at the aluminum surface forming a protective film. If solution saturation of soluble corrosion product is relieved before passivation, film formation may not occur. A careful analysis of exposure conditions is required in using aluminum alloys in dilute ammonia. Aluminum alloys have been used in refrigeration systems handling liquid ammonia containing up to 5% water and in producing synthetic ammonia. Aluminum alloy compressors, heat exchangers, evaporators, condensers, and piping have been used in producing ammonia. Aluminum alloy pressure vessels have been used for storing and transporting ammonia. Carbon dioxide and hydrogen sulfide have been used to inhibit corrosion under condensing conditions. See Ref: (1) p. 125, (2) p. 46, (3) pp. 43, 58, 61, 223, (7) p. 14.

AMMONIUM ACETATE. CH_3COONH_4. Solid ammonium acetate caused mild attack (~3 mpy) of alloys 3003 and 5154 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1, 5 and 10% solutions of ammonium acetate at ambient temperature caused mild attack of 3003 alloy while the alloy was resistant to concentrated solutions. Dry ammonium acetate has been stored and transported in aluminum alloy containers. See also Ref: (1) p. 125, (3) p. 71, (5) p. 11, (7) p. 15.

AMMONIUM BICARBONATE. NH_4HCO_3. Aluminum alloy equipment has been used in the production of ammonium bicarbonate. See also Ref: (1) p. 125, (3) p. 67, (5) p. 11, (7) p. 15.

AMMONIUM CARBAMATE. $NH_2 \cdot COO \cdot NH_4$. Ammonium carbamate has been produced and handled in aluminum alloy equipment, including tanks, piping and subliming equipment. See also Ref: (1) p. 125, (3) p. 68.

AMMONIUM CARBONATE. $(NH_4)_2CO_3$. Solid ammonium carbonate caused mild attack (~2 mpy) on 5154 alloy while 3003 alloy was resistant to solid ammonium carbonate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Other laboratory tests indicated that alloy 3003 was resistant to 1%, 5% and 50% aqueous solutions of ammonium carbonate. Aluminum alloy storage tanks and piping have been used for handling ammonium carbonate. See also Ref: (1) p. 125, (3) p. 67, (7) p. 15.

AMMONIUM CHLORIDE. NH_4Cl. In laboratory tests at ambient temperature, aqueous solutions (up to 20%) of ammonium chloride caused mild attack (~3 mpy) on 1100 alloy with localized pitting occurring at all concentrations. Solid ammonium chloride resulted in moderate attack (~6 mpy) on alloy 3003 in other laboratory tests under conditions of 100% relative humidity at ambient temperature. Concentrated solutions of ammonium chloride at the boiling point are very corrosive. See also Ref: (1) p. 125, (2) p. 50, (3) p. 62, (7) p. 15.

AMMONIUM DICHROMATE. $(NH_4)_2Cr_2O_7$. Alloy 3003 was resistant to solid ammonium dichromate in laboratory tests under conditions of 100% relative humidity at ambient temperature. Similar results were obtained in other laboratory tests involving aqueous solutions (up to 10%) of ammonium dichromate at ambient temperature. See also Ref: (1) p. 125, (3) p. 70, (7) p. 17.

AMMONIUM FLUORIDE. NH_4F. In laboratory tests, solid ammonium fluoride caused mild attack (~3 mpy) of alloy 3003 under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 50% solutions of ammonium fluoride were very corrosive to alloy 3003 at 93°C (200°F), but at ambient temperature, 1100 alloy was resistant to solutions of 10% to 25%. See also Ref: (1) p. 125, (3) p. 63, (7) p. 17.

AMMONIUM HYDROXIDE. NH_4OH. In laboratory tests, ammonium hydroxide solutions have a rapid initial reaction on aluminum alloys which decreased dramatically as concentration and pH increase. The rate of attack of dilute ammonium hydroxide solutions was moderate (~6 mpy) for 1100 alloy but decreased to less than 1 mpy when the concentration reached 10 N. Similarly, the rate was mild (~2 mpy) as the pH of the solutions reached 13. These decreases have been attributed to film formation on aluminum alloys which has been promoted by pre-saturation of the solution with aluminum. It has also been retarded or prevented by the presence of precipitation resulting from over saturation. Aluminum alloys have been used in processing equipment, including pressure vessels, piping, storage tanks and tank cars. See also Ref: (1) p. 125, (3) pp. 43, 58, 61, (4) pp. 34, 35, 36, 37, 69 (7) p. 17.

AMMONIUM IODIDE. NH_4I. Solid ammonium iodide caused mild attack (~2 mpy) of 3003 alloy and mild attack (~4 mpy) with blistering of alloy 5154 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also. Ref: (3) p. 63.

AMMONIUM LACTATE. $NH_4C_3H_5O_3$. In laboratory tests at ambient temperature, 30% and 50% aqueous solutions of ammonium lactate caused mild attack (~5 mpy) on alloy 3003, while at boiling temperature, 30% solutions were very corrosive. See also Ref: (3) p. 71.

AMMONIUM MOLYBDATE. $(NH_4)_2MoO_4$. Alloy 3003 was resistant to solid ammonium molybdate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (7) pp. 16, 17.

AMMONIUM NITRATE. NH_4NO_3. See also AMMONIUM NITRATE (AMMONIATED). In laboratory tests, alloy 3003 was found to be resistant to

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

dry ammonium nitrate at ambient temperature and to aqueous solutions of ammonium nitrate at ambient and elevated temperatures (up to 180°F). Ammonium nitrate solutions used mainly for fertilizers, have been produced, piped and stored in aluminum alloy tank cars in concentrations up to 83% by weight and at temperatures up to 121°C (250°F). In the hot 83% solution, corrosion can be stimulated particularly at welds by the presence of free nitric acid. To avoid this, the pH of the hot solution should be maintained above 6 and the solution agitated to maintain a uniform pH. Welded 3003 alloy is more tolerant of these acidic conditions and has been used for tank bottoms and piping. Mercury contamination can also be a serious problem in ammonium nitrate service and must be avoided. Roofing, siding, and prilling towers have been used in ammonium nitrate plants. See also Ref: (1) p. 125, (2) p. 55, (3) p. 66, (7) p. 17.

AMMONIUM NITRATE (AMMONIATED). Ammoniated solutions of ammonium nitrate have been shipped, stored, and handled in aluminum alloy equipment. See also Ref: (1) p. 125, (2) p. 55, (3) p. 66.

AMMONIUM OXALATE. $(NH_4)_2C_2O_4 \cdot H_2O$. Solid ammonium oxalate caused mild attack (~2 mpy) of 3003 alloy in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1% solution of ammonium oxalate at ambient temperature caused mild attack (~3 mpy) and 4% solution was corrosive to alloy 3003; while at the boiling temperature, 1% solution was very corrosive. See also Ref: (1) p. 125, (3) p. 71, (7) p. 17.

AMMONIUM PERCHLORATE. NH_4ClO_4. Aluminum alloy equipment has been used for producing and handling ammonium perchlorate. See also Ref: (3) p. 63, (7) p. 17.

AMMONIUM PERSULFATE. $(NH_4)_2S_2O_8$. Alloys 3003 and 5154 were resistant to solid ammonium persulfate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 125, (2) p. 58, (3) p. 65, (7) p. 17.

AMMONIUM PHOSPHATE. Monobasic $NH_4H_2PO_4$. Dibasic $(NH_4)_2HPO_4$. The action of ammonium phosphates on aluminum is a function of both the concentration and the temperature. Solutions of the monobasic salt are less corrosive than are solutions of the dibasic salt and the rate of attack decreases with time. Laboratory tests showed that solutions of the monobasic salt up to 28% caused moderate attack (~10 mpy) on alloy 3003. Solutions of the diammonium salt are corrosive to aluminum alloys and should not be used with aluminum equipment unless inhibitors are employed. See also Ref: (1) p. 125, (2) p. 60.

AMMONIUM SULFAMATE. $NH_4SO_3NH_2$. Laboratory tests indicated that 1100 alloy was resistant to aqueous solutions of ammonium sulfamate at ambient temperature. See also Ref: (7) pp. 17, 18.

AMMONIUM SULFATE. $(NH_4)_2SO_4$. In laboratory tests, alloy 3003 was resistant to solid ammonium sulfate under conditions of 100% relative humidity at ambient temperature. Other laboratory tests showed that 1100 alloy was resistant to 1% to 45% solutions of ammonium sulfate at ambient temperature. Aluminum alloys have been used for handling ammonium sulfate. See also Ref: (1) p. 125, (2) p. 62, (3) p. 64, (7) p. 19.

AMMONIUM SULFIDE. $(NH_4)_2S$. In laboratory tests, 1100 alloy was resistant to 15% to 40% solutions of ammonium sulfide at ambient temperature. Aluminum alloys have been used for piping, coolers and tanks with ammonium sulfide. See also Ref: (1) p. 125, (3) p. 63, (7) p. 19.

AMMONIUM THIOCYANATE. NH_4SCN. Alloys 3003 and 5154 were resistant to solid ammonium thiocyanate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, alloys 3003, 5052 and 6061 were resistant to 1, 25 and 50% solutions of ammonium thiocyanate at ambient temperature. Aluminum alloy tanks and piping have been used to handle ammonium thiocyanate. See also Ref: (1) p. 126, (2) p. 66, (3) p. 69, (7) p. 19.

AMMONIUM THIOGLYCOLATE. $HSCH_2COONH_4$. Ammonium thioglycolate has been handled and shipped in aluminum alloy containers. See also Ref: (3) p. 71.

AMMONIUM THIOSULFATE. $(NH_4)_2S_2O_3$. Laboratory tests showed that alloy 3003 was resistant to aqueous solutions of ammonium thiosulfate at ambient temperature. Aqueous ammonium thiosulfate solutions have been shipped in aluminum drums. See also Ref: (3) p. 65, (7) p. 19.

AMYL ACETATE. $CH_3(CH_2)_3OOCCH_3$. In laboratory tests, alloys 3003 and 5052 were resistant to amyl acetate at temperatures up to 204°C (400°F). In other laboratory tests, condensing amyl acetate caused mild attack (~3 mpy) of alloy 3003. Pure amyl acetate has been stored in aluminum alloy tanks. See also Ref: (1) p. 126, (2) p. 68, (3) p. 136, (7) p. 19.

AMYL ALCOHOL. $CH_3(CH_2)_4OH$. Limited laboratory tests indicated that alloy 3003 was resistant to amyl alcohol at 100°C (212°F). Amyl alcohol was very corrosive to 204°C (400°F) and at the boiling point. Aluminum alloys have been used to handle amyl alcohol. See also Ref: (2) p. 71, (3) p. 113, (7) p. 21.

AMYL MERCAPTAN. $CH_3(CH_2)_4SH$. Amyl mercaptan has been stored in aluminum alloy tanks. See also Ref: (3) p. 133, (7) p. 21.

AMYL VALERATE. $(CH_3)_2CHCH_2COOC_5H_{11}$. Laboratory tests indicated that 1100 alloy was resistant to concentrated amyl valerate at ambient temperature. Amyl valerate is handled in aluminum containers. See also Ref: (7) pp. 20, 21.

ANILINE. $C_6H_5NH_2$. Laboratory tests indicated that 1100 alloy was resistant to aniline vapors at ambient and 75°C (167°F) temperatures. However, concentrated solutions of aniline were corrosive to 1100 alloy at the boiling point 184°C (364°F). Aluminum alloy equipment has been used in processes involving aniline. See also Ref: (1) p. 126, (2) p. 73, (3) p. 144, (7) p. 21.

ANISE OIL. Aluminum alloy tanks have been used for storing anise oil. See also Ref: (8) p. 125.

ANTIFREEZE SOLUTIONS. Water Solutions of Methyl Alcohol, Glycerin or Glycol. Laboratory tests have shown that alloys 1100 and 3003 were resistant to many commercial antifreeze solutions. In automotive applications, the antifreeze solution must be maintained at the proper concentration in order that sufficient inhibitor is present to prevent deposition corrosion by heavy metal ions picked up from dissimilar metals in the system. Aluminum alloys have been used for automotive radiators and heat exchangers. See also Ref: (1) p. 126, (3) pp. 23, 114, 115, 136, 240.

ANTIPESTICIDES, INSECTICIDES. Dinitrocresol, (chlorophenoxy) acetic acid, copper oxychloride (0.5% Max.) and calcium polysulfides. In laboratory tests most insecticides were corrosive to aluminum alloys. See also Ref: (10) p. 101.

APPLE BRINE. Limited laboratory tests indicated that 5052 alloy was resistant to apple brine at 100°C (212°F).

AQUA REGIA. A mixture of nitric and hydrochloric acid. In laboratory tests, aqua regia was very corrosive to all aluminum alloys. See also Ref: (2) p. 80, (3) p. 38.

ARGON. A. Aluminum alloys have been used for pressure vessels and containers handling argon. See also Ref: (3) p. 35.

ARSENIC ACID. H_3AsO_4. In limited laboratory tests, concentrated arsenic acid was very corrosive to 6061 alloy at ambient temperature. See also Ref: (3) p. 49, (7) p. 25.

ARSENIC TRIOXIDE. As_2O_3. Alloys 3003 and 5154 were resistant to solid arsenic trioxide in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (3) p. 49, (7) p. 25.

ASBESTOS. Laboratory tests have shown that wet asbestos will cause corrosion when in intimate contact with all aluminum alloys. This has been confirmed by service experience. Dry asbestos does not cause corrosion of aluminum alloys. See also Ref: (1) p. 126, (5) p. 12.

ASPARTIC ACID. $HOOC \cdot CH_2CH(NH_2) \cdot COOH$. In limited laboratory tests, alloy 3003 was resistant to aspartic acid at 204°C (400°F). See also Ref: (1) p. 126, (3) p. 146, (7) p. 25.

ASPHALT. Bituminous substances from petroleum or purified tar. Aluminum alloy piping and tankers have been used for handling asphalt. See also Ref: (1) p. 126, (3) p. 221.

ASPIRIN. $CH_3COOC_6H_4COOH$. Aluminum alloys have been used in reaction and crystallization equipment for the preparation of aspirin. See also Ref: (2) p. 26, (3) pp. 130, 239.

ATMOSPHERES. Most aluminum alloys have resisted atmospheric weathering in laboratory controlled tests and have been widely used for architectural and structural purposes. The earliest known example of aluminum exposed to the weather is the cap piece on the well-known Washington Monument erected in 1884. That 100 ounce casting was examined in 1934 and again in 1964. Both examinations confirmed the resistance to weathering of the cap, as evidenced by the legibility of the original engraved inscriptions. The earliest known use of aluminum sheet for a roof is found on the St. Gioacchino church in Rome, Italy. Installed in 1897, examination after 70 years disclosed a measured corrosion depth of 0.06 mm (2.5 mils) average. A number of applications of aluminum for electrical power cables began early in the present century and continue in use today. An early stranded aluminum power cable in service near Hartford, CT, for 51 years, exhibited an average measured corrosion depth of 0.109 mm (4.3 mils). Aluminum castings have been used for thousands of spandrel panels on many buildings such as those in the Radio City complex completed during 1932 in New York and the Koppers Building completed during 1929 in Pittsburgh, PA. The Empire State Building also completed during 1929 in New York City had about 825,000 pounds of aluminum applied to its exterior.

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TABLE 5.2: ALUMINUM ALLOYS–ALUMINUM ASSOCIATION (continued)

The A. O. Smith Building completed during 1930 in Milwaukee, Wisconsin, may have been the forerunner of aluminum curtain wall construction. Examination in 1962 of a cast panel from the Smith Building disclosed average measured depth of attack to be 0.053 mm (2.1 mils) in the 6.35 mm (250 mils) thick metal. Aluminum residential roof shingles were marketed beginning in 1928 and examination of such a roof after 30 years in an industrial atmosphere revealed an average depth of corrosion penetration of 0.076 mm (3.0 mils) in the 0.508 mm (20 mils) thick 3003 alloy sheet. Since 1930, many applications of aluminum roofing and siding have been made throughout the world. Alclad aluminum industrial roofing and siding have been used for many years in a wide variety of highly industrial atmospheres. Corrosion depth is arrested at the cladding-core interface under the effect of cathodic protection by the 1% zinc-bearing aluminum alloy cladding. Port facilities throughout the nation have used large quantities of those alclad aluminum sheet products for transit sheds, storage buildings and the like. Literally hundreds of studies have been made on aluminum alloys after service for many years in industrial and seacoast localities.

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BARIUM CARBONATE. $BaCO_3$. Alloy 3003 was resistant to solid barium carbonate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (3) p. 76, (7) p. 27.

BARIUM CHLORIDE. $BaCl_2 \cdot 2\ H_2O$. Alloy 3003 was resistant to solid barium chloride in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to 0.001 to 0.4 N solutions of barium chloride at ambient temperature. See also Ref: (1) p. 127, (2) p. 84, (3) p. 73, (7) p. 27.

BARIUM HYDROXIDE. $Ba(OH)_2 \cdot 8\ H_2O$. Laboratory tests have shown that aqueous solutions of barium hydroxide are very corrosive to aluminum alloys. Aluminum alloys are not ordinarily used with barium hydroxide solutions. See also Ref: (1) p. 127, (3) p. 72, (7) p. 27.

BARIUM NITRATE. $Ba(NO_3)_2$. Alloy 3003 was resistant to solid barium nitrate in laboratory tests under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to dilute aqueous solution of barium nitrate at ambient temperature. See also Ref: (3) p. 75, (7) p. 27.

BARIUM SULFIDE. BaS. In limited laboratory tests, a 10% aqueous solution of barium sulfide was corrosive to 3003 alloy at ambient temperature and at 50°C (122°F). See also Ref: (3) p. 74, (7) p. 27.

BAUXITE. Ore of aluminum, containing a high content of hydrated aluminum oxide together with lesser amounts of oxides of iron, silicon and titanium and some minor impurities. Aluminum alloys have been used for transporting bauxite and as building components in bauxite plants. See also Ref: (8) pp. 100, 190.

BEANS. Beans have been canned in coated aluminum alloy cans. See also Ref: (6) p. 11.

BEER. Laboratory tests have shown that beer causes mild attack of most aluminum alloys and even less of high purity aluminum. In the brewing of beer, aluminum alloys have been used for fermenters, yeast tubs, culture tanks, carbonating tanks, coolers, storage tanks, beer kegs and other containers. Aluminum alloys have also been used for wort receiving and settling vessels and filtering apparatus. Aluminum alloy beer cans are coated internally. See also Ref: (1) p. 127, (3) p. 202, (4) pp. 94, 95, 96, 97, 128, (6) p. 10.

BEESWAX. Contains about 80% myricin. Beeswax has been used as a protective coating for aluminum alloy stress corrosion cracking test fixtures. See also Ref: (1) p. 127, (3) p. 225.

BENZALDEHYDE. C_6H_5CHO. In laboratory tests, alloys 3003, 5052 and 5154 were resistant to benzaldehyde at 50°C (122°F) and 204°C (400°F). Under boiling and condensing conditions, benzaldehyde caused moderate attack with localized pitting (~8 mpy). In other laboratory tests, the addition of water to benzaldehyde caused moderate corrosion with the maximum attack (~12 mpy) of 1100 alloy developing at about a 10% mixture of benzaldehyde in water. Aluminum alloy drums and tanks, distillation columns, condensers and dephlegmators have been used to handle pure benzaldehyde. See also Ref: (1) p. 127, (2) p. 87, (3) p. 120, (7) p. 27.

BENZENE. C_6H_6. In laboratory tests, alloys 3003, 5052, 5154 and 6061 were resistant to benzene at ambient and 50°C (122°F) temperatures. The addition of moisture increases the corrosivity of benzene towards aluminum alloys. Aluminum equipment has been used for stills, fractionators, dephlegmators, condensers, tanks and heat exchangers for benzene. See also Ref: (1) p. 127, (2) p. 90, (3) pp. 104, 223, 242, (7) p. 31.

BENZENE HEXACHLORIDE. $C_6H_6Cl_6$. Aluminum alloy equipment has been used in handling benzene hexachloride. *CAUTION*: see "Halogenated Hydrocarbons." See also Ref: (3) p. 110, (7) p. 31.

BENZIL. $C_6H_5COCOC_6H_5$. In limited laboratory tests, alloy 3003 was resistant to benzil at 204°C (400°F). Localized pitting was evidenced on the 3003. See also Ref: (3) p. 121, (7) p. 31.

BENZOIC ACID. C_6H_5COOH. Alloys 3003 and 5154 were resistant to solid benzoic acid in laboratory tests under conditions of 100% relative humidity at ambient temperature. Aluminum alloy sublimating equipment, hoppers and piping have been used in the production of benzoic acid. See also Ref: (1) p. 127, (2) p. 96, (3) p. 132, (7) p. 29.

BENZOYL CHLORIDE. C_6H_5COCl. Limited laboratory tests indicate that benzoyl chloride is corrosive to high purity aluminum at boiling temperature 198°C (388°F). *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (1) p. 127, (3) p. 133.

BENZYL ACETATE. $C_6H_5CH_2OOCCH_3$. In laboratory tests, alloy 3003 was resistant to benzyl acetate at 100°C (212°F) but was corroded under boiling and condensing conditions.

BENZYL ALCOHOL. $C_6H_5CH_2OH$. In laboratory tests, alloy 3003 was resistant to benzyl alcohol at 204°C (400°F) and under refluxing conditions. Benzyl alcohol has been handled in aluminum alloy tanks. See also Ref: (3) p. 113, (7) p. 33.

BENZYL CHLORIDE. $C_6H_5CH_2Cl$. High purity aluminum was resistant to benzyl chloride in laboratory tests at ambient temperature. Benzyl chloride caused corrosion of other alloys, increasing as temperature increased. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (2) p. 100, (3) p. 111, (7) p. 33.

BERYLLIUM CHLORIDE. $BeCl_2$. Aluminum alloy containers have been used for storing and transporting beryllium chloride. See also Ref: (2) p. 102, (3) p. 73, (7) p. 35.

BISMUTH NITRATE. $Bi(NO_3)_3 \cdot 5\ H_2O$. Alloys 3003 and 5154 were resistant to solid bismuth nitrate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (8) p. 106.

BITUMINOUS PAINT. Laboratory tests have shown that bituminous paint is protective to aluminum alloys. See also Ref: (1) p. 127, (3) pp. 218, 221, (4) p. 141.

BLACKBERRY JUICE. In laboratory tests, blackberry pomace and juice mixture was corrosive to 3003 alloy at 100°C (212°F). See also Ref: (4) pp. 88, 89.

BORDEAUX MIXTURE. A mixture of cupric sulfate, calcium oxide, and water. Aluminum alloy equipment has been used to handle Bordeaux mixture. See also Ref: (1) p. 127.

BORIC ACID. H_3BO_3. Alloys 3003 and 5154 were resistant to solid boric acid in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, alloys 1100, 3003 and 6061 were resistant to aqueous solutions (1–15%) of boric acid at ambient temperature and at 60°C (140°F). Aluminum alloy drying kilns, trays, conveyors, hoods, tanks and valves have been used for handling boric acid. See also Ref: (1) p. 127, (2) p. 108, (3) p. 51, (4) pp. 123, 124, 125, (7) p. 35.

BORON TRIFLUORIDE. BF_3. Aluminum alloy reactors have been used in the manufacture of naphthalene in which boron trifluoride is used as a catalyst. See also Ref: (1) p. 127, (3) p. 51, (7) p. 37.

BOROSILICATES. In laboratory tests, 3003 alloy was resistant to borosilicate glass wool under conditions of 100% relative humidity at 52°C (125°F). See also Ref: (10) pp. 29, 108.

BROMOFORM. $CHBr_3$. In limited laboratory tests, bromoform was corrosive to aluminum alloys with the attack being accelerated as the temperature increased. Inhibitors such as amines have promise of reducing the attack to some degree. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (1) p. 128, (3) pp. 23, 106, (7) p. 37.

BROMOMETHANE. CH_3Br. In limited laboratory tests, bromomethane was very corrosive to high purity aluminum at 50°C (122°F). See also Ref: (3) p. 105.

BULK (DRY) MATERIALS. Aluminum alloys have been used to handle a wide variety of materials in bins, cars, drums and wrappings. Listed below are some examples of these materials. See also Ref: (6) pp. 10, 11, 12.

Flour	Phosphorus suspensions
Sugar	Cement
Synthetic detergents	Whiting
Soap flakes	Ethycel
Cocoa	Salt
Instant coffee	

1,3-BUTADIENE. $CH_2{:}(CH)_2{:}CH_2$. This product has been stored and transported in aluminum alloy equipment. See also Ref: (3) p. 103.

BUTANE. $CH_3(CH_2)_2CH_3$. Aluminum alloy pipe and tube have been used to handle butane. See also Ref: (1) p. 128, (3) p. 214, (7) p. 39.

BUTTER. Aluminum alloy equipment has been

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

used to handle butter. Aluminum foil has been used for packaging butter. See also Ref: (1) p. 128, (3) p. 205, (4) pp. 84, 100, 102, 103, 114, (6) p. 11.

BUTYL ACETATE $CH_3COO(CH_2)_3CH_3$. In laboratory tests, alloy 3003 was resistant to butyl acetate at ambient temperature and at the boiling point. Under refluxing conditions, butyl acetate caused mild attack (~3 mpy) of 3003 alloy. Aluminum alloy storage tanks have been used for butyl acetate. See also Ref: (1) p. 128, (2) p. 118, (3) p. 136, (7) p. 39.

BUTYL ALCOHOLS. $CH_3 \cdot CH_2 \cdot CH_2 \cdot CH_2 \cdot OH$, $CH_3 \cdot CH(OH) \cdot CH_2 \cdot CH_3$, $(CH_3)_3C \cdot OH$. In laboratory tests, alloy 3003 water cooled tube was resistant to condensing vapors from n-butyl alcohol. In other laboratory tests at 204°C (400°F), n-butyl alcohol containing as much as 1.5% water was very corrosive to 3003 alloy, but with 5% water, 3003 alloy was resistant. At the same temperature, alloy 3003 was resistant to secondary and tertiary butyl alcohols with 0.3% water. Aluminum alloy decanters, heat exchangers and tanks have been used with pure butyl alcohol or butyl alcohol-water mixtures. See also Ref: (1) p. 128, (2) p. 120, (3) p. 113, (7) p. 39.

BUTYL "CELLOSOLVE." $CH_2OH \cdot CH_2 \cdot O \cdot C_4H_9$. In limited laboratory tests, commercial pure butyl "Cellosolve" caused very severe corrosion of 3003 alloy under refluxing conditions. This corrosion was eliminated in those tests by the addition of a small amount of nitrobenzene.

BUTYL "CELLOSOLVE" ACETYL RECINOLEATE. $C_{26}H_{48}O_5$. This product has been manufactured and handled in aluminum alloy equipment.

BUTYL LACTATE. $CH_3CH(OH)COOC_4H_9$. In laboratory tests, alloys 3003, 5052 and 5154 were resistant to butyl lactate at temperatures from ambient to 188°C (370°F). As condensing vapors, butyl lactate caused mild attack (~2 mpy) of 3003 alloy. Butyl lactate has been handled in drums, tank trucks and tank cars made from aluminum alloys. See also Ref: (7) pp. 40, 41.

n-BUTYRALDEHYDE. $C_2H_5 \cdot CH_2 \cdot CHO$. In laboratory tests, 1100 alloy was resistant to solutions of butyraldehyde (1-100%) at ambient temperature. Corrosion increased at elevated temperatures, particularly at lower concentrations in the same tests. Aluminum alloy still and condenser tubes, shipping drums and tank cars have been used with n-butyraldehyde. See also Ref: (3) p. 120, (7) p. 41.

BUTYRIC ACID. $CH_3(CH_2)_2$ COOH. The effect of butyric acid on aluminum is similar to that of acetic acid and propionic acid.
The corrosion rates pass through a minimum at 5% acid and then increase again at approximately 70-80%. Above this concentration, the corrosion rates drop to low values for commercial strength butyric acid containing about 0.2% water. Dehydrated acid, containing about 0.05% water corrodes aluminum. Aluminum alloy storage tanks and shipping drums have been used. Heat exchangers made of aluminum-manganese alloys have proved to be satisfactory. Alloy 356.0 valves are used for handling butyric acid. See also Ref: (1) p. 128, (2) p. 123, (3) p. 127, (4) pp. 24, 29, 30, 31, (7) p. 41.

BUTYRIC ANHYDRIDE. $[CH_3(CH_2)_2CO]_2O$. In laboratory tests, butyric anhydride and mixtures of butyric anhydride and butyric acid at temperatures from ambient to boiling caused moderate attack (~7 mpy) of 1100 alloy. In the same tests, a mixture of dehydrated butyric acid and commercial strength anhydride was corrosive to 1100 alloy. Aluminum alloy storage tanks and shipping drums have been used for butyric anhydride. See Ref: (3) p. 128, (7) p. 41.

C

CADMIUM CHLORIDE. $CdCl_2 \cdot 2\frac{1}{2} H_2O$. Solid cadmium chloride was very corrosive to 3003 and 5154 alloys in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (3) p. 80, (7) p. 45.

CADMIUM SULFATE. $CdSO_4$. Alloys 3003 and 5154 were resistant to solid cadmium sulfate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solution (1-15%) caused mild attack of 3003 alloy at ambient temperature. Aluminum alloy piping, filter press plates, and tanks have been used to handle cadmium sulfate. See also Ref: (3) p. 80, (7) p. 45.

CALCIUM CARBIDE. CaC_2. Solid calcium carbide caused mild attack of alloy 5154, while alloy 3003 was resistant in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 128, (3) p. 76, (7) p. 45.

CALCIUM CARBONATE. $CaCO_3$. In laboratory tests, saturated solutions of calcium carbonate caused mild attack (~2 mpy) on alloy 1100 at ambient temperature. The rate decreased with time. Dry calcium carbonate had no effect. See also Ref: (1) p. 128, (3) p. 76, (7) p. 45.

CALCIUM CHLORIDE. $CaCl_2 \cdot 6H_2O$. In laboratory tests, solid calcium chloride caused moderate attack (~6 mpy) of alloys 3003, 5154, and 6061 under conditions of 100% relative humidity at ambient temperature. Other laboratory tests show that aqueous solutions (up to 45%) caused mild attack at ambient temperature with pitting in evidence. The action of calcium chloride can be inhibited by the addition of sodium dichromate. Inhibited calcium chloride refrigeration brines have been commonly handled in aluminum alloy equipment. Alloy 356.0 valves have been used for handling calcium chloride solutions. See also Ref: (1) p. 128, (2) p. 129, (3) pp. 23, 73, 240, (7) p. 47.

CALCIUM CHROMATE. $CaCrO_4$. Calcium chromate has been used as an inhibitive pigment in organic coatings on aluminum alloys. See also Ref: (7) p. 47.

CALCIUM GLUCONATE.
$Ca[HO \cdot CH_2 (CH \cdot OH)_4COO]_2 \cdot H_2O$. Aluminum alloy tanks have been used in the production of calcium gluconate. See also Ref: (3) p. 77, (7) p. 47

CALCIUM HYDROXIDE. $Ca(OH)_2$. In laboratory tests, calcium hydroxide solutions have rapid etching action on aluminum alloys which quickly subsides as the result of the formation of protective films on the aluminum surface. See also Ref: (1) p. 128, (2) p. 133, (3) p. 72, (4) p. 47.

CALCIUM HYPOCHLORITE. $Ca(ClO)_2 \cdot 2 H_2O$. Solid calcium hypochlorite was corrosive (~27 mpy) to alloy 3003 and caused moderate attack (~10 mpy) of alloy 5154 in laboratory tests under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solutions, except those at very low concentrations, were corrosive to 3003 alloy at ambient temperature. Aluminum baskets and rotary driers have been used with calcium hypochlorite. See also Ref: (1) p. 128, (2) p. 104, (3) pp. 73, 247, (7) p. 47.

CALCIUM NITRATE. $Ca(NO_3)_2$. In laboratory tests, alloy 3003 was resistant to aqueous solutions (1-50%) of calcium nitrate at ambient temperature. See also Ref: (1) p. 128, (3) p. 75, (7) p. 47.

CALCIUM OXIDE. CaO. Alloy 3003 was resistant to solid calcium oxide in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In the presence of liquid water, calcium hydroxide is formed, leading to the formation of protective films on the aluminum surface (see CALCIUM HYDROXIDE). See also Ref: (1) p. 128, (3) p. 72, (7) p. 49.

CALCIUM PROPIONATE. $Ca(CH_3 \cdot CH_2 \cdot COO)_2$. Calcium propionate has been stored in aluminum alloy tanks. See also Ref: (3) p. 77.

CALCIUM SILICATE. Ca_3SiO_5(OR 3 CaO · SiO_2). Aluminum alloy driers have been used with calcium silicate. See also Ref: (3) p. 76, (7) p. 49.

CAMPHOR. $C_{10}H_{16}O$. Aluminum alloy equipment has been used to handle camphor. See also Ref: (1) p. 129, (3) pp. 104, 121, 226 (7) p. 51.

CANE SUGAR LIQUORS. Aluminum alloy equipment has been used in the processing and handling of cane sugar liquors. See also Ref: (4) pp. 74, 90.

n-CAPROIC ACID. $CH_3 \cdot (CH_2)_4 \cdot COOH$. In laboratory tests, alloys 3003, 5154, and 6061 were resistant to n-caproic acid at 50°C (122°F) and at the boiling point. Under refluxing conditions, n-caproic acid was corrosive to aluminum alloys. This acid has been stored in aluminum alloy containers. See also Ref: (2) p. 274, (3) p. 127.

CAPROLACTAM. $CH_2(CH_2)_4NHCO$. Laboratory tests indicate that caprolactam is discolored by contact with aluminum alloys.

n-CAPRYLIC ACID. $CH_3(CH_2)_6 \cdot COOH$. In limited laboratory tests, alloys 3003 and 5052 were resistant to caprylic acid at ambient temperature. This acid has been shipped in aluminum alloy containers. See also Ref: (2) p. 274, (3) p. 127.

CARBOLIC ACID. C_6H_5OH. See PHENOL. See also Ref: (2) p. 537, (3) p. 116.

CARBON. C. In laboratory tests, various aluminum alloys were resistant to carbon when dry. When wet, carbon acts as a cathode to contacting aluminum and causes corrosion as a result of galvanic action. Carbon black has been handled in aluminum alloy containers and hopper cars. See also Ref: (1) p. 129, (2) p. 50.

CARBON DIOXIDE. CO_2 Carbon dioxide in liquid, solid or gaseous form has been handled in aluminum alloy equipment including pipe lines. See also Ref: (1) p. 129, (2) p. 141, (3) pp. 50, 214, (4) pp. 43, 47, 48, 93.

CARBON DISULFIDE. CS_2. Alloy 1100 was resistant to carbon disulfide in laboratory tests conducted at ambient temperature and at the boiling point. Aluminum absorbers, distillation columns, condensers, and piping have been used in carbon disulfide recovery systems. Alloy 356.0 valves have been used for handling carbon disulfide. See also Ref: (1) p. 129, (2) p. 146, (3) p. 51 (7) p. 51.

CARBONIC ACID. H_2CO_3. Carbonated beverages have been handled in aluminum alloy equipment. See also Ref: (1) p. 129, (2) p. 141, (3) p. 22, (7) p. 51.

(continued)

TABLE 5.2: ALUMINUM ALLOYS–ALUMINUM ASSOCIATION (continued)

CARBON TETRACHLORIDE. CCl_4. In laboratory tests, alloys 3003, 5052 and 5154 were resistant to carbon tetrachloride at ambient temperature, whereas, boiling carbon tetrachloride was corrosive to these alloys as well as to many others. Two products of this reaction are aluminum chloride and hexachloroethane. The reaction apparently is electrochemical in nature and accelerated by anhydrous aluminum chloride. The reaction decreases rapidly as the temperature is dropped from boiling [77°C (170°F)] to 50°C (122°F). The rate increases markedly on superheating. The presence of water, carbon disulfide or oxygen increases the action at lower temperatures and decreases it at higher temperatures. The action can also be minimized by adding stabilizers. Aluminum powder in contact with carbon tetrachloride should not be used as a milling medium for comminuting aluminum. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (1) p. 129, (2) p. 153, (3) pp. 23, 106.

CELLULOSE. $(C_6H_{10}O_5)_n$. Aluminum alloy equipment has been used to handle cellulose. See also Ref: (1) p. 129, (3) pp. 124, 231.

CELLULOSE ACETATE BUTYRATE. Aluminum alloy silos, piping, and conveyors have been used for handling cellulose acetate butyrate. See also Ref: (3) p. 136, (7) p. 53.

CELLULOSE ACETATES. Aluminum alloys have been used in the preparation and storage of cellulose acetates. See also Ref: (1) p. 129, (3) pp. 136, 232, (7) p. 53.

CEMENT, PORTLAND. While in the fluid state, Portland cement causes etching of aluminum alloys as indicated in laboratory tests and in service applications. After the cement has set, no further corrosion occurs as a result of a protective film forming on the aluminum. Galvanic corrosion will develop if aluminum is coupled to dissimilar metals in cement or concrete to which chlorides have been added for high early strength. Aluminum alloys have been used for freight cars, hopper cars, and tote bins handling cement. Aluminum has also been used successfully for racks and pallets in the concrete block industry, molds and forms, and terrazzo divider strips. See also Ref: (1) p. 129, (2) p. 161, (3) p. 228.

CEREALS. Aluminum alloy equipment has been used for handling and preparation of cereals.

CHEESE. Cheeses vary in their action on aluminum alloys. In laboratory tests, aluminum alloys were resistant to some cheeses, while other cheeses were corrosive. When necessary, aluminum alloys can be protected readily. Aluminum vats and molds have been used for processing cheese. Aluminum wrappings and containers have been used for cheese. Those have usually been protected. See also Ref: (1) p. 129, (3) pp. 199, 205, (4) pp. 84, 102, 103, 114, 115, (6) pp. 9, 11, 14, 15.

CHERRIES. In laboratory tests, cherries in brine caused moderate attack of 3003, 5052, and Alclad 3003 alloys at ambient temperature. Alclad 3003 when exposed at ambient temperature was resistant to Maraschino cherries in another laboratory test. Fresh cherries in water have been carried by aluminum alloy irrigation pipe to processing tanks.

CHERRY JUICE. In laboratory tests, sweet red cherry juice caused mild attack (~4 mpy) of 3003 alloy at 100°C (212°F) while black cherry juice caused moderate attack (~8 mpy). See also Ref: (4) pp. 88, 89, (6) p. 10.

CHLORDANE. $C_{10}H_6Cl_8$. In laboratory tests, 3003 alloy was resistant to technical chlordane with or without 0.2% water additions at ambient temperature. Similar results were obtained with 2% and 20% solutions of chlordane in kerosene. However, the addition of as little as 0.2% distilled water to these solutions increased their corrosivity greatly. Aluminum alloy containers have been used for the bulk shipment of chlordane. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (3) p. 110, (7) p. 55.

CHLORINE. Cl_2. In laboratory tests, aqueous solutions containing 25, 50, and 100 ppm chlorine caused moderate attack of 1100 and 6061 alloys at ambient temperature. Dry chlorine gas does not attack aluminum alloys, but in the presence of water is corrosive. Aluminum alloy bus bar has been used in caustic-chlorine plants. Hot chlorine gas has been cooled in aluminum alloy heat exchangers. See also Ref: (1) p. 129, (2) p. 167, (3) pp. 36, 247, (7) p. 57.

CHLOROACETIC ACID. $CH_2Cl \cdot COOH$. Laboratory tests indicated that pure chloroacetic acid is very corrosive to 3003 alloy at 204°C (400°F). *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (7) pp. 56, 57.

CHLOROBENZENE. C_6H_5Cl. Laboratory tests indicated that alloy 3003 was resistant to chlorobenzene at 100°C (212°F) and refluxing temperatures. Chlorobenzene has been shipped in aluminum alloy tank trucks. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (2) p. 173, (3) p. 111, (7) p. 57.

1-CHLOROBUTANE. C_4H_9Cl. Laboratory tests showed that 3003 alloy was resistant to 1-chlorobutane at ambient temperature and 50°C (122°F). At the reflux temperature 1-chlorobutane was corrosive to alloy 3003 and high purity aluminum. *CAUTION*: See "Halogenated Hydrocarbons."

2-CHLOROBUTANE. $CH_3CH_2CHClCH_3$. In laboratory tests, alloy 3003 was resistant to 2-chlorobutane at ambient temperature. At higher temperatures, 2-chlorobutane was corrosive to 3003 alloy. *CAUTION*: See "Halogenated Hydrocarbons."

2-CHLOROETHANOL. CH_2ClCH_2OH. In laboratory tests, 3003 alloy was resistant to 2-chloroethanol at ambient temperature. Corrosion increased significantly as temperature increased with 2-chloroethanol being very corrosive at the boiling point. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (3) p. 133, (7) p. 87.

CHLOROFORM. $CHCl_3$. In laboratory tests, 1100 alloy was resistant to chloroform with a trace of water at temperatures up to the boiling point 61°C (142°F). In the same test, anhydrous chloroform was corrosive. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (1) p. 130, (2) p. 179, (3) p. 106, (7) p. 59.

CHLORONITROBENZENE. $NO_2C_6H_4Cl$. In limited laboratory tests, 3003 alloy was resistant to chloronitrobenzene at ambient temperature. *CAUTION*: See "Halogenated hydrocarbons." See also Ref: (2) p. 185.

CHOCOLATE. Aluminum alloy equipment has been used in the preparation and manufacture of chocolate candy. Aluminum foil has been used to package chocolate products. See also Ref: (3) pp. 200, 203, (4) p. 115, (6) p. 12.

CHROMIC ACID. H_2CrO_4. In laboratory tests, 1100 alloy was resistant to aqueous chromic acid solutions in concentrations up to 0.1 N at ambient temperature. See also Ref: (1) p. 130, (2) p. 194, (3) pp. 82, 236, (4) pp. 21, 121, (7) p. 63.

CHROMIUM. Cr. Chromium plated aluminum alloy products have been used. See also Ref: (3) p. 82, (4) pp. 83, 134.

CHROMIUM OXIDE. Cr_2O_3. Chromium oxide in the dry state has been handled in aluminum alloy equipment. See also Ref: (1) p. 130, (3) p. 82.

CHROMIUM POTASSIUM SULFATE. $CrK(SO_4)_2 \cdot 12H_2O$. Alloys 3003 and 5154 were resistant to solid chromium potassium sulfate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (7) pp. 62, 63.

CHROMIUM SULFATE. $Cr_2(SO_4)_3 \cdot 15\ H_2O$. Solid chromium sulfate was corrosive to 3003 alloy in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 130, (3) p. 82, (7) p. 63.

CHROMIUM TRIOXIDE. CrO_3. Solid chromium trioxide caused moderate attack (~17 mpy) of 3003 alloy in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Alloy 356.0 valves have been used for handling chromic acid solutions. See also Ref: (2) p. 194, (3) p. 82, (7) p. 63.

CIDER. In laboratory tests, 5052 alloy was resistant to apple cider at 38°C (100°F). See also Ref: (1) p. 130, (3) p. 202, (4) pp. 78, 97, (6) p. 10.

CITRIC ACID. $(HOOC)CH_2C \cdot (OH)(COOH) \cdot CH_2COOH$. In laboratory tests, 1100 alloy was resistant to aqueous solutions of citric acid at ambient temperature. While increased concentration had little effect, increasing temperature caused the corrosivity of the solutions to increase substantially. The presence of chlorides or heavy metals increases the corrosivity of these solutions. Aluminum has no harmful action on the organisms used in the manufacture of citric acid and is suitable for equipment such as fermenting vats, crystallizers, solution storage vats, and piping. Alloy 356.0 valves have been used for handling citric acid solutions. See also Ref: (1) p. 130, (2) p. 199, (3) pp. 131, 209, (4) pp. 22, 25, 26, 27, 28, 29, 30, 31, 109, 110, 113, (7) p. 65.

CITRUS FRUIT JUICES. Laboratory tests indicated that alloys 3003, 5052, and 5086 were resistant to citrus fruit juices at ambient and refrigerated temperatures. See also Ref: (4) p. 90, (6) p. 10, 13.

CLAY. Variable substance with a base of hydrous aluminum silicate. Dry clay and clay slurries have been handled in aluminum alloy piping, fittings, and valves. See also Ref: (1) p. 130, (3) p. 228.

COAL. Mainly carbon, containing also many organic compounds. A controlled field test indicated that aluminum alloys performed well when contacting various types of coal for 30 years. Aluminum alloys have been used for trucks, hopper cars, chutes, skips, cages, trolleys, pit props, and hand tools in the handling of coal. Aluminum liners have given satisfactory service in coal bunkers to assist in the flow of the coal. See also Ref: (1) p. 130, (3) pp. 50, 221.

COAL GAS. Containing hydrogen, methane, carbon monoxide, ethane, carbon dioxide, oxygen, nitrogen and volatile organic compounds. Limited laboratory tests showed that 443.0 casting alloy was resistant to coal gas at ambient temperature. See also Ref: (3) p. 221, (7) p. 65.

COAL TAR. Containing benzene, toluene, naphthalene, anthracene, xylene, other aromatics; phenol, cresol, other phenolics; ammonia, pyridene, other organic bases, thiophene. Aluminum alloy equipment including distillation columns, condensers and piping have been used in the production of coal tar. See also Ref: (3) pp. 223, 224.

(continued)

TABLE 5.2: ALUMINUM ALLOYS–ALUMINUM ASSOCIATION (continued)

COBALT COMPOUNDS. Solid cobaltous chloride was very corrosive to alloys 3003 and 5154 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Solid cobaltous nitrate caused mild attack (~3 mpy) of 3003 alloy in the same tests. See also Ref: (3) p. 84, (5) p. 13.

COCA COLA* SYRUP. In laboratory tests, Coca Cola syrup is corrosive to aluminum alloys. Unprotected aluminum is not ordinarily used with this product.

*Registered trademark

COCONUT OIL. Contains trimyristin, trilaurin, tripalmitin, tristearin, other glycerides. Coconut oil has been stored in aluminum alloy tanks. See also Ref: (7) p. 93.

COD LIVER OIL. A fixed oil containing vitamins A and D, glycerides of palmitic, stearic, etc., acids, cholesterol, butyl alcohol esters. Cod liver oil has been processed and stored in aluminum alloy equipment. See also Ref: (1) p. 130, (2) p. 294, (3) p. 239.

COFFEE. Coffee has been prepared in aluminum alloy cooking equipment and utensils. See also Ref: (1) p. 130, (3) p. 211, (4) pp. 80, 84, 97, (6) p. 12.

COKE. (From destructive distillation of coal and other carbonaceous materials.) The resistance of aluminum to coke has been reflected by its use for coke conveyor buckets and as sprayed coatings to protect steel cars used for coke quenching. Aluminum alloy equipment has been used in many applications handling coke oven gas. Deacidifiers, pipes, heat exchangers, heating coils, regenerators, and absorbers made of aluminum alloys have been in service processing coke oven gas. See also Ref: (1) p. 130, (3) pp. 218, 221, 223.

COKE OVEN GAS. Contains hydrogen, methane, carbon dioxide and volatile organic compounds. Aluminum alloy deacidifiers, heat exchangers, and heating coils have been used in the Collins process for the desulfurization of coke oven gas. Condensation of moisture on surfaces contacting coke oven gas can accelerate corrosion on aluminum alloys as the result of the formation of sulfurous acid. See also Ref: (1) p. 130, (2) p. 859.

COLLODION. Pyroxylin dissolved in alcohol and ether. Laboratory tests showed that alloy 6053 was resistant to collodion at ambient temperature. Collodion has been stored in aluminum alloy containers. See also Ref: (3) p. 124.

CONCRETE. Aluminum alloys embedded in fresh mortar or concrete have been used in many applications. As shown by laboratory tests, some surface attack occurs during the first few hours while the concrete is still fluid. However, further attack is substantially retarded because of the formation of highly protective films on the aluminum. Measured depths of the attack that take place during the setting period of concrete are generally less than 1 mil while after 6 months or after 8 or 27 years in service measured depths of attack have been found no greater than 5 mils. Laboratory tests have demonstrated that the volume of concrete in contact with aluminum as well as availability of external moisture have no more than a minor effect on the performance of aluminum alloys embedded in concrete. In many applications, aluminum alloys embedded in concrete are coupled directly or indirectly to reinforcing or structural steel. Laboratory tests have shown that aluminum is anodic to steel in concrete. Nonetheless, when coupled electrically in the laboratory to steel in concrete, aluminum alloys have been found less affected than when not coupled as the result of more rapid formation of protective films. Calcium chloride is often added to mortar and concrete to accelerate curing and to develop high early strength. Sodium chloride may also be present, as a contaminant of the water and sand. In laboratory tests, the addition of appreciable amounts of either calcium chloride or sodium chloride to concrete had little effect on the corrosivity of the concrete to aluminum alloys. However, these tests and service experience show that small amounts of chlorides will aggravate corrosion of alloys and even cause deterioration of the concrete when the corrosion is of a galvanic nature, especially when the concrete is either intermittently or continuously wet after curing. While aluminum alloys perform well in many applications involving mortar and concrete, definite benefits may be obtained by using protective coatings to prevent staining, eliminate crevice corrosion, minimize galvanic corrosion, and improve adhesion by decreasing gas evolution at the metal interface. See also Ref: (10) p. 29.

COPAL. Contains trachylolic acid, isotrachylolic acid, resene and volatile oil or contains dammaric acid, dammaran and a resin. Aluminum alloy equipment has been used for the production of varnishes made from copal resins. See also Ref: (1) p. 131, (2) p. 210, (3) p. 226, (7) p. 65.

COPPER COMPOUNDS. In laboratory tests, aqueous solutions of copper compounds were corrosive to aluminum alloys causing localized pitting. See also Ref: (1) p. 131, (3) p. 238.

CORK. The light, porous outer bark of the cork oak. In laboratory tests, cork was corrosive to contacting 3003 alloy under conditions of 100% relative humidity at 52°C (125°F) which caused wetting of the cork. See also Ref: (10) p. 29.

CORN OIL. A refined oil expressed from grain of Zea mays L. Corn oil has been stored in aluminum alloy containers. See also Ref: (6) p. 11.

CORN PRODUCTS. In laboratory tests, alloys 1100 and 3003 were resistant to many corn products tested. Aluminum alloy equipment has been used in the production of corn products. Aluminum alloy hoods, ducts, piping, and conveyors have been used.

CORN SYRUP. A mixture of dextrose and dextrins in water. Laboratory tests indicated that 6061 alloy was resistant to corn syrup at ambient temperature. Corn syrup has been stored in aluminum alloy containers. See also Ref: (2) p. 229, (6) p. 10.

COSMETICS. In laboratory tests, many cosmetics have been tested with variable results. Aluminum alloy containers have been used for a variety of creams, powders, lotions, and soaps. See also Ref: (3) pp. 117, 239.

COTTONSEED OIL. A refined oil expressed from the seeds of *Gossypium herbaceun* and other species of *Gossypium*. In laboratory tests, 6061 alloy was resistant to cottonseed oil at ambient temperature. Aluminum alloy storage tanks have been used for cottonseed oil. See also Ref: (2) p. 872.

CREAM. Aluminum alloys have been used for cream separators. See also Ref: (3) p. 204, (4) pp. 26, 102, (6) p. 11.

CRESOL. $C_6H_4(OH)(CH_3)$. In laboratory tests, 1100 alloy was resistant to 1%, 3%, and 100% solutions of cresol at ambient temperature. In other laboratory tests, cresol was very corrosive to 1100 alloy at the boiling point. See also Ref: (1) p. 131, (2) p. 221, (3) p. 116, (7) p. 67.

CRESYLIC ACID. A mixture of phenols from coal tar. In laboratory tests, 1100 alloy was resistant to 1%, 3%, and 100% solutions of cresylic acid at ambient temperature. See also Ref: (2) p. 221, (7) p. 67.

CRYOLITE. (SODIUM ALUMINUM FLUORIDE). Alloy 3003 was resistant to solid cryolite in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (7) pp. 160, 161.

CUMENE. $C_6H_5 \cdot CH(CH_3)_2$. In limited laboratory tests, 3003 alloy was resistant to cumene under refluxing conditions. Cumene has been stored in aluminum alloy containers. See also Ref: (7) p. 69.

CURRANTS (BLACK AND RED). In limited laboratory tests, red currants were corrosive to 3003 alloy at 100°C (212°F). Aluminum equipment has been used in processing and preparing currants. See also Ref: (6) p. 10.

CYCLOHEXANE. C_6H_{12}. In laboratory tests, 3003 alloy was resistant to cyclohexane under refluxing conditions. Aluminum alloy tank trucks have been used to ship cyclohexane. See also Ref: (3) p. 104, (7) p. 71.

CYMENE. $C_{10}H_{14}$. In laboratory tests, 3003 alloy was resistant to cymene under boiling and condensing conditions and under refluxing conditions. See also Ref: (3) p. 104.

D

2, 4-D. $Cl_2 \cdot C_6H_3 \cdot O \cdot CH_2 \cdot COOH$. Limited laboratory tests indicate that dilute aqueous solutions of 2, 4-D caused mild attack of 3003 alloy at ambient temperature. 2, 4-D has been handled in aluminum alloy sprayers and piping. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (3) p. 127.

DAIRY PRODUCTS. Aluminum alloys have been used for milk pails, milk cans, storage tanks, truck tankers, pasteurizers, coolers, butter churns and tubs, foil hoods, and powdered milk driers. See also Ref: (3) p. 204, (6) p. 11.

DDT. $(ClC_6H_4)_2CHCCl_3$. Laboratory tests showed that 3003 alloy was resistant to dry DDT and dilute aqueous solutions of DDT at ambient temperature. Aluminum alloy cans have been used for aerosol solutions of DDT. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (2) p. 226, (3) pp. 111, 241, (7) p. 75.

DETERGENTS. Aluminum alloys perform in different ways in different detergents. When in solution, some detergents stain and/or corrode aluminum. Since general conclusions cannot be drawn, detergents should be tested individually before use with aluminum alloys. Aluminum bins, silos, piping, and packages have been used for detergents. See also Ref: (1) p. 131, (3) p. 243, (4) pp. 34, 72, 75, 76, 85, 86, 87, 96, 103.

DIACETONE ALCOHOL. $(CH_3)_2C(OH)CH_2COCH_3$. In limited laboratory tests, 3003, 5052, and 5454 alloys were resistant to diacetone alcohol at ambient temperature and at 54°C (130°F). See also Ref: (3) p. 121.

DICHLOROACETIC ACID. $CHCl_2COOH$. In limited laboratory tests, dichloroacetic acid was corrosive to 3003 alloy at 204°C (400°F). *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (3) p. 127.

DICHLOROBENZENE. $C_6H_4Cl_2$. In laboratory tests, alloys 3003 and 5154 were resistant to dichlorobenzene at 50°C (122°F). Dichlorobenzene has been

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

handled in aluminum alloy tanks, filters, and heat exchangers. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (2) p. 173, (3) p. 111, (7) p. 75.

DICYCLOPENTENYL ALCOHOL. In laboratory tests, 3003 alloy was resistant to dicyclopentenyl alcohol at boiling temperature.

DIETHANOLAMINE. $HN(CH_2 \cdot CH_2OH)_2$. Laboratory tests showed that alloy 3003 was resistant to diethanolamine at ambient temperature. However, at the boiling temperature and under refluxing conditions diethanolamine caused moderate attack. While aluminum alloy heat exchangers have been used to handle diethanolamine solutions, tests under the anticipated conditions should be made prior to use in service. See also Ref: (3) p. 145.

DIETHYLAMINE. $(C_2H_5)_2NH$. Alloy 3003 was resistant to diethylamine in laboratory tests conducted at elevated temperatures of 100°C (212°F) and 204°C (400°F). Aluminum alloy stills and condenser tubes have been used in processing and handling diethylamine. See also Ref: (7) pp. 76, 77.

DIETHYLENE GLYCOL. $HO \cdot CH_2 \cdot CH_2 \cdot O \cdot CH_2 \cdot CH_2OH$. In laboratory tests, 3003 alloy was resistant to diethylene glycol under refluxing conditions. See also Ref: (3) pp. 25, 135, (7) pp. 76, 77.

n-DIMETHYL FORMAMIDE. $HCON(CH_3)_2$. In laboratory tests, 3003 alloy was resistant to dimethyl formamide at ambient temperature and at the boiling point. Dimethyl formamide has been handled in aluminum alloy tanks, piping, heat exchangers, and distillation towers. See also Ref: (3) p. 147, (7) p. 81.

UNS-DIMETHYLHYDRAZINE $(CH_3)_2NNH_2$. In laboratory tests, alloys 1100, 3003 and 5052 were resistant to uns-dimethylhydrazine when exposed at 30°C (86°F) and 63°C (145°F). Dimethylhydrazine has been stored in aluminum alloy containers. See also Ref: (7) pp. 80, 81.

DIMETHYL SULFATE. $(CH_3)_2SO_4$. Dimethyl sulfate has been stored in aluminum alloy containers. See also Ref: (2) p. 233.

DIMETHYL TEREPHTHALATE. $C_6H_4(COOCH_3)_2$. Aluminum alloy containers have been used for handling dimethyl terephthalate.

DIOCTYL PHTHALATE. $C_6H_4(COOCH_2CH(C_2H_5)C_4H_9)_2$. Aluminum alloy tanks have been used to store dioctyl phthalate. See also Ref: (7) p. 81.

DIPHENYL $C_6H_5 \cdot C_6H_5$. Aluminum alloy equipment has been used to handle diphenyl. See also Ref: (2) p. 247, (3) p. 104, (7) p. 81.

DYES. Aluminum alloy equipment has been used in some manufacturing processes for dyes in some dyeing processes for dye kettles, dye sticks and drying pans. See also Ref: (1) p. 131, (2) p. 252, (3) pp. 105, 119, 121, 132, 144, 145, 146, 235, (4) p. 73.

DYNAMITE. An explosive mixture containing nitroglycerin with other substances both inert and active. Aluminum alloys have been used for parts in dynamite packing machines and for dynamite driers and mixers. See also Ref: (1) p. 131, (3) p. 115.

E

EGGS. Aluminum alloy equipment has been used for the preparation and dessication of egg powder. Aluminum alloy trays have been used for drying egg whites. See also Ref: (1) p. 131, (3) p. 198, (4) p. 115, (6) pp. 8, 11.

ESSENTIAL OILS Volatile oils derived from plants and usually carrying the essential odor or flavor of the plant used. Aluminum alloy equipment has been used in the preparation, storage, and transport of essential oils. See also Ref: (1) p. 131, (2) p. 255, (3) p. 239.

ESTER GUMS. The glyceryl, methyl and ethyl esters of resin acids. Aluminum alloys have been used for piping ester gums.

ETHANOLAMINE. $H_2N \cdot CH_2 \cdot CH_2 \cdot OH$. Limited laboratory tests under refluxing conditions indicate that ethanolamine caused mild attack (~4 mpy) of 3003 alloy. Aluminum alloy heat exchangers have been used for handling a ethanolamine-diethylene glycol mixture to remove CO_2, H_2S, and water from natural gas. Aluminum alloy tanks have been used to transport ethanolamine. See also Ref: (1) p. 131.

ETHER. $C_2H_5 \cdot O \cdot C_2H_5$. Laboratory tests indicated that alloy 3003 was resistant to ether at both ambient and elevated temperatures. Aluminum processing, handling and degreasing equipment have been in use. Alloy 356.0 valves have been used for handling ether. See also Ref: (2) p. 258, (3) p. 135, (7) p. 77.

ETHYL ACETATE. $CH_3 \cdot COO \cdot C_2H_5$. In laboratory tests, alloy 3003 was resistant to ethyl acetate and its condensing vapors. Aluminum alloy heat exchangers, tank cars, etc., have been used for handling ethyl acetate. See also Ref: (1) p. 132, (2) p. 260, (3) p. 136, (7) p. 85.

ETHYL ALCOHOL. C_2H_5OH. In laboratory tests, alloy 3003 was resistant to commercial (95%) ethyl alcohol and its aqueous solutions. In other laboratory tests, anhydrous ethyl alcohol was corrosive to aluminum alloys. Aluminum alloys have been used commercially for stills, heat exchangers, drums, tanks, and piping in the processing of ethyl alcohol and products employing ethyl alcohol in their manufacture. See also Ref: (1) p. 132, (2) p. 28, (3) pp. 23, 112, (4) pp. 93, 97, 142, (7) p. 85.

n-ETHYLANILINE. $C_2H_5NHC_6H_5$. In laboratory tests, alloy 3003 was resistant to n-ethylaniline at the boiling temperature and under refluxing conditions. Ethylaniline has been stored in aluminum alloy containers.

ETHYLBENZENE. $C_6H_5 \cdot C_2H_5$. In laboratory tests, alloy 3003 was resistant to ethylbenzene at the boiling temperature and at 204°C (400°F). Ethylbenzene has been handled in aluminum alloy heat exchangers. See also Ref: (2) p. 263, (3) p. 104, (7) p. 87.

ETHYLBUTYL ACETYLRICINOLEATE. Aluminum alloy equipment has been used to produce and handle ethylbutyl acetylricinoleate.

ETHYL BUTYRATE. $CH_3 \cdot CH_2 \cdot CH_2 \cdot COOC_2H_5$. In laboratory tests, ethyl butyrate caused mild attack (~2 mpy) of 3003 alloy under boiling and condensing conditions and under refluxing conditions. Aluminum alloy equipment has been used in the production and handling of ethyl butyrate. See also Ref: (1) p. 132, (3) p. 137, (7) p. 87.

ETHYLENE. $CH_2{:}CH_2$. Ethylene has been handled in aluminum alloy heat exchangers and tanks. See also Ref: (3) p. 103, (7) p. 87.

ETHYLENEDIAMINE. $NH_2 \cdot CH_2 \cdot CH_2 \cdot NH_2$. In limited laboratory tests, 3003 alloy was resistant to ethylenediamine at 100°C (212°F) and 204°C (400°F). See also Ref: (1) p. 132, (3) p. 145, (5) p. 9, (7) p. 89.

ETHYLENE DICHLORIDE. $CH_2Cl \cdot CH_2Cl$. Limited laboratory tests indicate that 3003 alloy was resistant to dry ethylene dichloride vapor at the boiling point. The presence of water causes increased corrosion because of hydrochloric acid formed by hydrolysis. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (1) p. 132, (2) p. 268.

ETHYLENE GLYCOL. $HO \cdot CH_2 \cdot CH_2 \cdot OH$. Laboratory tests have indicated that 3003 alloy was resistant to ethylene glycol at ambient temperature and under refluxing and boiling and condensing conditions. Aluminum alloy equipment has been used in the processing of ethylene glycol and for storage tanks and pressure vessels. Inhibited ethylene glycol-water solutions have been used in automotive radiators and heat exchangers. Aluminum alloys should not be used in applications with stagnant ethylene glycol where very high temperatures are involved [200°C (392°F) and above]. Violent reactions are possible under these conditions. See also Ref: (1) p. 132, (3) pp. 25, 114, (7) p. 89.

ETHYLENE OXIDE. $(CH_2)_2O$. Aluminum alloys have been used to produce and handle ethylene oxide. Violent reactions are possible if aluminum chloride and aluminum oxide are present. See also Ref: (1) p. 132, (3) p. 135, (7) p. 89.

ETHYL FORMATE. $HCOO \cdot C_2H_5$. In laboratory tests, alloy 3003 was resistant to ethyl formate at ambient temperature and at the boiling temperature. In other laboratory tests, 3003 alloy was resistant to ethyl formate as condensing vapors. See also, Ref: (1) p. 132, (2) p. 136, (7) p. 91.

ETHYL LACTATE. $CH_3CH(OH)COOC_2H_5$. In laboratory tests at ambient temperature, alloy 6053 was resistant to ethyl lactate. See also Ref: (1) p. 132, (3) p. 137.

ETHYL PROPIONATE. $CH_3CH_2 \cdot COOC_2H_5$. In limited laboratory tests, alloy 3003 was resistant to ethyl propionate under boiling and condensing conditions. Aluminum alloy stills and condenser tubes have been used in the production of ethyl propionate. See also Ref: (7) pp. 90, 91.

EUCALYPTUS OIL. A volatile oil containing eucalyptol; valeric, butyric, etc., aldehydes; d-pinene. Aluminum alloys have been used for handling eucalyptus oil. See also Ref: (1) p. 132.

EUGENOL. $C_{10}H_{12}O_2$. Aluminum alloy drums have been used to store and transport eugenol.

F

FATS. Aluminum alloy equipment has been used to handle fats. See also Ref: (1) p. 132, (2) p. 271, (3) p. 198, (4) pp. 72, 78, 83, 84, 99, 100, 109, (7) p. 93.

FATTY ACIDS. RCOOH. Laboratory tests have shown that fatty acids cause mild attack of 1100 alloy at ambient temperature. Anhydrous fatty acids were found to be very corrosive to aluminum alloys at the boiling point in other laboratory tests. Aluminum alloy storage tanks, separators, settling and receiving tanks, condensers, vapor lines, and steam trace lines have been used to process and handle fatty acids and fatty acid derivatives. See also Ref: (1) p. 132, (2) p. 274, (3) pp. 125, 127, (4) pp. 25, 100, (7) p. 93.

FERRIC CHLORIDE. $FeCl_3 \cdot 6H_2O$. Solid ferric chloride was very corrosive (244 mpy) to 3003 alloy in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Also in laboratory tests, aqueous solutions of ferric chloride

(continued)

TABLE 5.2: ALUMINUM ALLOYS–ALUMINUM ASSOCIATION (continued)

were very corrosive to aluminum alloys. See also Ref: (1) p. 132, (2) p. 288, (3) p. 84, (7) p. 93.

FERRIC OXIDE. Fe_2O_3. Alloys 3003 and 5154 were resistant to solid ferric oxide in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 132.

FERROUS SULFATE. $FeSO_4 \cdot 7H_2O$. Alloy 3003 was resistant to solid ferrous sulfate while 5154 alloy suffered mild attack (~4 mpy) in laboratory tests under conditions of 100% relative humidity at ambient temperature. In other laboratory tests at ambient temperature, aqueous solutions (0.0001-10%) caused mild attack (~3 mpy) of 1100 alloy. Aluminum spray tanks and alloy A356.0 valves have been used with ferrous sulfate solutions. At elevated temperature, ferrous sulfate oxidizes to ferric sulfate which is aggressive to aluminum alloys. See also Ref: (1) p. 133, (2) p. 291, (3) p. 84, (7) p. 93.

FERTILIZERS. In laboratory tests, the corrosive effects of fertilizers on aluminum alloys vary greatly with some being compatible and others very corrosive. Generally the solid and liquid nitrogen fertilizers have been the least corrosive while the complete mix neutral fertilizers have been the most corrosive. Aluminum alloy equipment has been used in the manufacture and handling of the nitrogen fertilizers. See also Ref: (3) p. 64.

FISH. Laboratory tests have shown that alloys 1100 and 3003 are resistant to most fish products at ambient temperature. Aluminum alloys have been widely used in the construction of fish holds and linings of fishing vessels, fish boxes, trays, smoke racks, and tables. Many fish products can be preserved in either protected or unprotected aluminum alloy containers. See also Ref: (1) p. 133, (3) pp. 198, 207, 208, (4) pp. 72, 78, (6) p. 12.

FLOUR. Aluminum equipment has been used in milling and handling flour. See also Ref: (3) p. 203, (6) p. 10.

FLUE GASES. The corrosivity of flue gases to aluminum alloys depends on the sulfur content of the fuel being burned and if condensation is present. The sulfur content of fuels increases in the following order: processed natural gas, fuel oil, hard coal, soft coal. Aluminum alloys have been widely used for flue linings and vent pipes serving domestic gas-fired appliances and has been specified by many gas companies and public utilities. Aluminum alloy flue liners have been widely used for house chimneys. Generally, aluminum alloys will suffer some corrosion if condensation is present in the flue. See also Ref: (1) p. 133.

FLUOPHOSPHORIC ACIDS.
H_2PO_3F (or $(HO)_2POF$); HPO_2F_2 (or $HOPOF_2$); HPF_6. Aluminum alloy reactors and tanks have been used in the manufacture and handling of fluophosphoric acids. See also Ref: (3) p. 37.

FLUORINATED HYDROCARBONS. Fluorinated hydrocarbons are the most stable halogenated hydrocarbons and the most compatible with aluminum alloys. They have been used as propellants and refrigerants in contact with aluminum alloys in many applications. See "Freon" and "Halogenated Hydrocarbons."

FLUORINE. F. In laboratory tests, 1100 alloy was resistant to fluorine at temperatures up to 450°C (842°F). In the presence of moisture, hydrofluoric acid is formed which corrodes aluminum alloys. Dry fluorine gas has been handled in aluminum alloy equipment. A durable protective coating is formed on the aluminum surfaces contacting the gas. See also Ref: (1) p. 133, (2) p. 297, (3) p. 35, (7) p. 95.

FLY ASH. Laboratory tests have shown that alloy 3003 is resistant to dry fly ash at ambient temperature. The results of similar tests showed that wet fly ash caused variable results depending upon the composition of the fly ash, particularly the pH, chloride content and heavy metal content. Tests should be conducted prior to using aluminum alloys in applications involving contact with fly ash.

FOOD. (SEE SPECIFIC FOODS). The use of aluminum alloy cooking utensils has been universal for the preparation and cooking of foods. See also Ref: (3) p. 197.

FORMALDEHYDE GAS. HCHO. Aluminum alloy equipment has been used for distillation, storage, and shipment of formaldehyde. Alloy 356.0 valves have been used for handling formaldehyde. See also Ref: (1) p. 133, (2) p. 307, (3) p. 119, (4) pp. 73, 86, 97, (7) p. 95.

FORMALIN. A solution of formaldehyde gas in water usually with methanol added. Laboratory tests at ambient temperature and at 38°C (100°F) indicated that 1100, 3003 and 5052 alloys were resistant to 19% solution of formalin. At boiling conditions, formalin (37% solution) caused substantial pitting corrosion. Chlorides and copper salts increase pitting in formalin solutions. Aluminum alloy piping, storage tanks, drums and tank trucks have been used for handling formalin solutions. See also Ref: (1) p. 133, (3) p. 119, (7) p. 95.

FORMAMIDE. $H \cdot CO \cdot NH_2$. Alloy 1100 was resistant to aqueous solutions of formamide (10-100%) at ambient temperature and at 50°C (122°F) in laboratory tests. Similar solutions (greater than 10%) at the boiling temperatures were very corrosive. See also Ref: (3) pp. 143, 147, (7) p. 95.

FORMIC ACID. HCOOH. Solutions of formic acid caused mild attack of 1100 alloy in laboratory tests at ambient temperature. In laboratory tests at 50°C (122°F), the formic acid was corrosive, and at the boiling temperture, formic acid was very corrosive. Aluminum is not recommended for use with formic acid except in special cases. See also Ref: (1) p. 133, (2) p. 315, (3) pp. 22, 124, 125, 227, (7) p. 95.

FREON*. A group of halogenated hydrocarbons used as refrigerants, propellants, blowing agents, fire extinguishing agents, and solvents. Laboratory tests have shown that 1100 alloy is resistant to most dry Freons at elevated temperature 200°C (392°F). In similar laboratory tests, the presence of moisture permitted hydrolysis of the Freons and subsequent corrosion of the aluminum. Aluminum alloy refrigeration and air conditioning equipment has been used with Freons. See also Ref: (1) p. 133, (2) p. 239, (3) p. 107, (7) pp. 58, 60, 74.

*Registered Trade Mark.

FRUIT. Some of the acids in fruits have been found to be corrosive to aluminum alloys in laboratory tests. Because of the presence of dextrose, proteins and pectin in fruit, the corrosive action is inhibited in many cases. Protected aluminum alloys have been used for canning fruit and foil has been used for wrapping and containers. See also Ref: (1) p. 133, (3) p. 208, (4) pp. 72, 79, 80, 81, (6) p. 10.

FRUIT JUICES. (See also Citrus Fruit Juices). Fruit juices are processed and handled in aluminum equipment. Orange squeezers have been made of aluminum alloys. Frozen juice cans have aluminum alloy ends. Fruit juices are generally less corrosive to aluminum alloys than are the corresponding fruit acids. See also Ref: (1) p. 133, (2) p. 321, (3) pp. 131, 201, (4) pp. 88, 89, 90, (6) p. 10, (7) p. 95.

FUDGE. In laboratory tests, alloy 3003 was resistant to fudge at ambient temperature and 62°C (143°F). Milk chocolate fudge has been processed in aluminum alloy equipment. See also Ref: (6) p. 12.

FUEL OIL. Fuel oil has been stored and transported in aluminum alloy equipment. See also Ref: (1) p. 133, (3) p. 220.

FUELS, MISSILE. United States Defense Research reports that aluminum is resistant to many oxidizers and fuels used as missile propellants. Aluminum alloys are used with chlorine trifluoride, ethylene oxide, fluorine, hydrazine, unsymmetrical dimethyl hydrazine, hydrogen peroxide, liquid oxygen, nitrogen tetroxide (0.1% or less moisture), fuming nitric acid, n-propyl nitrate, liquid nitrogen, alkyl boranes, perchloryl fluoride (anhydrous) and liquid hydrogen. Ref: Titan II Storable Propellant Handbook—Bell Aerospace Company, New York, Report No. 8111-933003

FURFURAL. $C_5H_4O_2$. In laboratory tests, alloy 3003 was resistant to solutions of furfural at ambient temperature and 200°C (392°F). Aluminum storage tanks, evaporators, condensers, valves and pumps have been used to handle gasoline-furfural mixtures. Aluminum bubble caps, trays and heat exchangers have been used where furfural is used as the selective solvent. Pure furfural for pharmaceuticals has been stored in aluminum. Alloy 356.0 valves have been used for handling furfural. See also Ref: (1) p. 133, (2) p. 325, (3) p. 148, (7) p. 95.

G

GASOLINE. A mixture of C_4 to C_{12} hydrocarbons; also paraffins, olefins, naphthenes, and aromatics; traces of tetraethyl lead, ethylene dibromide or dichloride and proprietary additives. Laboratory tests have shown that aluminum alloys including 3003 were resistant to gasoline at room temperature. These tests also showed that the sump water in gasoline tanks can be corrosive because of the accumulation of halogen and lead compounds. Gasoline has been handled in aluminum alloy drums and tanks. Aircraft fuel tanks have been fabricated from aluminum alloys. Alloys 3003, Alclad 3003, 5052, 6061, and A356.0 have been used with gasoline. See also Ref: (1) p. 133.

GELATIN. Gelatins are handled extensively in aluminum alloy equipment. Aluminum vats are used to digest pork skins, calf skins, and animal bones at 66°C (150°F) using dilute solutions of H_3PO_4, HCl, HNO_3, H_2SO_4, or SO_2 depending on the final pH requirements of the gelatin (pH range 3-7). Aluminum alloys have also been used in evaporators, piping, tubing, tanks, pumps, drying tunnels, and conveyors. Aluminun is one of the few metals in which edible gelatin can be produced to meet requirements of the Pure Food and Drug Law. It is not recommended as containers for finished gelatin solutions unless protected because of the presence of salt. See also Ref: (1) p. 133, (2) p. 328, (3) p. 210, (4) pp. 48, 73, 84, 100, (6) pp. 10, (7) p. 97.

GLASS WOOL. Fine filaments of glass intermingled like wool. In laboratory tests, 3003 alloy was resistant to all dry glass wools, but when wet in 100% relative humidity environments, soft glass wools were corrosive whereas, 3003 alloy was resistant to hard glass (borosilicate type) wools. The binders used in glass wools may be corrosive to aluminum alloys in some cases. Glass wool has been used to insulate many aluminum alloy products. See also Ref: (10) pp. 29, 108.

GLUCONIC ACID. $C_6H_{12}O_7$. Laboratory tests indi-

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

cated that 1100 alloy was resistant to 10% solutions of gluconic acid at ambient temperature. Increase in temperature resulted in substantially increased corrosion. Aluminum alloy equipment has been used to produce gluconic acid from sugars by the fermentation process. Neutralization of gluconic acid to produce calcium gluconate is carried out in aluminum alloy equipment. See also Ref: (1) p. 133, (2) p. 332, (3) p. 129, (7) p. 97.

GLUCOSE. $C_6H_{12}O_6 \cdot H_2O$. Glucose solutions have been stored in alloy 6061 tanks. Alloy 356.0 valves have been used for handling glucose solutions. See also Ref: (1) p. 133, (3) p. 123.

GLUE. Originally an impure form of gelatin. In more modern times, glue is one of many types of adhesives used for bonding. In laboratory tests, most adhesives were found to be either innocuous or protective to aluminum alloys. However, exceptions were found and included the alkaline water base latex adhesives, acetic anhydride adhesives, and adhesives that have been made electrically conductive by the addition of copper, silver, or carbon. Such adhesives should be used with caution and with the knowledge that corrosion could develop. Adhesives are used with aluminum alloys in many applications. See also Ref: (1) p. 133, (3) pp. 124, 199, 231, 233, (4) pp. 107, 115, R. L. Patrick, Editor, "Treatise of Adhesion and Adhesives," Vol. III, Marcel Dekker, New York, 1973.

GLYCERIN. $CH_2OH \cdot CHOH \cdot CH_2OH$. Laboratory tests indicate that alloy 3003 is resistant to glycerin solutions at ambient and boiling temperatures. Aluminum alloys have been used for stills, condensers, heat exchangers, storage tanks, and tank cars for handling glycerin. Alloy 356.0 valves have also been used. See also Ref: (1) p. 133, (2) p. 337, (3) pp. 115, 240, (7) p. 97.

GLYCEROPHOSPHATE. $H_2O_3POCH_2 \cdot CHOH \cdot CH_2OH$. Glycerophosphate has been shipped in aluminum alloy containers. See also Ref: (3) p. 137.

GLYCOLIC ACID. $HOCH_2COOH$ (Hydroxyacetic Acid). In laboratory tests, glycolic acid was corrosive to 3003 and 5154 alloys at 100°C (212°). Glycolic acid solutions have been stored and shipped in aluminum alloy containers. See also Ref: (1) p. 133, (3) p. 129, (7) p. 105.

GRAPEFRUIT JUICE. Laboratory tests indicated that 1100 alloy was resistant to grapefruit juice at ambient and refrigerated temperatures (see Fruit and Fruit Juices). See also Ref: (4) p. 90, (6) p. 10.

GRAPE JUICE. In laboratory tests, unfermented grape juice caused mild attack (2 mpy) of 1100, 3003, and 3004 alloys at room temperature. Aluminum alloy equipment has been used for harvesting grapes and grape juice has been transported in aluminum alloy tank cars (see Fruit and Fruit Juices). See also Ref: (4) pp. 88, 91, (6) p. 10.

GRAPHITE. Alloys 3003, 5154 and 6061 were resistant to solid graphite in laboratory tests under conditions of 100% relative humidity at ambient temperature and 54°C (130°F). Other laboratory tests have shown that "graphite smears" on aluminum are corrosive because of galvanic corrosion of the aluminum. See also Ref: (3) p. 50, (5) p. 13.

GUM ARABIC. A dried gummy exudation from the stems and branches of *Acacia*. Aluminum alloy containers have been used for storing gum arabic solutions. See also Ref: (1) p. 134, (3) p. 226.

H

HALOGENATED HYDROCARBONS. Aluminum alloys are usually resistant to pure halogenated hydrocarbons and other organic chemicals containing halogens under most conditions particularly at room temperature or lower. Under certain conditions some of these hydrocarbons may produce a rapid rate of corrosion of aluminum or a violent reaction. Hence, the service conditions to insure safety should be recognized or established before aluminum alloys are used with any halogenated hydrocarbon.

Halogenated hydrocarbons may decompose by hydrolysis if water is present or by other processes to yield mineral acids such as hydrochloric acid. These acids corrode aluminum alloys because they destroy the protective surface oxide film naturally present that provides inherent resistance to corrosion. Corrosion of aluminum alloys by these acids may also promote reactions of the hydrocarbons themselves because aluminum halides formed by corrosion are catalysts for some of these reactions (e.g. $AlCl_3$ for a Friedel-Crafts reaction). In some instances, aluminum alkyls may be produced. Because of the rapid rate of evolution of heat, corrosion of aluminum and reaction of a halogenated hydrocarbon, once initiated, may tend to become autocatalytic.

The reactivity of aluminum alloys with halogenated hydrocarbons decreases generally in the order of increasing chemical stability of these hydrocarbons, which may be established precisely by thermodynamic data whenever these data are available, or qualitatively by the structural formulas of the hydrocarbons and by the halogens they contain. Thus, aluminum is most resistant to hydrocarbons halogenated with fluorine followed in order of decreasing resistance to those with chlorine, bromine and iodine. It is also resistant to highly polymerized halogenated hydrocarbons, reflecting the high degree of chemical stability of these materials.

The behavior of aluminum alloys in a mixture of halogenated hydrocarbons, or mixtures of these hydrocarbons with other organic compounds cannot be predicted from its behavior with each of the components. Some mixtures (e.g. of methyl alcohol and carbon tetrachloride) produce rapid corrosion of some aluminum alloys at ambient temperature even though the components alone do not.

The resistance of aluminum alloys to halogenated hydrocarbons tends to decrease as the temperature is raised and the rate of corrosion in many liquid halogenated hydrocarbons remains low until the boiling point is reached; in some, it is low or non-existent even at this temperature. Other factors that affect resistance include the presence of an inhibitor and the purity of a halogenated hydrocarbon; amines or various heterocyclic compounds have been effectively used as inhibitors in certain cases.

Aluminum in a finely divided form, as in a powder, should not be exposed to a halogenated hydrocarbon. The likelihood of creating a violent reaction that may lead to an explosion is increased when aluminum with a large surface area is exposed to a small volume of a halogenated hydrocarbon, and even more so when this operation is carried out under pressure. Specific entries in this book for fluorinated hydrocarbons such as Freons and inhibited halogenated hydrocarbons such as solvents for degreasing illustrate applications with halogenated hydrocarbons.

In summary, the service conditions to insure safety should be recognized or established before aluminum alloys are used with any halogenated hydrocarbon. With respect to aluminum and a specific halogenated hydrocarbon under specific conditions, aluminum producers may be able to submit useful data.

HELIUM. He. Aluminum alloys have been used for heat exchangers in the manufacture of helium and for covering on lighter than air ships. See also Ref: (1) p. 134, (3) p. 35.

HEPTYL ALDEHYDE. $CH_3(CH_2)_5 \cdot CHO$. Aluminum alloy separators, rectifier tanks, and storage tanks have been used with both crude and refined heptyl aldehyde. See also Ref: (3) p. 120, (7) p. 99.

n-HEXANE. $CH_3 \cdot (CH_2)_4CH_3$. Aluminum alloy heat exchangers have been used with n-hexane. See also Ref: (7) pp. 98, 99.

HONEY. Contains mainly levulose and dextrose; some sucrose, wax, pollen, and other organic matter. Aluminum alloy equipment has been used for pasteurizing honey. Honey has been packed in aluminum containers. See also Ref: (1) p. 134, (3) p. 203, (6) p. 10.

HYDRAZINE. H_2NNH_2. In laboratory tests, hydrazine caused mild attack of 3003 and 5154 alloys at ambient temperature. The action of hydrazine on aluminum alloys is increased by the presence of moisture resulting in hydrolysis. See also Ref: (1) p. 134, (2) p. 353, (3) p. 44, (7) p. 101.

HYDROABIETYL ALCOHOL. $C_{19}H_{31}CH_2OH$. Aluminum alloys have been used for piping, full flow filters, final condensers, and steam heated storage tanks in the production of hydroabietyl alcohol. See also Ref: (3) p. 115, (7) p. 101.

HYDROCARBONS. Organic compounds containing hydrogen and carbon. In laboratory tests, alloy 1100 and 3003 were resistant to most hydrocarbons. Aluminum alloys have been used to piping, pumps, valves, impellers, condensers, heat exchangers, ducts, fan and blowers, storage tanks, and shipping containers for handling hydrocarbons. See also Ref: (3) p. 101.

HYDROCHLORIC ACID. HCl. Aluminum is corroded by hydrochloric acid. The rate of attack increases with acid concentration and temperature. Metal purity plays a significant role in the degree of attack by hydrochloric acid. Increasing purity of the aluminum decreases the rate of attack by hydrochloric acid significantly. Inhibitors can be effective in reducing the corrosive effects of hydrochloric acid, particularly in dilute (< 10%) solutions. Such inhibited acid has been used to clean aluminum equipment and containers. See also Ref: (1) p. 134, (2) p. 359, (3) pp. 22, 37, 244, (4) pp. 15, 16, 17, 27, 29, 30, 31, 34, 73, 74, 97, 127, (7) p. 101.

HYDROCYANIC ACID. HCN. In laboratory tests, alloys 3003, 5052, and 6053 were resistant to a 77% solution of hydrocyanic acid at ambient temperature. Hydrocyanic acid has been processed in aluminum distillation towers, reflux condensers, final condensers, adsorption towers, heat exchangers, tankage, shipping drums, and piping. See also Ref: (1) p. 134, (2) p. 368, (3) p. 51, (7) p. 101.

HYDROFLUORIC ACID. HF. Aluminum alloys are corroded by hydrofluoric acid. With most alloys, the action is uniform and imparts a bright silvery appearance. This acid has been used as an etchant on aluminum in preparing decorative patterns. See also Ref: (1) p. 134, (2) p. 372, (3) p. 36, (4) p. 86, (7) pp. 101, 103.

HYDROGEN. H_2. Aluminum alloy equipment has been used to produce and to store hydrogen. See also Ref: (2) p. 379, (3) p. 35, (7) p. 103.

HYDROGEN CHLORIDE GAS. HCl (SEE HYDROCHLORIC ACID). Aluminum alloys are cor-

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

roded by hydrogen chloride gas. The reaction becomes more rapid as temperature is increased. Aluminum equipment has been used with dry hydrogen chloride gas at 288°C (550°F). See also Ref: (2) p. 383, (3) p. 36, (7) p. 103.

HYDROGEN CYANIDE GAS. HCN (SEE ALSO HYDROCYANIC ACID. In laboratory tests, alloy 3003 was resistant to hydrogen cyanide gas at ambient temperature. Aluminum alloy heat exchangers, reactor towers, tanks, and piping have been used in the manufacture of hydrogen cyanide gas. See also Ref: (2) p. 368, (3) p. 51.

HYDROGEN PEROXIDE. H_2O_2. In laboratory tests, alloys 1060, 5052 and 6063 were resistant to chloride free hydrogen peroxide at ambient temperature. Aluminum alloy distillation towers, heat exchangers, storage tanks, piping, tank cars and shipping drums have been used with hydrogen peroxide. Alloy 1060 has been preferred for long term storage, whereas, the 5XXX series alloys often have been used for short term storage. Alloy 6063 has been used for piping. See also Ref: (1) p. 134, (2) p. 391, (3) pp. 39, 234, (4) p. 55, (7) p. 103.

HYDROGEN SULFIDE. H_2S. In laboratory tests, aqueous solutions of hydrogen sulfide and hydrogen sulfide gas caused mild attack (~2 mpy) of alloys 1100 and 3003 at ambient temperature. Aluminum alloy storage tank roofs for sour crude oils, bubble caps, and heat exchangers have been used in refinery service handling hydrocarbon liquids and vapors containing hydrogen sulfide. See also Ref: (1) p. 134, (2) p. 396, (3) pp. 40, 214, 223, 234, (7) p. 103.

I

ICE. Aluminum alloy equipment has been used in the manufacture of ice and for refrigeration units. See also Ref: (3) p. 28, (4) p. 49.

ICE CREAM. Aluminum alloy trays, molds, pans and freezer components have been used to handle ice cream. See also Ref: (4) pp. 102, 115, (6) p. 11.

INK. Laboratory tests have indicated that inks vary widely in their corrosivity to aluminum alloys. Generally, writing inks have been found to be corrosive, while marking inks are not. However, in view of the wide variability, it is desirable to conduct preliminary tests to establish the suitability of aluminum alloys with a particular ink. Aluminum alloy tanks have been used for transporting printing ink. See also Ref: (1) p. 134, (3) p. 199, 238.

INVERT SUGAR. A mixture of about 50% dextrose and 50% levulose obtained by hydrolysis of sucrose. Aluminum alloy piping and tanks have been used to handle invert sugar.

IODINE. I_2. In laboratory tests, alcohol solutions of iodine were corrosive to aluminum alloys. See also Ref: (1) p. 134, (2) p. 406, (3) p. 36, (7) p. 107.

IODOFORM. CHI_3. Solid iodoform caused moderate attack (~7 mpy) of alloy 3003 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (1) p. 135, (3) p. 106, (7) p. 107.

IRON OXIDES. Fe_2O_3, Fe_3O_4. Alloys 3003 and 5154 were resistant to solid ferric oxide in laboratory tests under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 135, (3) p. 83.

IRON SULFIDE, FeS. Dry iron sulfide has been shipped in aluminum alloy containers. In laboratory tests, iron sulfide accelerated corrosion of contacting aluminum alloys as the result of galvanic action. See also Ref: (3) p. 84.

ISOAMYL ACETATE. $(CH_3 \cdot COO \cdot CH_2 \cdot CH_2CH(CH_3)_2$. Laboratory tests showed that 3003 and 5052 alloys were resistant to isoamyl acetate at temperatures up to and including the boiling temperature. See also Ref: (3) p. 136, (7) p. 107.

ISOAMYL ALCOHOL. $(CH_3)_2CHCH_2CH_2OH$. Laboratory tests indicated that alloy 5154 was resistant to 85% isoamyl alcohol at 93°C (200°F). See also Ref: (3) p. 113.

ISOBUTYL ACETATE. $CH_3 \cdot COO \cdot CH_2 \cdot CH(CH_3)_2$. Aluminum alloy tank cars have been used to transport isobutyl acetate. See also Ref: (7) p. 107.

ISOBUTYL ALCOHOL. $(CH_3)_2CH \cdot CH_2 \cdot OH$. Limited laboratory tests indicated that 3003 alloy was resistant to isobutyl alcohol at ambient temperature, but is corrosive (~18 mpy) at elevated temperature 204°C (400°F). See also Ref: (3) p. 113.

ISOBUTYRIC ACID. $(CH_3)_2 \cdot CH \cdot COOH$. Isobutyric acid has been stored in aluminum alloy tanks and handled in aluminum alloy piping. See also Ref: The Corrosion of Light Metals (p. 14) Goddard, Jepson, Bothwell and Kane.

ISOEUGENOL. $C_{10}H_{12}O_2$. Isoeugenol has been stored and shipped in aluminum alloy containers. See also Ref: (3) p. 118.

ISOOCTANOIC ACID. $(CH_3)_2CH(CH_2)_4COOH$. Aluminum alloy containers have been used for storage and handling of isooctanoic acid.

ISOPROPYL ALCOHOL. $CH_3CHOHCH_3$. Laboratory tests showed that alloy 3003 was resistant to isopropyl alcohol at 100°C (212°F) and 204°C (400°F). See also Ref: (1) p. 135, (3) p. 113, (7) p. 109.

ITACONIC ACID. $CH_2C(COOH)CH_2COOH$. Aluminum alloy pans have been used in the processing of itaconic acid.

K

KEROSENE. Kerosene has been processed and handled in aluminum alloy equipment. Aluminum alloys have also been used for vapor degreasing equipment. See also Ref: (1) p. 135, (3) pp. 218, 219.

KIPPERS. Kippers have been packed in aluminum alloy cans. See also Ref: (4) pp. 106, 108, (6) p. 12.

L

LACQUERS. May contain nitrocellulose or a viscous liquid obtained from plants plus diluents, plasticizers, resins and pigments. Lacquers have been used extensively for coating aluminum alloys. Aluminum alloys have been used for the production, handling, and storage of lacquers. See also Ref: (1) p. 135, (3) p. 225, (4) pp. 48, 79, 95, 96, 97, 103, 105, 109, 110, 114, 115, 117, 119, 137, 140, 141.

dl-LACTIC ACID. $CH_3 \cdot CH(OH) \cdot COOH$. In laboratory tests, aqueous solutions of lactic acid (0.05 to 80%) caused mild attack (~3 mpy) of 3003 alloy. At 100°C (212°F), aqueous solution of lactic acid was very corrosive with the maximum attack occurring at about 5% concentration. See also Ref: (1) p. 135, (2) p. 417, (3) pp. 22, 129, (4) pp. 25, 26, 28, 29, 30, 31, 62, 92, 97, 102, (7) p. 111.

LARD OIL. Lard oil has been handled in aluminum alloy equipment. See also Ref: (6) p. 12.

LATEX. Principally isoprene polymers. In laboratory tests, latex with pH 10 caused mild attack of 3003 alloy at ambient temperature. Aluminum alloy tanks and steam-jacketed kettles have been used in storing and processing latex. Aluminum alloy cups have been used for collecting latex from rubber trees. See also Ref: (3) pp. 103, 125, 227.

LEAD ACETATE. $Pb(C_2H_3O_2)_2 \cdot 3H_2O$. Solid lead acetate caused mild attack (~4 mpy) of alloys 3003, 5154 and 6061 at ambient temperature, but was corrosive to the same alloys at 54°C (130°F) in laboratory tests conducted under conditions of 100% relative humidity. In other laboratory tests, alloy 3003 was resistant to 0.1% aqueous solution of lead acetate, while 1.0% and 10% solutions were corrosive at ambient temperature. See also Ref: (1) p. 135, (3) p. 81, (7) p. 111.

LEAD AZIDE. $Pb(N_3)_2$. Aluminum alloy trays have been used for drying lead azide at temperatures not exceeding 60°C (140°F). See also Ref: (3) p. 81; H. Kast and H. Heid, Z. Angew, Chem. 38; pp. 43-52 (1925).

LEAD MONOXIDE. PbO. Alloys 3003 and 5154 were resistant to solid lead monoxide in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 135.

LEAD NITRATE. $Pb(NO_3)_2$. Solid lead nitrate was very corrosive (more than 50 mpy) to 3003, 5154 and 6061 alloys in laboratory tests under conditions of 100% relative humidity at ambient temperature. See also Ref: (3) p. 81, (7) p. 113.

LEAD OXIDE. Pb_3O_4. Alloys 3003, 5154 and 6061 were resistant to solid lead oxide in laboratory tests under conditions of 100% relative humidity at ambient temperature and at 54°C (130°F). Priming paints containing lead should not be used on aluminum alloys because of the possibility of accelerated corrosion. See also Ref: (3) p. 238.

LEAD TETRAETHYL. $Pb(C_2H_5)_4$. Laboratory tests showed that 3003 alloy was resistant to gasoline containing lead tetraethyl at ambient temperature. Aluminum alloy tank trucks and aircraft gasoline tanks have been used to handle leaded gasoline. In the presence of a separated water phase, some byproducts of the lead tetraethyl, such as lead bromide, accumulate in the water and cause corrosion. See also Ref: (1) p. 135, (3) p. 218.

LEATHER. Aluminum alloy equipment has been used in handling leather. See also Ref: (9) pp. 42, 43.

LEMON JUICE. In laboratory tests, alloy 3003 was resistant to lemon juice at ambient and refrigerated temperatures. Domestic aluminum alloy juicers for lemons have been used (see Fruits and Fruit Juices). See also Ref: (1) p. 135, (4) pp. 88, 90, (6) p. 10.

LIME. CaO. Solid lime caused mild attack (~1 mpy) of alloy 3003 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 128, (2) p. 133, (3) pp. 229, 242.

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

LIME JUICE. Laboratory tests showed that alloys 3003, 5052 and 5086 were resistant to lime juice at ambient and refrigerated temperatures. See also Ref: (6) p. 10.

LIME MORTAR. Contains hydrated lime, sand, Portland cement, coloring. During the period when mortar is liquid, aluminum alloys show etching which ceases when the mortar dries because of the formation of a protective film. It is good engineering practice to protect aluminum alloys contacting mortar in a faying surface to minimize crevice corrosion. See also Ref: (1) p. 129, (2) p. 161, (3) p. 72.

LIMESTONE. $CaCO_3$. Aluminum alloy equipment has been used in handling limestone. Aluminum alloy building products have been used in contact with limestone. See also Ref: (3) p. 76.

LINSEED OIL. Contains glycerides of linoleic, oleic, stearic, palmitic and myristic acids. In laboratory tests, alloy 3003 was resistant to linseed oil at 300, 350 and 380°C (572, 662, and 716°F). In the same tests, linseed oil vapors at these temperatures were corrosive to 3003 alloy. Aluminum alloy vessels have been used to heat linseed oil to 250°C (482°F). See also Ref: (1) p. 135, (2) p. 427, (3) p. 238, (7) p. 113.

LITHIUM CHLORIDE. LiCl. Alloys 3003, 5154 and 6061 were resistant to solid lithium chloride in laboratory tests conducted under conditions of 100% relative humidity and at ambient temperature. In the same tests conducted at 54°C (130°F), solid lithium chloride caused mild attack of the same alloys. In 1% to 40% aqueous solutions, lithium chloride caused mild attack (~3 mpy) of 3003, 5052 and 6061 alloys at ambient temperature and at 50°C (122°F). Local pitting was encountered in the solution tests. See also Ref: (1) p. 135, (2) p. 429, (7) p. 113.

LITHOPONE. A mixture of zinc sulfide, barium sulfate and some zinc oxide. Solid lithopone caused mild attack (~1 mpy) of 3003 and 5154 alloys in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Aluminum alloys have been used for pipe lines and driers in the manufacture of lithopone. See also Ref: (1) p. 135, (2) p. 433, (3) p. 238, (7) p. 115.

LUBRICATING OILS. Laboratory tests indicate that alloy 3003 was resistant to most lubricating oils at ambient temperature and at 66°C (150°F). Aluminum alloys generally do not accelerate oxidation of lubricating oils. Aluminum alloy tank trucks and cans have been used for lubricating oils. Alloy 356.0 valves have been used for handling lubricating oils. See also Ref: (1) p. 135, (3) p. 220.

M

MAGNESIUM CHLORIDE. $MgCl_2$. Alloy 3003 was resistant to solid magnesium chloride in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, alloy 1100 was resistant to aqueous solutions (up to 10%) of magnesium chloride at ambient temperature. Localized pitting was encountered in the aqueous solution tests. See also Ref: (1) p. 136, (2) p. 435, (3) pp. 73, 230, (7) p. 117.

MAGNESIUM HYDROXIDE. $Mg(OH)_2$. Limited laboratory tests showed that magnesium hydroxide is corrosive to 1100 alloy at ambient temperature and that the corrosion rate increases as the pH of the solution increases. See also Ref: (1) p. 136, (7) p. 117.

MAGNESIUM NITRATE. $Mg(NO_3)_2 \cdot 6H_2O$. Alloys 3003, 5154 and 6061 were resistant to solid magnesium nitrate at ambient temperature but suffered mild attack (~2 mpy) at 54°C (130°F) in laboratory tests conducted under conditions of 100% relative humidity. In other laboratory tests, 3003 alloy was resistant to 1%, 5% and 10% solutions at ambient temperature. See also Ref: (1) p. 136, (3) p. 75, (7) p. 117.

MAGNESIUM OXIDE. MgO. Alloys 3003, 5154 and 6061 were resistant to solid magnesium oxide in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature and at 54°C (130°F). See also Ref: (3) pp. 72, 230.

MAGNESIUM SILICATE. $MgSiO_3$. Alloys 3003, 5154 and 6061 were resistant to solid magnesium silicate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature and at 54°C (130°F). See also Ref: (3) p. 76.

MAGNESIUM SULFATE. $MgSO_4 \cdot 7H_2O$. In limited laboratory tests, 1100 alloy was resistant to aqueous solutions of magnesium sulfate (0.0001% to 10%) at ambient temperature. See also Ref: (1) p. 136, (2) p. 440, (3) p. 75, (7) p. 117.

MALEIC ACID. HOOCCH:CHCOOH. Alloys 3003 and 5154 were resistant to solid maleic acid in laboratory tests conducted under conditions of 100% relative humidity and ambient temperature. In other laboratory tests, 30% aqueous solutions of maleic acid caused mild attack (~5 mpy) of 1100 alloy at 52°C (126°F). Other laboratory tests conducted at 100°C (212°F) showed that maleic acid was corrosive to 1100 alloy. See also Ref: (1) p. 136, (3) p. 131, (7) p. 117.

MALEIC ANHYDRIDE. $(CHCO)_2O$. Alloys 3003 and 5154 were resistant to solid maleic anhydride in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Molten maleic anhydride has been stored in aluminum alloy tanks. See also Ref: (1) p. 136, (3) p. 131, (7) p. 119.

l-MALIC ACID. $HOOCCH(OH) \cdot CH_2COOH$. In laboratory tests, aqueous solutions (up to 55%) of malic acid caused mild attack (~2 mpy) of 1100 alloy at ambient temperature. In the same tests, these solutions were corrosive to 1100 alloy at 100°C (212°F). See also Ref: (1) p. 136, (3) pp. 131, 209, (4) pp. 25, 26, 29, 30, (7) p. 119.

MALONIC ACID. $HOOC \cdot CH_2 \cdot COOH$. Limited laboratory tests indicated that 3003 alloy was resistant to malonic acid at ambient temperature. See also Ref: (1) p. 136, (3) p. 130, (7) p. 119.

MAPLE SYRUP. In laboratory tests, alloy 1100 was resistant to maple syrup at ambient temperature. Aluminum alloys have been used for evaporators and other equipment in processing maple syrup. See also Ref: (1) p. 136, (6) p. 10.

MARGARINE. A mixture of natural or hydrogenated animal or vegetable fats plus coloring and flavoring. In laboratory tests, alloy 3003 was resistant to margarine at ambient and refrigerated temperatures. Aluminum alloys have been used for storing and packaging margarine. See also Ref: (3) p. 206, (4) pp. 100, 103.

MEAT. Aluminum alloy equipment has been used in the meat industry for steam jacketed pans, cookers, wagons, rods, racks, boilers and waste barrels. Aluminum alloy foil has been used to wrap meat to be frozen. See also Ref: (1) p. 136, (3) pp. 198, 206, (4) pp. 72, 78, 80, 99, 106, 109, (6) p. 12.

MERCURY. Hg. The action of metallic mercury on aluminum is unique. It tends to amalgamate with aluminum to produce a surface that corrodes at an extraordinary rate in the presence of moisture with the production of voluminous columnar corrosion products. When that reaction is started, the rate of corrosion is dependent upon relative humidity. When dry, metallic mercury reacts only with difficulty because of the oxide film on the aluminum surface. Traces of acidity or halides on the surface give rise to rapid attack. Solutions containing mercury ions tend to cause rapid pitting of aluminum alloys because of plating out of mercury in localized areas. Mercury can be removed from aluminum surfaces by treatment with 70% nitric acid. Mercury can be distilled away from an aluminum surface by treatment with steam or hot air. See also Ref: (1) p. 136, (2) p. 446, (3) p. 80.

MERCURY SALTS. In laboratory tests, aqueous solutions of mercury salts were very corrosive to aluminum alloys. See also Ref: (1) p. 136, (2) p. 444, (3) pp. 80, 132, 238.

METHANE. CH_4. Aluminum alloys have been used for pressure vessels in the storage and transport of compressed methane gas. Aluminum alloy tanks and pipe lines have been used extensively for handling liquid methane at temperatures as low as −160°C (−256°F). See also Ref: (1) p. 136, (3) pp. 103, 214, (7) p. 121.

METHYL ALCOHOL. CH_3OH. Laboratory tests showed that 1100 alloy was resistant to commercial absolute methanol at ambient and boiling temperatures. In the same tests, aqueous solutions of methanol varied in their corrosivity with concentration. Anhydrous methanol at the boiling point was corrosive. Aluminum alloys have been used for drums, tanks and piping for processing and handling methyl alcohol. See also Ref: (1) p. 137, (2) p. 449, (3) p. 112, (7) p. 121.

METHYLAMINE. CH_3NH_2. Aluminum alloy equipment has been used in refrigeration systems operating with methylamine. See also Ref: (1) p. 137, (2) p. 452, (3) p. 143, (7) p. 123.

METHYL CHLORIDE. CH_3Cl. Methyl chloride, under certain conditions, reacts with aluminum alloys to form metallo-organic compounds which are spontaneously explosive upon exposure to air. Aluminum is not recommended for use with methyl chloride. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (1) p. 137, (2) p. 454, (3) p. 105, (7) p. 123.

METHYLENE CHLORIDE. CH_2Cl_2. Limited laboratory tests indicated that alloy 3003 was resistant to methylene chloride at ambient temperature and at the boiling point. Inhibited methylene chloride has been shipped in aluminum alloy containers. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (1) p. 137, (2) p. 437, (3) p. 106, (7) p. 125.

METHYL ETHYL KETONE. $CH_3 \cdot CO \cdot CH_2 \cdot CH_3$. In laboratory tests, alloy 3003 was resistant to condensing vapors of methyl ethyl ketone. Methyl ethyl ketone has been distilled and condensed in aluminum alloy equipment. See also Ref: (1) p. 137, (3) p. 121, (7) p. 125.

METHYL FORMATE. $HCOOCH_3$. In limited laboratory tests, 3003 alloy was resistant to methyl formate at ambient temperature. See also Ref: (1) p. 137, (3) p. 136, (5) p. 10, (7) p. 125.

METHYL GLYCEROL. $CH_2(OH)CH(OH)COOCH_3$. Aluminum alloy pipe and containers have been used for handling methyl glycerol.

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

METHYL ISOBUTYL KETONE. $(CH_3)_2CHCH_2COCH_3$. In laboratory tests, alloy 3003 was resistant to methyl isobutyl ketone under boiling and condensing conditions. Methyl isobutyl ketone has been handled in aluminum alloy tanks and piping. See also Ref: (7) pp. 124, 125.

METHYL METHACRYLATE. $CH_2 \cdot C \cdot CH_3 \cdot COO \cdot CH_3$ Methyl methacrylate has been processed in aluminum alloy equipment and handled in aluminum alloy containers. See also Ref: (3) p. 137.

METHYL SALICYLATE. $C_6H_4OHCOOCH_3$. Limited laboratory tests indicated that alloy 6061 was resistant to methyl salicylate at ambient temperature. Methyl salicylate has been shipped in aluminum alloy containers. See also Ref: (3) p. 137.

MILK. In laboratory tests, alloys 1100 and 3003 were resistant to sweet milk at ambient and boiling temperatures. Aluminum alloys have not affected the taste of milk. Aluminum alloy equipment has been used for handling whole milk and sweetened or unsweetened condensed milk. Powdered milk has been dried in aluminum alloy towers. Foil hoods have been used to protect and seal bottles. Fresh milk has been transported in aluminum alloy equipment. See also Ref: (1) p. 137, (2) p. 463, (3) p. 204, (4) pp. 78, 84, 98, 100, 101, 102, 106, 109, (6) p. 11, (7) p. 127.

MINERAL OILS. A mixture of liquid hydrocarbons from petroleum. Laboratory tests indicate that many mineral oils are protective to aluminum alloys. Mineral oils have been stored and transported in aluminum alloy equipment. Alloy A356.0 valves have been used for handling mineral oils. See also Ref: (1) p. 137, (3) p. 102.

MOLASSES. Alloys 3003, 5052, 5086 and 6061 were resistant to molasses in laboratory tests at ambient and 46°C (114°F) temperatures. Copper from earlier processing equipment can make molasses corrosive to aluminum alloys. It is desirable to test a source of molasses prior to handling in aluminum equipment. Aluminum alloys have been used for fermenting vats, piping, containers and tanks with molasses. See also Ref: (1) p. 137, (2) p. 474, (6) p. 10, (7) p. 127.

MOLYBDENUM DISULFIDE. MoS_2. In laboratory tests, molybdenum disulfide accelerated corrosion of aluminum alloys in the presence of a conductive electrolyte. See also Ref: (3) p. 82.

MONOETHANOLAMINE. $NH_2CH_2CH_2OH$ (2 AMINOETHANOL). In laboratory tests, solutions of monoethanolamine have reacted with aluminum alloys in much the same manner as ammonium hydroxide solutions. Solutions containing up to 50% monoethanolamine have an initial rapid reaction, but the aluminum develops a protective film that inhibits further action. Medium strength solutions (~15%) cause more corrosion while a film is forming than do either more dilute or more concentrated solutions. In greater than 50% solutions, initial corrosion is slight. The effects can be accelerated by elevated temperature. The presence of carbon dioxide or hydrogen sulfide in monoethanolamine solutions retards corrosion of aluminum alloys. Hence, aluminum alloy equipment has been used in natural gas processing plants employing monoethanolamine as an acid gas removal agent. See also Ref: (3) p. 145, (7) p. 127.

MORTAR. In laboratory tests, conventional mortars react with aluminum alloys in the same manner as cement and concrete. While the mortar is liquid, etching of aluminum alloys occurs; but the reaction stops after the mortar sets. It is good engineering practice to protect the aluminum from crevice corrosion where contacting the mortar. See also Ref: (1) p. 137, (2) p. 161, (3) p. 72.

MUSTARD. Prepared mustard has been packaged in protected aluminum alloys. See also Ref: (1) p. 137, (3) p. 211, (6) p. 12.

MUSTARD OIL. (Constituents: alkyl isothiocyanate; carbon disulfide; alkyl cyanide). Mustard oil has been handled in aluminum alloy columns and condensers.

N

NAPHTHA. Limited laboratory tests indicated that alloys 1100, 3003, 5052 and 6061 were resistant to naphtha at ambient temperature. Naphtha has been handled in aluminum alloy stills, fractionators, dephlegmators, heat exchangers, condensers, and tanks. See also Ref: (7) pp. 128, 129.

NAPHTHALENE. $C_{10}H_8$. Aluminum alloy stills, dephlegmators, fractionators, heat exchangers, and condensers have been used at temperatures above 150°C (302°F) in the production of naphthalene. Naphthalene has been stored in aluminum alloy tanks. See also Ref: (3) p. 105, (7) p. 129.

NAPHTHENIC ACID. $C_7H_{12}O_2$. In laboratory tests, alloy 3003 was resistant to commercial naphthenic acid at ambient temperature and 82°C (180°F). Boiling naphthenic acid was very corrosive to 3003 alloy in the same test. Naphthenic acid has been transported in aluminum alloy tank cars. Aluminum alloy fractionating columns, condensers, receivers and piping have been used in the production and handling of naphthenic acid. See also Ref: (1) p. 137, (7) p. 129.

NATURAL GAS. About 85% methane, 9% ethane, 3% propane, 2% nitrogen, 1% butane, occasionally helium or more nitrogen plus other contaminants. Natural gas has been handled in aluminum alloy equipment including processing equipment, distillation apparatus and pipe lines. Alloy A356.0 valves have been used for handling natural gas. Large tanks on ships have also been used to transport liquid natural gas. See also Ref: (1) p. 137, (3) p. 214.

NAVAL STORES. These include turpentine, rosin, copal, pentene, dipentene and pinene. In laboratory tests, alloy 3003 was resistant to products such as these. Naval stores have been processed and handled in aluminum alloy equipment including rosin kettles, evaporators, condensers, storage tanks, transfer lines, distillation equipment, piping and shipping containers. See also Ref: (3) p. 226.

NEOPRENE. $(CH_2CCl{:}CHCH_2)_n$. In laboratory tests, various aluminum alloys were resistant to pure neoprene. However, the amount and type of filler materials were found to affect corrosion. See also Ref: (3) pp. 104, 110, 228.

NICKEL COMPOUNDS. In laboratory tests, aqueous solutions of nickel salts at ambient temperature caused varying degrees (from less than 1 mpy to more than 60 mpy) of attack of 1100 alloy depending upon the concentration and the specific compound. Most solutions of nickel compounds are inherently corrosive to aluminum alloys. In laboratory tests conducted under conditions of 100% relative humidity at ambient and 54°C (130°F) temperatures, solid nickel chloride was very corrosive to alloys 3003, 5154 and 6061 at both temperatures, solid nickelous acetate caused mild attack of these alloys at ambient temperature and was corrosive (~40 mpy) at 54°C (130°F). Solid nickelous nitrate caused mild attack at ambient temperature and was corrosive at 54°C (130°F). See also Ref: (1) p. 137, (3) p. 84.

NICOTINE SULFATE. $(C_{10}H_{14}N_2)_2 \cdot H_2SO_4$. In laboratory tests, alloy 3003 was resistant to a 40% solution of nicotine sulfate at 204°C (400°F). See also Ref: (1) p. 137, (3) p. 149.

NITRIC ACID. HNO_3. In laboratory tests, the action of nitric acid on aluminum alloys varies with concentration and temperature and is increased by agitation or the presence of nitrogen oxide. At ambient temperature, the rate of attack of 1100 alloy shows a maximum at 20% concentration. Above 82%, the attack is between 0 and 5 mpy. Aluminum alloys have been widely used for storing and shipping fuming nitric acids. Red fuming nitric acid inhibited with hydrofluoric acid is compatibile with all aluminum alloys to at least 71°C (160°F). Solutions of the lower oxides of nitrogen and the gases themselves have mild corrosion effects on aluminum alloys. As a result, aluminum alloys have been used for the catalytic oxidation of ammonia in the production of nitric acid. Aluminum alloy equipment used in this process has included piping for supplying ammonia and oxygen to the oxidizing reactor, whirlwind gas mixers, refrigeration tanks for storing raw materials, principal parts of the autoclave, refining columns, intermediate reservoirs, heat exchangers for cooling the nitric acid before storage, tanks and drums for storage and transportation of the concentrated acid. See also Ref: (1) p. 138, (2) p. 480, (3) pp. 22, 45, 244, (4) pp. 19, 20, 21, 29, 30, 31, 34, 74, 96, (7) p. 130.

NITRIC SULFURIC ACIDS. (MIXED ACID: NITRATING ACID). In laboratory tests, mixed acids had varying corrosive effects on aluminum alloys which were dependent upon the composition of the mixed acids. Mixed acid containing 85% HNO_3, 12% H_2SO_4, and 3% water caused mild attack (~2 mpy) of 1100 alloy while an 80, 15, 5 mixture caused moderate attack (~10 mpy) of alloy 1100. Mixtures containing 60% HNO_3, 38% H_2SO_4, and 2% H_2O were corrosive while those containing 45% or less HNO_3 were very corrosive. Hydrofluoric acid has been used as an inhibitor for the less corrosive mixed acids. Aluminum alloy tanks have been used to handle mixed acids. See also Ref: (2) p. 466, (7) p. 127.

NITROBENZENE. $C_6H_5 \cdot NO_2$. In laboratory tests, alloys 3003, 5052 and 6061 were resistant to nitrobenzene at temperatures ranging from ambient to the boiling point. See also Ref: (1) p. 138, (2) p. 488, (3) p. 141, (7) p. 131.

2 NITRO-1-BUTANOL. $CH_3CH_2CHNO_2CH_2OH$. Aluminum alloy equipment has been used to handle 2-nitro-1-butanol.

NITROCELLULOSE. $C_{12}H_{16}N_4O_{18}$(SEE ALSO CELLULOSE NITRATES). Nitrocellulose has been produced and washed in aluminum alloy equipment. Nitrocellulose lacquers and enamels have been used on aluminum alloys. See also Ref: (1) p. 138, (2) p. 490, (3) pp. 124, 232, (4) pp. 95, 140, 141.

NITROETHANE. $CH_3 \cdot CH_2 \cdot NO_2$. In laboratory tests, alloy 3003 was resistant to nitroethane at 114°C (237°F) and 204°C (400°F). Nitroethane has been stored in aluminum alloy tanks. See also Ref: (3) p. 141.

2-NITRO-2 ETHYL-1, 3 PROPANEDIOL. $CH_2 \cdot OHC(C_2H_5)NO_2CH_2OH$. Aluminum alloy equipment has been used to handle 2-nitro-2 ethyl-1, 3 propanediol.

NITROGEN. N_2. Liquid nitrogen has been pro-

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

cessed and handled in aluminum alloy equipment. See also Ref: (1) p. 138, (3) pp. 43, 214.

NITROGEN TETROXIDE. N_2O_4. Nitrogen tetroxide is handled in aluminum alloy missile fuel tanks under stringent moisture controlled conditions. See also Ref: (7) pp. 132, 133; Titan II Storable Propellant Handbook—Bell Aerospace Company, Buffalo, New York, Report No. 8111-933003.

NITROGLYCERIN. $C_3H_5(ONO_2)_3$. Nitroglycerin has been handled in aluminum alloy containers, pipe lines, and tanks. See also Ref: (1) p. 138, (2) p. 497, (3) pp. 115, 142, (7) p. 133.

NITROMETHANE. CH_3NO_2. Nitromethane has been stored in aluminum alloy tanks. See also Ref: (7) pp. 132, 133.

NITROPARAFFINS. Organic compounds derived from paraffin hydrocarbons by replacement of one or more hydrogen atoms by a nitro (NO_2) group. Controlled field service tests showed that nitroparaffins caused mild attack of 3003 alloy. Nitroparaffins have been stored in aluminum alloy tanks.

NITROPHENOL. $NO_2C_6H_4OH$. Alloy 3003 was resistant to solid p-nitrophenol in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 138, (2) p. 499, (3) p. 141, (7) p. 133.

NITRO PROPANES (1- AND 2-). $CH_3CH_2CH_2NO_2$, $(CH_3)_2CHNO_2$. In laboratory tests, alloy 3003 was resistant to nitro propanes under refluxing conditions and suffered mild attack under boiling and condensing conditions. Nitro propanes have been handled in aluminum alloy equipment. See also Ref: (7) pp. 132, 133.

NITRO TOLUENES (o, m, p). $NO_2C_6H_4CH_3$. In laboratory tests, alloy 3003 was resistant to o-nitro toluene at boiling and refluxing conditions. Aluminum alloy equipment has been used to handle nitro toluenes. See also Ref: (2) p. 505, (3) p. 141, (7) p. 133.

NITROUS OXIDE. N_2O. Aluminum alloy retorts have been used in the manufacturing of nitrous oxide. See also Ref: (1) p. 138, (3) p. 47, (7) p. 135.

NYLON. $[CO(CH_2)_4CONH(CH_2)_6NH]_n$. Aluminum alloys have been used for tanks, piping, bins, railroad cars and tank cars for handling nylon. See also Ref: (3) p. 127.

O

OINTMENTS. Aluminum alloys have been used for the packaging of ointments. See also Ref: (10) p. 100.

OLEIC ACID. $CH_3 \cdot (CH_2)_7CH:CH(CH_2)_7 \cdot COOH$. In laboratory tests, alloys 1100, 3003 and 6061 were resistant to oleic acid at ambient temperature. Oleic acid has been shipped in aluminum alloy tank cars. See also Ref: (1) p. 138, (2) p. 510, (3) p. 129, (4) p. 25, (7) p. 137.

OLIVE OIL. Mixed glycerides of oleic, palmitic, linoleic, stearic and arachidic acids; squalene phytosterol, tocopherols. Olive oil has been processed and handled in aluminum alloy equipment. See also Ref: (1) p. 138, (2) p. 872, (3) pp. 129, 206, (6) p. 11.

ONION JUICE. In limited laboratory tests, alloys 1100, 3003 and 5052 were resistant to onion juice at ambient temperature. See also Ref: (1) p. 138.

ORANGE JUICE. In laboratory tests, alloy 3003 was resistant to orange juice at ambient and refrigerated temperatures. Aluminum alloy equipment has been used for handling orange juice. Aluminum alloy squeezers for oranges have been used as have foil closures for bottles of homogenized orange juice (see Fruit and Fruit Juices). See also Ref: (1) p. 138, (6) p. 10.

ORES. Many ores have been handled in aluminum alloy equipment, e.g., bauxite. Composition and physical characteristics of the ore generally govern its suitability for use with aluminum alloys.

ORLON*. Acrylic fiber, a polymer containing at least 85% acrylonitrile units ($-CH_2CH(CN)-$). Aluminum alloys have been used in the manufacture, handling, storage, and shipment of orlon.

*Registered Trade Mark

OXALIC ACID. $HOOC \cdot COOH \cdot 2\,H_2O$. Solid oxalic acid was corrosive (~20 mpy) to 3003 alloy in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solutions (0.1 to 12%) were corrosive (~15 mpy) to 1100 alloy at ambient temperature. At 50°C (122°F) and boiling temperatures, those solutions were corrosive to 1100 alloy. Oxalic acid has been handled in aluminum alloy filters and crystallizers, because aluminum salts do not discolor the product. See also Ref: (1) p. 138, (2) p. 520, (3) p. 130, (4) pp. 22, 28, 29, 30, 120, 121, 122, 123, 124, 125, 126, 127, 128, (7) p. 137.

OXOGLUCONIC ACID. $C_6H_{10}O_7$. Aluminum alloys have been used in the fermentation process of oxogluconic acid.

OXYGEN. O_2. Aluminum alloy equipment has been used in the manufacture and transportation of liquid oxygen. Aluminum alloys are particularly suitable for these applications since they retain mechanical properties at low temperatures. Alloy A356.0 valves have been used for handling liquid oxygen. See also Ref: (1) p. 138, (3) p. 38, (4) pp. 2, 117; Corrosion Effects of Liquid Fluorine and Liquid Oxygen on Materials of Construction, CORROSION, *17*, No. 2, 80-82 (1961 February).

OZONE. O_3. Aluminum alloys have been used in the construction of ozonizers. See also Ref: (1) p. 139, (2) p. 524, (3) p. 38, (7) p. 137.

P

PAINTS. In laboratory tests, most paints were found to be protective to all aluminum alloys. Exceptions were those containing mercury, lead or copper compound pigments. These were corrosive. Aluminum alloy equipment has been used for process and storage tanks, pipe, heat exchanger tube, condensers, and reaction vessels in the paint industry. See also Ref: (1) p. 139, (3) p. 237, (4) pp. 95, 117, 119, 134, 137, 140.

PALMITIC ACID. $CH_3 \cdot (CH_2)_{14} \cdot COOH$. Palmitic acid has been shipped in aluminum alloy containers. See also Ref: (1) p. 139, (2) p. 274, (3) p. 127, (7) p. 139.

PALM OIL. Containing palmitin, stearin, linolein. Palm oil has been handled in aluminum alloy equipment. See also Ref: (2) p. 872.

PAPER. Mainly cellulose; clay, starch, fillers. Laboratory tests indicated that the corrosive effects of paper on aluminum alloys vary with composition of the papers. Paper when wet can cause corrosion of aluminum alloys by poultice action. Papers with controlled composition have been used to interleave aluminum alloy products. See also Ref: (10) p. 106.

PARAFFIN. A wax consisting of a mixture of lower hydrocarbons with a softening point about 50°C (122°F) and having the general formula C_nH_{2n+2}. Paraffin has been processed and stored in aluminum alloy equipment. Block paraffin has been produced in aluminum alloy molds. See also Ref: (1) p. 139, (3) pp. 102, 218, 220.

PARAFORMALDEHYDE. $(CH_2O)_n$. Aluminum alloy equipment has been used to handle paraformaldehyde. See also Ref: (1) p. 139, (2) p. 527, (3) p. 119, (7) p. 139.

PARALDEHYDE. $C_6H_{12}O_3$. Paraldehyde has been processed in aluminum alloy equipment and handled in aluminum alloy drums. See also Ref: (1) p. 139, (3) p. 120, (7) p. 139.

PEANUT OIL. Aluminum alloy equipment has been used to handle peanut oil. See also Ref: (2) p. 872.

PENICILLIN. $CH(COOH) \cdot C(CH_3)_2S \cdot CH:N \cdot CO \cdot CH \cdot NHCOR$. Where R is a side chain of varying identity. Penicillin has been produced in aluminum alloy equipment and packaged in vials with aluminum caps. See also Ref: (2) p. 529, (3) p. 146.

PENTACHLOROETHANE. $CCl_3 \cdot CHCl_2$. Limited laboratory tests indicated that alloys 3003, 5052 and 6061 were resistant to pentachloroethane at ambient temperature and at 50°C (122°F). At the boiling temperature, pentachloroethane was very corrosive to all alloys. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (2) p. 530, (3) p. 109, (7) p. 139.

PENTACHLOROPHENOL. C_6Cl_5OH. Wood treated with pentachlorophenol or its sodium salt has been used in contact with aluminum alloy products. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (3) pp. 133, 242, (7) p. 139.

PENTAERYTHRITOL. $C_5H_{12}O_4$. Aluminum alloy filters have been used in the production of pentaerythritol. See also Ref: (3) p. 115, (7) p. 139.

PENTAERYTHRITYL TETRANITRATE. $C_5H_8N_4O_{12}$. Aluminum alloy containers have been used for pentaerythrityl tetranitrate. See also Ref: (3) pp. 115, 138, 142.

PENTANE. $CH_3 \cdot (CH_2)_3 \cdot CH_3$. In laboratory tests, 3003 alloy was resistant to pentane under refluxing conditions. See also Ref: (3) pp. 103, 214, (7) p. 139.

PEPPERMINT OIL. Aluminum alloy equipment has been used for stills, piping, drums, tanks, and condensers for handling peppermint oil.

PERACETIC ACID. $CH_3CO \cdot O \cdot OH$. Peracetic acid has been shipped in aluminum alloy drums. See also Ref: (3) p. 126.

PERCHLORIC ACID. $HClO_4$. In laboratory tests, perchloric acid was very corrosive to aluminum alloys. See also Ref: (1) p. 139, (2) p. 533, (3) p. 37, (7) p. 139.

PERCHLOROETHYLENE. See TETRACHLOROETHYLENE. See also Ref: (7) p. 139.

PETROLEUM OR CRUDE OIL. A mixture of hydrocarbons obtained from an oil well. Usually an oil well also produces salt water brine. In general, these brines are corrosive to metals. Some brines are corrosive to aluminum alloys while others can be handled in aluminum alloy equipment. Tests are necessary

(continued)

TABLE 5.2: ALUMINUM ALLOYS–ALUMINUM ASSOCIATION (continued)

with the product of a specific oil field before using aluminum alloy equipment to handle oil field brines. The crude oil may also contain appreciable amounts of sulfur compounds in which case it is designated as "sour." Sour crudes are more corrosive to metal than are sweet crudes. Aluminum alloys have found increased use in the petroleum industry as a result of their superior corrosion resistance compared to steel. They have been used for pipe lines, distillation columns, heat exchangers, storage tanks, piping and valves. A corrosion hazard to aluminum alloys is iron sulfide scale that may be deposited on aluminum alloy equipment from sour products previously in contact with steel equipment. See also Ref: (1) p. 139, (3) pp. 102, 214, 216.

PETROLEUM JELLY. Purified mixture of semi-solid hydrocarbons, chiefly alkanes. Laboratory tests showed that many petroleum jellies are protective to aluminum alloys.

PHENETHYL ALCOHOL. $C_6H_5CH_2CH_2OH$. In limited laboratory tests, 1100 alloy was resistant to phenethyl alcohol at the boiling point – 204°C (399°F). See also Ref: (3) p. 114.

PHENOL. $C_6H_5 \cdot OH$. In laboratory tests, alloy 3003 was resistant to anhydrous phenol at temperatures up to 50°C (122°F). Above that temperature, phenol was very corrosive to aluminum alloys. Aqueous solutions of phenol caused mild attack (~ 5 mpy) of 1100 alloy at temperatures from ambient to 50°C (122°F). Aluminum alloy tubes and A356.0 valves have been used to handle phenol. Solid phenol has been handled in aluminum alloy drums. See also Ref: (1) p. 139, (2) p. 537, (3) p. 116, (7) p. 141.

PHENYL ETHER. $C_6H_5OC_6H_5$. In laboratory tests, alloy 3003 was resistant to phenyl ether at refluxing conditions and at 204°C (400°F). Phenyl ether has been handled in aluminum alloy heat exchangers and stored and shipped in aluminum alloy containers. See also Ref: (2) p. 263, (3) p. 135.

PHOSPHATE ROCK. Aluminum alloy equipment and hopper cars have been used for handling phosphate rock.

PHOSPHORIC ACID. H_3PO_4. In laboratory tests, aqueous solutions of phosphoric acid (5-85%) were corrosive to 1100 alloy and the corrosion increased with concentration at ambient temperature. The rate of attack was ~ 100 mpy at 5% and ~ 1200 mpy at 85% concentration. The action of phosphoric acid can be reduced by the addition of inhibitors. Aqueous solutions containing phosphoric acid and chromium trioxide have been used as cleaning solutions and as surface preparation for painting of aluminum alloys. See also Ref: (1) p. 139, (2) p. 566, (3) p. 132, (4) pp. 21, 29, 30, 74, 86, 138, 139, (7) p. 143.

PHOSPHOR SUSPENSIONS. Suspension of substances which will fluoresce under ultraviolet light. Phosphor suspensions used in manufacturing fluorescent lights are handled in aluminum alloy containers.

PHOSPHORUS. P. In limited laboratory tests, alloy 1100 was resistant to solid and liquid white phosphorus at ambient temperature. Water cooled aluminum alloy pans have been used to handle molten phosphorus. See also Ref: (1) p. 139, (3) p. 48.

PHOSPHORUS PENTASULFIDE. P_2S_5. Dry phosphorus pentasulfide has been handled in aluminim alloy tote bins.

PHOSPHORUS SESQUISULFIDE. P_4S_3. Aluminum alloy equipment has been used in the manufacture of phosphorus sesquisulfide. See also Ref: (3) p. 48.

PHTHALIC ANHYDRIDE. $C_6H_4(CO)_2O$. Aluminum alloy condensers have been used in the production of phthalic anhydride. Molten phthalic anhydride has been stored in the aluminum alloy tanks. See also Ref: (1) p. 139, (2) p. 573, (3) p. 132, (7) p. 143.

PICKLES. In laboratory tests, pickles were corrosive to aluminum alloys. Sodium chloride and vinegar contribute to this corrosion. See also Ref: (1) p. 139, (4) pp. 78, 92, (6) p. 11.

PICOLINES. $C_5H_4NCH_3$. In limited laboratory tests, mixed picolines (alpha, beta, gamma) were corrosive to 3003 alloy at 66°C (150°F). Picolines have been handled in aluminum alloy containers. See also Ref: (3) p. 149.

PINEAPPLE JUICE. In laboratory tests, 1100 alloy was resistant to pineapple juice at ambient temperature. In another laboratory test, pineapple juice was corrosive to 3003 alloy at 100°C (212°F). See also Ref: (6) p. 10.

PINENE. $C_{10}H_{16}$. Aluminum alloy equipment including stills, condensers, filters and tanks has been used with pinene. See also Ref: (3) pp. 104, 226.

PIPERAZINE. $NHCH_2CH_2NHCH_2CH_2$. Piperazine has been handled in aluminum alloy piping and stored in aluminum alloy tanks.

PLASTER. $(CaSO_4)_2 \cdot H_2O$. In laboratory tests, plaster caused an initial reaction of contacting aluminum alloys while the plaster was liquid after which corrosion did not continue. Aluminum alloys have been used for nails, corner strips, and expanded metal lath with plaster. See also Ref: (1) p. 139, (2) p. 161, (3) p. 228.

PLASTICIZERS. (Non-volatile organic liquids or low melting solids, now especially phthalate, adipate, and sebacate esters and aryl phosphate esters). Plasticizers have been shipped in aluminum alloy containers.

PLUMS. In limited laboratory tests, blue plum pomace was corrosive to alloy 3003 at 38°C (100°F) while red plum pomace caused mild attack (~ 5 mpy). Coated aluminum alloys have been used for canning plums. See also Ref: (6) p. 10.

POLYETHYLENE. $(CH_2CH_2)_n$. Polyethylene has been handled in aluminum alloy equipment including weighing bins, blending bins, storage bins, and conveyor systems. Polyethylene has also been used as a covering on aluminum electrical conductor and in laminations with aluminum foil. See also Ref: (3) p. 237, (7) p. 145.

POLYPROPYLENE. $(C_3H_6)_n$. Aluminum alloy silos, driers, and conveyor systems have been used to handle polypropylene. See also Ref: (3) p. 237, (7) p. 145.

POLYSTYRENE. $(C_6H_5CHCH_2)_n$. In limited laboratory tests, alloys 3003 and 5154 were resistant to solid polystyrene under conditions of 100% relative humidity at ambient temperature. Aluminum alloy bins, hopper trucks, tanks, pipe lines and conveyors have been used in handling polystyrene. See also Ref: (3) p. 104, (7) p. 147.

POLYVINYL ACETATE. $(CH_2COCOCH_3)_n$. In limited laboratory tests, 3003 alloy was resistant to polyvinyl acetate emulsions. Polyvinyl acetate has been prepared in aluminum alloy equipment including condensers and piping.

POLYVINYL ALCOHOL. $(-CH_2CHOH-)_n$. A colorless plastic made by the acidic or basic hydrolysis of a polyvinyl ester, usually the acetates. Polyvinyl alcohol has been handled in aluminum alloy containers.

POLYVINYL BUTYRAL RESINS. Synthetic resins. Aluminum alloy containers have been used in handling polyvinyl butyral resins. See also Ref: (8) pp. 19, 199.

POTASH ORE. Aluminum alloy equipment has been used in handling and transporting potash ore. It has also been used in many mine and mill building applications. See also Ref: (9) p. 34.

POTASSIUM BITARTRATE. $KHC_4H_4O_6$. In limited laboratory tests, dilute aqueous solutions of potassium bitartrate caused varied degrees of corrosion of 3003 alloy at ambient temperature. 0.25% solutions caused moderate attack (~ 7 mpy) while 1.8% solutions were corrosive. See also Ref: (3) p. 71.

POTASSIUM BROMIDE. KBr. Limited laboratory tests indicated that potassium bromide solutions at ambient temperature have action on aluminum alloys similar to that of sodium chloride. See also Ref: (1) p. 140, (2) p. 585, (3) p. 63, (7) p. 147.

POTASSIUM CHLORATE. $KClO_3$. Aluminum alloy drying pans have been used in the commercial production of potassium chlorate. See also Ref: (1) p. 140, (2) p. 592, (7) p. 147.

POTASSIUM CHLORIDE. KCl. Alloys 3003 and 5154 were resistant to solid potassium chloride in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Granular potassium chloride has been handled in aluminum alloy hopper cars. See also Ref: (1) p. 140, (3) pp. 62, 63, 214, (7) p. 147.

POTASSIUM CHROMATE. K_2CrO_4. In laboratory tests, 3003 alloy was resistant to aqueous solutions (1-36%) of potassium chromate at ambient temperature. Potassium chromate has been used as an inhibitor in natural waters and chloride containing solutions carried in aluminum alloy piping and equipment. See also Ref: (1) p. 140, (3) p. 70, (7) p. 147.

POTASSIUM CYANATE. KCNO. Potassium cyanate has been prepared in aluminum alloy reactors. See also Ref: (3) p. 68, (7) p. 149.

POTASSIUM DICHROMATE. $K_2Cr_2O_7$. Potassium dichromate has been a well-accepted inhibitor for use with aluminum alloys in natural and salt waters. It has been used to inhibit the corrosion of aluminum alloy piping and equipment exposed to such waters. See also Ref: (1) p. 140, (2) p. 598, (3) p. 70, (7) p. 149.

POTASSIUM HYDROXIDE. KOH. In laboratory tests, potassium hydroxide was very corrosive to all aluminum alloys. See also Ref: (1) p. 140, (2) p. 606, (3) p. 61, (4) pp. 34, 35, 36, (7) p. 149.

POTASSIUM IODIDE. KI. Limited laboratory tests indicated that potassium iodide solutions at ambient temperature have action on aluminum alloys similar to that of sodium chloride. See also Ref: (1) p. 140, (3) p. 63, (7) p. 149.

POTASSIUM NITRATE. KNO_3. Alloys 3003 and 5154 were resistant to solid potassium nitrate in laboratory tests conducted at 100% relative humidity at ambient temperature. In similar tests conducted at 54°C (130°F), solid potassium nitrate was very corrosive to alloys 3003 and 5154. Aluminum alloy equip-

(continued)

TABLE 5.2: ALUMINUM ALLOYS–ALUMINUM ASSOCIATION (continued)

ment has been used for producing and handling potassium nitrate. See also Ref: (1) p. 140, (2) p. 613, (3) p. 66, (7) p. 151.

POTASSIUM PERMANGANATE. $KMnO_4$. Solid potassium permanganate was corrosive to 3003 alloy in laboratory tests under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 141, (2) p. 617, (3) p. 70, (4) pp. 74, 75, (7) p. 151.

POTASSIUM PERSULFATE. $K_2S_2O_8$. Aluminum alloy equipment has been used for processing and shipping potassium persulfate. See also Ref: (2) p. 622, (3) p. 65, (7) p. 151.

POTASSIUM PYROSULFATE. $K_2S_2O_7$. Potassium pyrosulfate has been cast in aluminum alloy molds and shipped in aluminum alloy containers to avoid contamination. See also Ref: (3) p. 65.

POTASSIUM SULFATE. K_2SO_4. Alloys 3003 and 5154 were resistant to solid potassium sulfate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In similar tests at 54°C (130°F), potassium sulfate caused mild attack (~ 3 mpy) of these alloys. See also Ref: (1) p. 141, (2) p. 625, (3) p. 64, (7) p. 151.

POTASSIUM TARTRATE. $C_4H_4O_6K_2 \cdot ½\ H_2O$. Solid potassium tartrate caused moderate corrosion of 3003 alloy (14 mpy) and was corrosive to 5154 alloy in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also. Ref: (1) p. 141.

POTASSIUM THIOCYANATE. KSCN. Alloy 3003 was resistant to solid potassium thiocyanate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 3003 alloy was resistant to aqueous solutions (including saturated solutions) of potassium thiocyanate at ambient temperature. See also Ref: (1) p. 141, (3) p. 69, (7) p. 153.

PROPANE. $CH_3CH_2CH_3$. Propane has been handled in aluminum alloy tube. See also Ref: (1) p. 141, (3) pp. 103, 214, (7) p. 153.

PROPIONIC ACID. $CH_3 \cdot CH_2 \cdot COOH$. In laboratory tests, alloy 1100 was resistant to aqueous solutions (0.5% to 100%) of propionic acid at ambient temperature. As the temperature increases, solutions of propionic acid become aggressive. Completely anhydrous propionic acid was very corrosive, but the addition of a small amount of water reduced the attack significantly. Propionic acid has been handled, stored and shipped in aluminum alloy tanks, drums and tank cars. See also Ref: (1) p. 141, (2) p. 628, (3) p. 127, (4) p. 24.

PROPIONIC ALDEHYDE. CH_3CH_2CHO. In laboratory tests, 1100 alloy was resistant to aqueous solutions of propionic aldehyde at ambient temperature. At 50°C (122°F) and 100°C (212°F), these solutions caused moderate attack. Propionic aldehyde has been produced in aluminum alloy equipment and has been stored and shipped in aluminum alloy containers. See also Ref: (3) p. 120, (7) p. 153.

PROPIONIC ANHYDRIDE. $(CH_3CH_2CO)_2O$. In laboratory tests, 1100 alloy was resistant to propionic anhydride at ambient temperature and at 50°C (122°F). At the boiling point, propionic anhydride was very corrosive. Propionic anhydride has been handled in aluminum alloy storage tanks, drums and tank cars. See also Ref: (3) p. 128.

PROPYL ACETATE. $CH_3COOC_3H_7$. In laboratory tests, 3003 alloy was resistant to propyl acetate at the boiling temperature. Condensing vapors of propyl acetate caused mild attack of 3003 alloy in the same tests. See also Ref: (7) p. 153.

n-PROPYL ALCOHOL. $CH_3 \cdot CH_2 \cdot CH_2 \cdot OH$. In laboratory tests, n-propyl alcohol caused mild attack (~3 mpy) of 3003 alloy under boiling and condensing conditions. See also Ref: (1) p. 141, (3) p. 113, (7) p. 153.

PROPYLENE GLYCOL. $CH_3C \cdot HOH \cdot CH_2OH$. Propylene glycol has been handled in aluminum alloy stills, evaporators, and heat exchangers. See also Ref: (3) p. 114.

PYRIDINE. N:CHCH:CHCH:CH. In laboratory tests, 1100 and 3003 alloys were resistant to pyridine at ambient temperature. Aqueous solutions (1% and 5%) caused mild attack (~5 mpy) of 3003 alloy at ambient temperature. Aluminum alloy condensers and dephlegmators have been used with pyridine. See also Ref: (1) p. 141, (2) p. 633, (3) p. 149, (4) p. 73, (7) p. 155.

Q

QUEBRACHO EXTRACT. Contains quebracho alkaloids and tannen. In limited laboratory tests, quebracho extract caused mild attack (~4 mpy) of 3003 alloy at 204°C (400°F).

QUINOLINE. C_9H_7N. Quinoline has been handled in aluminum alloy containers. See also Ref: (1) p. 141, (2) p. 640, (3) p. 149, (7) p. 157.

R

RASPBERRY JUICE. In laboratory tests, alloys 1100, 3003, and alclad 6053 were resistant to black raspberry juice at refrigerated temperatures. In other laboratory tests, black and red raspberry juices caused moderate attack of 3003 alloy at 100°C (212°F). See also Ref: (1) p. 141, (4) pp. 88, 89 (6) p. 10.

RAYON INDUSTRY. Aluminum alloys have been used in the rayon industry for spinning buckets and bobbins, piping for viscose and wash water, filter presses and guide holders, desulfurization machines, ventilating and heater ducts, and blower equipment. See also Ref: (1) p. 141, (3) pp. 124, 232.

RESORCINOL FORMALDEHYDE. $C_7H_6O_3$. Resorcinol formaldehyde has been handled in aluminum alloy bulk containers.

RHUBARB. In laboratory tests, rhubarb pomace and rhubarb juice were corrosive to alloy 3003 at 100°C (212°F). See also Ref: (4) p. 80, (6) p. 11.

RICE. Aluminum alloy equipment has been used to process various rice products. See also Ref: (1) p. 141.

RICINOLEIC ACID. $CH_3 \cdot (CH_2)_5 \cdot CHOH \cdot CH_2CH{:}CH \cdot (CH_2)_7 \cdot COOH$. In limited laboratory tests, 3003 alloy was resistant to ricinoleic acid at ambient temperature. Ricinoleic acid has been processed in aluminum alloy distillation equipment, condensers and piping. It has been stored in aluminum alloy tanks. See also Ref: (2) p. 274, (3) p. 129.

ROSIN. Molten rosin has been carried in aluminum alloy pipe and shipped in aluminum alloy tank cars. Aluminum alloy equipment has been used in the manufacture of paints and varnishes containing rosin. See also Ref: (1) p. 141, (2) p. 866, (7) p. 159.

RUBBER. Mostly obtained from the coagulated milky juice of *Hevea brasiliensis*. Aluminum alloys have been used on rubber plantations for cups, latex vats, pans, buckets, coagulating tanks, and drums. Aluminum alloy molds have been used for the production of rubber articles and for vulcanizing. See also Ref: (1) p. 141, (3) pp. 103, 227.

RUM. In laboratory tests, rum was corrosive to aluminum alloys usually in the form of localized pitting. See also Ref: (1) p. 141.

S

SALICYLALDEHYDE. HOC_6H_4CHO. In laboratory tests, aluminum alloys caused discoloration of salicylaldehyde. Alloy 5052 caused less discoloration than other alloys. See also Ref: (3) p. 121.

SALICYLIC ACID. HOC_6H_4COOH. Alloys 3003 and 5154 were resistant to solid salicylic acid in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Salicyclic acid has been handled in aluminum alloy distillation columns, condensers, pumps and piping. The sublimed acid has been condensed in aluminum-lined chambers. In the preparation of aspirin, salicylic acid has been reacted with acetic anhydride in aluminum alloy kettles. See also Ref: (1) p. 142, (2) p. 644, (3) p. 130, (7) p. 161.

SARDINES. Coated aluminum alloy cans have been used to package sardines. See also Ref: (3) p. 208, (4) pp. 106, 108, 109, (6) p. 12.

SAUERKRAUT. In limited laboratory tests, sauerkraut caused localized pitting of 3003 alloy. See also Ref: (1) p. 142, (3) p. 209, (4) pp. 78, 80, 92, (6) p. 11.

SEAWATER. Many aluminum alloys have been shown to resist seawater in both laboratory controlled field tests and in service. These include aluminum-magnesium alloys 5052, 5154, 5083, 5086, and 5456 and aluminum-magnesium-silicon alloys 6061 and 6063. The high strength aluminum alloys 2219, 2024, and 7075 require protective measures when used in seawater.

In January, 1936, an aluminum hull section of a high speed boat was placed in the James River Estuary of the Chesepeake Bay. The hull was fabricated of 5052-H32 plate, the framing of 6053 extrusions and the assembly rivets of 6053-T41. The outside of the hull below the water line was painted except for a small area that was left bare to observe the effect of the seawater on the hull plate. When inspected 42 years later, even the unpainted area had resisted corrosion. The Alcoa Seaprobe was 244 feet long with hull of 5456 aluminum painted with a coal tar epoxy. When the vessel was decommissioned after 10 years of service, examination disclosed the hull plates to have resisted the effects of seawater. Aluminum alloys have been used for rowboats, canoes, and other pleasure craft; outboard motors; as well as naval and commercial vessels. When immersed in seawater, aluminum alloys, as most other metals, are protected from marine fouling by organic coatings. These antifouling coatings should not contain mercury or copper compounds. See also Ref: (3) pp. 32, 62, (4) pp. 42, 55, 56, 57, 58, 59.

SEWAGE. Aluminum alloys have generally per-

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

formed well when used with domestic and industrial sewage and the decomposition products of the sludges, including hydrogen sulfide, methane, carbon dioxide, and nitrogen. Aluminum alloys have been used for filters, gratings, thickeners, valves, pipes, and sludge handling equipment in sewage disposal plants. See also Ref: (1) p. 142, (3) p. 243.

SHAVING CREAM. Many shaving creams have been packaged in collapsible aluminum alloy tubes. See also Ref: (1) p. 142.

SHELLAC. A resinous excretion of the insect *Laccifer lacca.* In laboratory tests, 3003 alloy was resistant to shellac at ambient temperature. Aluminum alloy storage tanks have been used for shellac. See also Ref: (3) p. 226.

SHOE POLISH. Typically a mixture of hard waxes (carnauba, etc.), paraffin, ceresin of ozokerite, solvents (naphtha and turpentine, etc.) and dye. Aluminum alloy containers have been used for shoe polish. See also Ref: (9) p. 62.

SILVER COMPOUNDS. In laboratory tests, solutions of silver compounds were corrosive to all aluminum alloys causing localized pitting attack. See also Ref: (1) p. 142, (3) p. 73.

SOAP. Salt of fatty acids. In laboratory tests, the action of soaps on aluminum alloys is variable. Many soaps cause less than 1 mpy attack while others, usually those more alkaline, are corrosive. Aluminum alloy screw conveyors, compactors, packaging equipment, and tote bins have been used in the production of soap. Bar soap has been wrapped in aluminum foil laminates. See also Ref: (1) p. 142, (2) p. 647, (3) pp. 117, 239, 245 (7) p. 160.

SODA ASH. See SODIUM CARBONATE.

SODA WATER. In limited laboratory tests, 3003 alloy was resistant to soda water at ambient temperature. When tap water is used, the amount of corrosion is dependent upon the composition of the water used. See also Ref: (9) p. 65, (10) pp. 46, 93.

SODIUM. Na. Sodium has been heated on aluminum alloy trays in the production of sodium products. See also Ref: (1) p. 142, (3) p. 58.

SODIUM ACETATE. $CH_3COONa \cdot 3H_2O$. Alloy 3003 was resistant to solid sodium acetate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to aqueous solutions of sodium acetate (0.1% to 36%) at ambient temperature. See also Ref: (1) p. 142, (2) p. 650, (3) pp. 25, 71 (7) p. 161.

SODIUM ALUMINATE. $NaAlO_2$. Solid sodium aluminate was very corrosive to alloys 3003 and 5154 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (3) p. 70, (7) p. 161.

SODIUM ARSENATE. Na_2HAsO_4. Solid sodium arsenate caused moderate attack (~10 mpy) of 3003 and 5154 alloys in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 142, (7) p. 162.

SODIUM ARSENITE. $NaAsO_2$. Solid sodium arsenite caused mild attack (~5 mpy) of alloy 3003 while 5154 alloy was resistant to solid sodium arsenite in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Aluminum alloy tanks have been used to handle sodium arsenite. See also Ref: (7) pp. 162, 163.

SODIUM BENZENESULFONATE. $C_6H_5SO_2ONa$. Aluminum alloy rotary driers, fume hoods, and duct work have been used in the manufacture of sodium benzenesulfonate.

SODIUM BENZOATE. $C_6H_5 \cdot COONa$. Alloys 3003 and 5154 were resistant to solid sodium benzoate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (3) p. 71, (7) p. 163.

SODIUM BISULFITE. $NaHSO_3$. Solid sodium bisulfite was corrosive to alloys 3003 and 5154 with evidence of localized pitting in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solutions of sodium bisulfite (1% to 25%) at ambient temperature caused attack of alloy 3003 which increased with concentration. Solutions of 10% or less caused mild attack (~2 mpy) while 25% solutions were slightly more corrosive (~4 mpy). See also Ref: (2) p. 657, (3) p. 64, (7) p. 163.

SODIUM CARBONATE. Na_2CO_3. Solid sodium carbonate was very corrosive to alloy 3003 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solutions of sodium carbonate (1% to 10%) were very corrosive to 1100 alloy at ambient temperature. In the same tests, the action of these aqueous solutions was effectively inhibited by the addition of silicates. Aluminum alloy hopper cars have been used to transport sodium carbonate. See also Ref: (1) p. 142, (2) p. 660, (3) pp. 23, 67, (4) pp. 34, 37, 50, 76, 86, 96, 103.

SODIUM CHLORATE. $NaClO_3$. Alloy 3003 was resistant to solid sodium chlorate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Sodium chlorate has been dried in aluminum alloy equipment and shipped in aluminum alloy tanks cars. See also Ref: (7) pp. 164, 165.

SODIUM CHLORIDE. NaCl. Alloy 3003 was resistant to solid sodium chloride in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solutions of sodium chloride (0.1% to 25%) caused mild attack (~2 mpy) of 1100 alloy at ambient temperature with some localized pitting. The presence of heavy metals in these solutions accelerated attack. Sodium chloride has been the basic ingredient in many standard accelerated corrosion tests used in evaluating the resistance to corrosion and stress corrosion cracking of aluminum alloys. Aluminum alloy equipment has been used for hoppers, elevator buckets, drying towers and bins for handling sodium chloride. Solid sodium chloride has been shipped in aluminum alloy railway cars. Sodium chloride brines have been carried in aluminum alloy refrigeration systems.
See also Ref: (1) p. 143, (2) p. 665, (3) pp. 25, 61, 213, (7) p. 165.

SODIUM CHROMATE. $Na_2CrO_4 \cdot 4\ H_2O$. Alloys 3003 and 5154 were resistant to solid sodium chromate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to aqueous solutions of sodium chromate (up to 50%) at ambient temperature. Sodium chromate has been used extensively as an inhibitor to retard corrosion of aluminum alloys in many aqueous environments. See also Ref: (1) p. 143, (2) p. 678, (3) pp. 61, 62, 70, 73 (7) p. 165.

SODIUM CYANIDE. NaCN. In laboratory tests, aqueous solutions of sodium cyanide at ambient temperature caused attack of 3003 alloy which increased with concentration. At 0.1%, the sodium cyanide solution caused mild attack (~4 mpy) while at 20%, it was very corrosive. See also Ref: (1) p. 143, (2) p. 682, (3) p. 68, (7) p. 165.

SODIUM DICHROMATE. $Na_2Cr_2O_7 \cdot 2H_2O$. Sodium dichromate has been used as an inhibitor to retard corrosion of aluminum alloys in chloride solutions and ethylene glycol. See also Ref: (1) p. 143, (3) p. 70.

SODIUM DISILICATE. $Na_2Si_2O_5$. Sodium disilicate has been used as an inhibitor of corrosion of aluminum alloys in alkaline solutions. See also Ref: (7) p. 165.

SODIUM FLUORIDE. NaF. Solid sodium fluoride was corrosive to alloy 3003 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solutions of sodium fluoride (0.1% to 4%) caused moderate attack (~10 mpy) of 1100 alloy which varied with concentration. See also Ref: (1) p. 143, (3) p. 63, (7) p. 167.

SODIUM FLUOSILICATE. $Na_2(SiF_6)$. Alloys 3003 and 5154 were resistant to solid sodium fluosilicate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (2) p. 688, (3) p. 69.

SODIUM HYDROGEN SULFATE. $NaHSO_4$. Solid sodium hydrogen sulfate was very corrosive to alloys 3003 and 5154 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solutions of sodium hydrogen sulfate (1-25%) caused attack of 3003 alloy at ambient temperature which increased with concentration. Alloy 3003 was resistant to a 1% solution, while a 25% solution caused mild attack (~4 mpy). See also Ref: (1) p. 142, (2) p. 653, (3) p. 64.

SODIUM HYDROXIDE. NaOH. In laboratory tests, aqueous solutions of sodium hydroxide were very corrosive to all aluminum alloys at all concentrations and temperatures. Dilute solutions of sodium hydroxide have been inhibited by the addition of inhibitors, including potassium dichromate, ammonium metavanadate, or ammonium persulfate. See also Ref: (1) p. 143, (2) p. 693, (3) pp. 25, 60, (4) pp. 34, 35, 36, 37, 49, 103, (7) p. 169.

SODIUM HYPOCHLORITE. NaClO. In laboratory tests, aqueous solutions of sodium hypochlorite cause corrosion which varies with concentration. Alloy 1100 was resistant to dilute solutions of sodium hypochlorite at ambient temperature, whereas, more concentrated solutions were very corrosive. Silicates have been used as inhibitors for corrosion of aluminum alloys by sodium hypochlorite. See also Ref: (1) p. 143, (2) p. 703, (3) pp. 63, 247, (7) p. 169.

SODIUM LACTATE. $CH_3 \cdot CHOHC \cdot OONa$. In laboratory tests, 30% solution of sodium lactate was corrosive to 1100 alloy at ambient temperature and at 100°C (212°F). In the same tests, 1100 alloy was resistant to an 80% solution of sodium lactate at ambient temperature. See also Ref: (3) p. 71.

SODIUM LAURYL SULFATE. $CH_3 \cdot (CH_2)_{10}COONa \cdot SO_2$. In controlled field tests, aqueous solutions of sodium lauryl sulfate were corrosive to alloy 3003.

SODIUM MERCAPTOBENZOTHIAZOLE. $C_6H_4N{:}C(S) \cdot SNa$. Sodium mercaptobenzothiazole has been used as an inhibitor to retard corrosion of aluminum alloys in ethylene glycol solutions. See also Ref: (10) p. 30.

SODIUM NITRATE. $NaNO_3$. Alloy 3003 was resistant to solid sodium nitrate in laboratory tests conducted under conditions of 100% relative humidity

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

at ambient temperature. In other laboratory tests, 1100 alloy was resistant to aqueous solutions of sodium nitrate (0.1% to 43%) at ambient temperature. Sodium nitrate has been used in combination with sodium nitrite as an inhibitor to retard the corrosion of aluminum alloys. See also Ref: (1) p. 143, (2) p. 712, (3) p. 66, (7) p. 169.

SODIUM NITRITE. $NaNO_2$. Alloys 3003 and 5154 were resistant to solid sodium nitrite in laboratory tests under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 143, (3) p. 66, (7) p. 169.

SODIUM OXALATE. $Na_2C_2O_4$. Alloys 3003 and 5154 were resistant to solid sodium oxalate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 3003 alloy was resistant to saturated solutions of sodium oxalate at ambient temperature, while dilute solutions of sodium oxalate (3.1%) caused moderate attack (~7 mpy) of 3003 alloy at 100°C (212°F). See also Ref: (1) p. 143.

SODIUM PERBORATE. $NaBO_3 \cdot 4H_2O$. Alloys 3003 and 5154 were resistant to solid sodium perborate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 3003 alloy was resistant in moist sodium perborate at ambient temperature. See also Ref: (2) p. 718, (7) p. 169.

SODIUM PERCARBONATE.
$2\ Na_2CO_3 \cdot 3\ H_2O$, $Na_2CO_3 \cdot H_2O_2 \cdot 1/2\ H_2O$ or $Na_2C_2O_6$. Sodium percarbonate has been prepared in aluminum alloy reactors. See also Ref: (2) p. 720, (3) p. 68, (7) p. 169.

SODIUM PEROXIDE. Na_2O_2. Solid sodium peroxide was very corrosive to alloys 3003 and 5154 in laboratory tests under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 144, (2) p. 725, (3) p. 60, (7) p. 171.

SODIUM PHOSPHATE, DIBASIC. Na_2HPO_4. Alloys 3003 and 5154 were resistant to solid sodium phosphate, dibasic, in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 144.

SODIUM PHOSPHATE, TRIBASIC. Na_3PO_4. In laboratory tests, aqueous solutions of sodium phosphate, tribasic, were very corrosive to 1100 alloy at ambient temperature. Sodium silicate was found to be an effective inhibitor for this compound. Cleaning products containing this compound should be used only with great caution on aluminum alloy products. See also Ref: (1) p. 146, (2) p. 734, (3) p. 67, (4) pp. 34, 37, 50, 69, 75, 76, 86, 103, (7) p. 171.

SODIUM PROPIONATE. CH_3CH_2COONa. Sodium propionate solutions have been handled in aluminum alloy tanks. See also Ref: (3) p. 71.

SODIUM SILICATES. $SiO_2(Na_2O)$. The resistance to corrosion of aluminum alloys by sodium silicates depends on the weight ratio of SiO_2/Na_2O. Commercial sodium silicates with a weight ratio of 2 have been used as inhibitors of corrosion of aluminum alloys in alkaline solutions. In laboratory tests, sodium metasilicate with a weight ratio of 1 was very corrosive to 1100 alloy at ambient temperature. See also Ref: (1) p. 144, (2) p. 740, (3) p. 69, (4) pp. 37, 47, 76, 86, 96, 103, 119, 123, 138, (7) p. 171.

SODIUM SULFATE. $Na_2SO_4 \cdot 10\ H_2O$. In laboratory tests, alloy 3003 was resistant to solid sodium sulfate under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solutions of sodium sulfate (0.1 to 14%) caused mild attack (~2 mpy) of 1100 alloy at ambient temperature. Aluminum alloy tote bins have been used for handling sodium sulfate. See also Ref: (1) p. 144, (2) p. 744 (3) p. 64, (7) p. 173.

SODIUM SULFIDE. $Na_2S \cdot 9\ H_2O$. Solid sodium sulfide was very corrosive to 3003 and 5154 alloys in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 144, (2) p. 748, (3) p. 63, (7) p. 173.

SODIUM SULFITE. $Na_2SO_3 \cdot 7\ H_2O$. In laboratory tests, 1100 alloy was resistant to aqueous solutions of sodium sulfite (0.1 to 15%) at ambient temperature. Alloys 3003 and 5154 were resistant to solid sodium sulfite in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 144, (2) p. 754, (3) p. 64, (7) p. 173.

SODIUM THIOCYANATE. NaSCN. In laboratory tests, 1100 alloy was resistant to aqueous solutions (0.1 to 40%) of sodium thiocyanate at ambient temperature. Aluminum alloy troughs, tanks, rolls, piping and towers have been used to handle sodium thiocyanate solutions. See also Ref: (1) p. 144, (2) p. 760, (3) p. 69, (7) p. 173.

SODIUM THIOSULFATE. $Na_2S_2O_3 \cdot 5\ H_2O$.
Alloys 3003 and 5154 were resistant to solid sodium thiosulfate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to aqueous solutions of sodium thiosulfate (0.5% to 40%) at ambient temperature. Sodium thiosulfate has been used as a deicing salt on aluminum alloy equipment. See also Ref: (1) p. 144, (2) p. 763, (3) p. 65, (7) p. 173.

SOILS. Soils vary widely in their corrosivity towards aluminum alloys. Soil composition, the nature of chemicals in the ground water, and the degree of wetness and aeration are factors in the corrosivity of soil; but the corrosion of aluminum alloys in soil is so complex that even that information is not sufficient for accurate prediction of performance in a given soil. It is recommended that soil corrosivity be evaluated for each application while still in the design stage. Aluminum alloys buried in soil are usually protected by claddings, coatings, or wrappings. Cathodic protection is also used, sometimes in conjunction with other protective measures. Alloys containing copper, such as 2024, should not be used in soil. Aluminum alloys have been used for oil pipe lines and culvert pipe in soil. See also Ref: (1) p. 144.

SORBITOL. $C_6H_{14}O_6$. Sorbitol has been filtered in aluminum alloy filter presses and transported in aluminum alloy tank cars and shipping drums. See also Ref: (2) p. 766, (3) p. 115, (7) p. 173.

SORBOSE. $C_6H_{12}O_6$. Aluminum alloy equipment, including rotary fermenters and sterilizers, has been used in the production of Sorbose. See also Ref: (2) p. 768, (3) p. 123, (7) p. 173.

SOYA OIL. Consists of glycerides of oleic, linoleic, palmitic, stearic and linolenic acids. Aluminum alloy weight tanks and kettles have been used in the production of soya oil.

STANNIC CHLORIDE. $SnCl_4$ Solid stannic chloride was very corrosive to alloys 3003 and 5154 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 144, (2) p. 774, (3) p. 81, (7) p. 175.

STANNOUS CHLORIDE. $SnCl_2 \cdot 2\ H_2O$. Solid stannous chloride was very corrosive to alloys 3003 and 5154 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, dilute solutions of stannous chloride (0.0001% to 10%) caused mild attack (~4 mpy) of 1100 alloy at ambient temperature. See also Ref: (1) p. 144, (3) p. 81, (7) p. 175.

STARCH. Solid starch caused mild attack (~2 mpy) of alloy 3003, while 5154 alloy was resistant to solid starch in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Aluminum alloy conveyors and piping have been used in starch plants. See also Ref: (1) p. 144, (2) pp. 123, 124, 231, (4) p. 73.

STEAM. H_2O. In laboratory tests under static conditions, alloy 3003 was found to be resistant to pure steam over distilled water at temperatures up to 268°C (514°F). In fact, aluminum alloys exposed to steam at these temperatures had improved resistance to corrosion by other environments because of the increased thickness of the oxide film on the surface. In the same tests, steam at 268°C (514°F) was corrosive. High pressure steam can erode aluminum alloys by impingement corrosion erosion, particularly when the jet of steam is perpendicular to the surface. Aluminum alloy equipment including heat exchangers, dryers, steam jacketed kettles, piping have been used to handle steam in the petroleum, chemical and food processing industries. See also Ref: (1) p. 144, (2) p. 778, (4) p. 49, (7) p. 175.

STEARIC ACID. $CH_3 \cdot (CH_2)_{16} \cdot COOH$. Aluminum alloy equipment has been used for steam distillation, filtering and storing stearic acid. Alloys 3003 and 5154 were resistant to solid stearic acid under conditions of 100% relative humidity at ambient temperature. See also Ref: (1) p. 144, (2) p. 782, (3) p. 127, (4) p. 25, (7) p. 175.

STRAWBERRIES. In limited laboratory tests, fresh strawberries caused localized pitting of 5052 alloy. See also Ref: (4) pp. 106, 109.

STREPTOMYCIN. $C_{21}H_{39}N_7O_{12}$. Aluminum alloy media tanks, pre-seed tanks, absorption tanks, slurry tanks, pipe and fittings have been used in the production of streptomycin. See also Ref: (3) pp. 146, 239.

STROBANE*. (Constituents: Terpene polychlorinates such as camphene, pinene and related compounds). In controlled field tests, 3003, 5052, and 5154 alloys were resistant to Strobane at ambient temperature.

*Trademark

STYRENE. $C_6H_5CH \cdot CH_2$. Aluminum alloy heat exchangers, bubble caps, tank trucks, conveyors, piping, polymerization vessels and storage tanks have been used in the styrene industry. See also Ref: (3) pp. 104, 105, (7) p. 175.

SUCCINIC ACID. $HOOC \cdot CH_2 \cdot CH_2 \cdot COOH$.
Alloys 3003 and 5154 were resistant to solid succinic acid in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, aqueous solutions of succinic acid (0.25% to 50%) caused attack of 1100 alloy that increased with concentration and temperature. At 0.25% the attack was moderate (~6 mpy) while at 50% it was corrosive at 100°C (212°F).
See also Ref: (1) p. 145, (3) p. 130, (7) p. 175.

SUCROSE. $C_{12}H_{22}O_{11}$. Alloy 3003 was resistant to solid sucrose, while alloy 5154 showed mild attack (~2 mpy) in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Aluminum alloy piping, crystallizers and storage tank heaters have been used with sucrose. Dry sucrose has been handled in aluminum alloy piping. See also Ref: (1) p. 145, (2) p. 790, (3) p. 124, (6) p. 10.

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

SUGAR. $C_{12}H_{22}O_{11}$. Aluminum alloy equipment for piping, tankage and transportation has been used in the sugar industry. See also Ref: (1) p. 145 (2) p. 790, (3) pp. 123, 198, 203, 209, (4) pp. 73, 74, 88, 90, 91, 93, 98, (7) p. 175.

SULFAMIC ACID. $H_2N \cdot SO_2 \cdot OH$. In laboratory tests, aqueous solutions of sulfamic acid (0.1% to 20%) caused attack of 1100 alloy which increased with temperature. At ambient temperature, the attack was moderate (~10 mpy), while at 50°C (122°F) and 100°C (212°F), sulfamic acid solutions were very corrosive. See also Ref: (1) p. 145, (3) pp. 42, 244, (4) p. 124.

SULFITE WASTE LIQUOR. Aluminum alloy tank trucks have been used for handling dilute, unneutralized waste liquors. See also Ref: (2) p. 796.

SULFUR. S. In laboratory tests, 1100 and 3003 alloys were resistant to liquid sulfur at 135-154°C (275-310°F). Aluminum alloy equipment has been used for the recovery and purification of sulfur, in sulfur mining equipment, buildings, freight cars, hopper cars and conveyors. See also Ref: (1) p. 145, (2) p. 800, (3) pp. 40, 227; James R. West, "Sulphur and Sulphides vs. Materials of Chemical Plant Construction," *Chemical Engineering*, 1946 October.

SULFUR CHLORIDE. SCl or S_2Cl_2. Sulfur chloride has been shown to be very corrosive to aluminum alloys in laboratory tests. See also Ref: (7) pp. 176, 177.

SULFUR DIOXIDE. SO_2 In laboratory tests, sulfur dioxide saturated with water was corrosive to all aluminum alloys at ambient temperature. Aluminum alloy equipment has been used for refrigeration systems containing sulfur dioxide, for vulcanizing chambers, and petroleum refining stills involving sulfur dioxide, for heat exchangers in cooling sulfur dioxide, and for reactors converting sulfur dioxide to sulfur trioxide. See also Ref: (1) p. 145, (2) p. 806, (4) p. 97 (7) p. 177.

SULFURIC ACID. H_2SO_4. In laboratory tests, the corrosion of aluminum alloys in sulfuric acid varies with concentration of sulfuric acid.
The corrosion reaches a maximum at about 80% acid concentration. Above that concentration, attack decreases rapidly until at 98% it becomes mild, less than 5 mpy. In other laboratory tests, fuming acids containing 101, 103, 107 and 115% sulfuric acid caused moderate attack of 3003 alloy at ambient temperature. Aluminum alloy heat exchangers, piping and tanks have been used to handle sulfuric acid in 98% concentrations and at temperatures as high as 200°C (392°F). See also Ref: (1) p. 145, (2) p. 811, (3) pp. 22, 41, (4) pp. 18, 19, 29, 30, 31, 34, 74, 96, 97, (7) p. 177.

SULFUROUS ACID. H_2SO_3. In laboratory tests, dilute aqueous solutions of sulfurous acid caused corrosion of 1100 alloy which increased with concentration. At 0.1% sulfurous acid, the attack was mild (~4 mpy), while at 8%, the attack was moderate (~12 mpy). Sulfurous acid condensed from gases containing sulfur dioxide and moisture will cause corrosion of aluminum alloys. See also Ref: (1) p. 145, (2) p. 841, (3) p. 22, (4) pp. 19, 29, 30, (7) p. 179.

SULFUR TRIOXIDE. SO_3. Aluminum alloy reactors have been used for converting SO_2 to SO_3 (sulfur trioxide). See also Ref: (3) p. 40.

T

TALL OIL. Tall oil has been handled in aluminum alloy tanks, pipe lines, and heat exchangers. See also Ref: (7) pp. 180, 181.

TANNIC ACID. $C_{76}H_{52}O_{46}$. Solid tannic acid caused mild attack (~2 mpy) of alloys 3003 and 5154 in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 0.01% to 20% aqueous solutions caused mild attack (~2 mpy) of 1100 alloy at ambient temperature and moderate attack (~9 mpy) at 50°C (122°F). These solutions were corrosive at 100°C (212°F). Aluminum alloy processing equipment has been used in tanning plants. See also Ref: (1) p. 145, (4) pp. 29, 30, (7) p. 181.

TAR. Aluminum coils and heat exchangers have been used in tar distillation plants to condense hot creosote vapors. Tar and tar products have been handled in aluminum alloy tanks. See also Ref: (1) p. 145, (3) p. 223.

TARTARIC ACID. $HOO \cdot C(CHOH)_2COOH$.
Alloys 3003 and 5154 were resistant to solid tartaric acid in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to aqueous solutions (0.1% to 55%) at ambient temperature, but these solutions were corrosive at 50°C (122°F) and very corrosive at 100°C (212°F). Tartaric acid has been processed in aluminum alloy filters and crystallizers and has been stored in aluminum alloy tanks. See also Ref: (1) p. 145, (2) p. 848, (3) pp. 131, 209, (4) pp. 22, 25, 26, 27, 28, 29, 30, 88, (7) p. 181.

TEA. Aluminum alloys have been used for packaging, storing, and brewing tea. See also Ref: (1) p. 145, (3) p. 211, (4) pp. 79, 84, 97, 98, (6) p. 12.

TERPENES. $C_{10}H_{16}$. (Polymers of Isoprene C_5H_8). Aluminum alloy tanks have been used for storing terpenes. See also Ref: (3) p. 104, (7) p. 181.

TETRACHLOROETHANE. $Cl_2HC \cdot CHCl_2$.
Limited laboratory tests indicated that 3003 alloy was resistant to tetrachloroethane at ambient temperature but at boiling temperature tetrachloroethane was corrosive. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (3) p. 109.

TETRACHLOROETHYLENE. $Cl_2C \cdot CCl_2$. In limited laboratory tests, high purity aluminum was resistant to tetrachloroethylene at 50°C (122°F) and under refluxing conditions. In other laboratory tests, tetrachloroethylene caused mild attack (~5 mpy) of 3003 alloy under refluxing conditions. Aluminum alloy degreasing installations including stills and storage tanks have been used with tetrachloroethylene. See also Ref: (1) p. 145, (3) p. 108.

THIOCARBANILIDE. $CS(NHC_6H_5)_2$. In laboratory tests, thiocarbanilide caused mild attack (~4 mpy) of alloy 3003 at 204°C (400°F). Aluminum alloy drying trays have been used for handling thiocarbanilide at temperatures up to 88°C (190°F).

THIOGLYCOLIC ACID. $HS \cdot CH_2 \cdot COOH$. In laboratory tests, alloys 1100, 3003 and 5052 were resistant to 7.2% aqueous solutions of thioglycolic acid at ambient temperature. Aqueous solutions of 45% concentration were corrosive. Aluminum alloy tanks and receivers have been used for thioglycolic acid. See also Ref: (3) p. 133.

THIOPHENE. SCH:CHCH:CH. Limited laboratory tests indicated that 3003 alloy was resistant to thiophene at 204°C (400°F). See also Ref: (3) p. 148.

TITANIUM. Ti. In laboratory tests, titanium was found to cause corrosion of contacting aluminum alloys in high chloride-containing environments by galvanic action. Hermetically sealed aluminum alloy containers have been used for handling and transporting pure, dry titanium sponge.

TITANIUM DIOXIDE. TiO_2. Titanium dioxide pigment has been dried in large aluminum-lined steam tube driers. Aluminum alloy heat exchangers have been used to condense titanium dioxide vapors. See also Ref: (3) p. 78.

TITANIUM TETRACHLORIDE. $TiCl_4$. In limited laboratory tests, titanium tetrachloride caused mild attack (~5 mpy) of alloys 5052 and 6061 under refluxing conditions. See also Ref: (7) pp. 182, 183.

TOBACCO. In limited laboratory tests, moist tobacco caused localized pitting of 3003 and 5052 alloys at ambient temperature. Aluminum alloys have been used for packaging tobacco products. See also Ref: (1) p. 146.

TOLUENE. $C_6H_5 \cdot CH_3$. In laboratory tests, 3003 alloy was resistant to toluene at ambient temperature and the boiling temperature. Toluene has been handled in aluminum alloy equipment. See also Ref: (1) p. 146, (2) p. 855, (3) pp. 104, 223, (7) p. 183.

TOLUIDINES (m–, o–, and p–). $CH_3 \cdot C_6H_4 \cdot NH_2$. Toluidines have been handled in aluminum alloy steam heated stills. See also Ref: (1) p. 146, (3) p. 144.

TOMATOES AND TOMATO JUICE. In laboratory tests, 3003 and 5154 alloys were resistant to tomato paste at ambient temperature. In other laboratory tests, 3003 alloy was resistant to tomato juice at 100°C (212°F). Cooking and storage of tomatoes in aluminum alloy vessels has caused pitting on the metal. Tomato juice has been processed in aluminum alloy equipment. See also Ref: (1) p. 146, (3) p. 209, (4) pp. 88, 91, 92, (6) p. 11.

TOOTHPASTE. In laboratory tests, the corrosion effects of toothpastes are variable, with most causing little corrosion. Those containing fluorides are corrosive to aluminum alloys. Toothpastes have been packaged in collapsible aluminum tubes. See also Ref: (1) p. 146, (3) p. 239.

TOXAPHENE. $C_{10}H_{10}Cl_8$. In limited laboratory tests at ambient temperature and 52°C (126°F), toxaphene solutions caused localized pitting of 3003 alloy. Aluminum alloy tanks have been used to store and transport toxaphene. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (7) pp. 182, 183.

TRIACETIN. $(CH_3COO)_3C_3H_5$. Limited laboratory tests indicated that 6053 alloy was resistant to triacetin at ambient temperature. Aluminum alloy kettles and stills have been used in the production of triacetin. See also Ref: (10) p. 81.

TRICHLOROBENZENE. $C_6H_3Cl_3$. In laboratory tests, 3003 alloy was resistant to trichlorobenzene at ambient, 50°C (122°F), 100°C (212°F), and 204°C (400°F) temperatures and under refluxing conditions. Aluminum alloy tank cars have been used to ship trichlorobenzene. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (3) p. 111, (7) p. 185.

1,1,1—TRICHLOROETHANE. CCl_3CH_3. In limited laboratory tests, 3003 alloy was resistant to trichloroethane at ambient temperature and under refluxing conditions. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (3) p. 109, (7) p. 185.

TRICHLOROETHYLENE. $ClCH:CCl_2$. In limited laboratory tests, 3003 alloy was resistant to trichloroethylene in the dry condition at ambient temperature, 50°C (122°F) and under refluxing conditions. The

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

presence of water accelerates the corrosive effects of trichloroethylene. Aluminum alloy tank cars have been used for transporting dry trichloroethylene. Inhibited trichloroethylene has been used for degreasing of aluminum alloy products. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (1) p. 146, (3) pp. 25, 108, 244, (7) p. 185.

TRIETHANOLAMINE. $N(CH_2 \cdot CH_2 \cdot OH)_3$. In laboratory tests, alloy 2017 was resistant to triethanolamine at ambient temperature while triethanolamine was corrosive to 3003 alloy at 204°C (400°F) and under refluxing conditions. Aqueous solutions were very corrosive to aluminum alloys at ambient temperature. Triethanolamine has been stored and transported in aluminum alloy tanks. See also Ref: (1) p. 146, (2) p. 862, (3) pp. 25, 145, (5) p. 14.

TRIETHYLAMINE. $(C_2H_5)_3N$. Laboratory tests indicated that 3003 alloy was resistant to triethylamine at 100°C (212°F) and 204°C (400°F).

TRIETHYLENEDIAMINE. $NH_2(C_2H_4)_2C_2H_4NH_2$. Aluminum alloy steam tube has been used to handle triethylenediamine.

1, 2, 4 TRIMETHYLBENZENE (PSEUDOCUMENE). $C_6H_3(CH_3)_3$. Aluminum alloy stills have been used for the distillation of trimethylbenzene. See also Ref: (7) p. 187.

2, 4, 6-TRINITROTOLUENE. $(NO_2)_3 \cdot C_6H_2 \cdot CH_3$. Aluminum alloy kettles and heat exchangers have been used in the manufacture of trinitrotoluene. Aluminum alloy vessels have been used for melting trinitrotoluene.

TRI-o-CRESYL PHOSPHATE. $(CH_3 \cdot C_6H_4)_3PO_4$. In laboratory tests, 3003 alloy was resistant to tri-o-cresyl phosphate at 204°C (400°F). Under refluxing conditions tri-o-cresyl phosphate was corrosive to 3003 alloy. Aluminum alloy tank trucks have been used to transport tri-o-cresyl phosphate. See also Ref: (1) p. 146, (3) p. 138, (7) p. 185.

TUNA FISH. In laboratory tests, 3003 alloy was resistant to tuna fish at ambient temperature. See also Ref: (6) p. 12.

TUNG OIL. In limited laboratory tests, alloy 6061 was resistant to tung oil at ambient temperature.

TURPENTINE. (Usually contains mainly α and β pinene; also camphene, dipentene, other monocyclic terpenes, p-cymene). In laboratory tests, 3003 alloy was resistant to turpentine at ambient temperature and at the boiling temperature. Production of turpentine has been carried out with aluminum alloy distillation equipment, heat exchangers, and tanks. Alloy A356.0 valves have been used for handling turpentine. See also Ref: (2) p. 866, (3) pp. 104, 226, 238, (7) p. 189.

U

UNDECYLENIC ACID. $CH_2{:}CH \cdot (CH_2)_8 \cdot COOH$. Aluminum alloy receivers and storage tanks have been used for handling undecylenic acid.

UREA. $H_2N \cdot CO \cdot NH_2$. Alloy 3003 was resistant to solid urea while 5154 alloy suffered mild attack in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 3003 alloy was resistant to solutions of urea at ambient temperature. Aluminum alloy equipment, including distillation columns, driers, heat exchangers, storage tanks, and piping, has been used for handling urea. See also Ref: (1) p. 146, (3) p. 147, (7) p. 191.

V

VALERIC ACID. $CH_3(CH_2)_3COOH$. In laboratory tests, 3003 alloy was resistant to valeric acid at 100°C (212°F). See also Ref: (1) p. 146 (3) p. 127.

VANILLIN. $CH_3O(OH)C_6H_3CHO$. Aluminum equipment has been used to handle synthetic vanillin. See also Ref: (8) p. 124.

VARNISH. A resinous solution or drying oil. Aluminum alloys have been used for varnish kettles. Lead drying agents have caused pitting and failure in some aluminum alloy varnish kettles. See also Ref: (1) p. 146, (2) p. 770, (3) pp. 131, 237.

VEGETABLES. Vegetables have been prepared in aluminum alloy kitchenware. The cooking periods are relatively short, and even acidic vegetables have negligible effect. Aluminum alloys have been used for certain canned vegetables. See also Ref: (1) p. 146, (3) pp. 198, 208, (4) pp. 78, 79, 80, 88, 106, 109, 115, (6) p. 11.

VINEGAR. In laboratory tests, 1100 alloy was resistant to various types of vinegar at ambient temperature. At 50°C (122°F), the corrosion was increased and the attack was moderate (~ 7 mpy). Aluminum alloy distillation columns, tube, pipe and tanks have been used in producing vinegar. Vinegar contaminated with chloride or heavy metal ions promotes pitting of aluminum alloys. See also Ref: (1) p. 146, (3) pp. 126, 198, 210, (4) pp. 22, 24, 31, 84, 92.

VINYL ACETATE. $CH_3 \cdot COO \cdot CH \cdot CH_2$. Aluminum alloy equipment has been used for polymerization kettles, driers, containers and tank trucks in the production and handling of vinyl acetate. See also Ref: (3) p. 136, (7) p. 193.

VINYL CHLORIDE MONOMER. $CH_2{:}CHCl$. Aluminum alloy aerosol containers have been used to handle vinyl chloride. Vinyl chloride slurries have been handled in aluminum alloy pipe. *CAUTION*: See "Halogenated Hydrocarbons." See also Ref: (2) p. 875, (3) p. 108, (7) p. 193.

VINYL CHLORIDE POLYMER. See POLYVINYL CHLORIDE.

VINYL RESINS. Vinyl resins have been shipped in aluminum alloy tanks and drums. Aluminum alloy tanks, conveyors, and bins have been used for in-plant storage and handling of vinyl resins. See also Ref: (3) p. 233.

VITAMINS. Aluminum alloy equipment has been used to process and handle vitamins. See also Ref: (2) p. 82, (3) pp. 104, 115, 124, 138, 198, 205.

W

WATER. H_2O. Aluminum alloys have been used for handling a wide variety of waters. In high purity water, laboratory tests show that a slight reaction occurs originally between the aluminum alloys and distilled, deionized, and uncontaminated rain water, but after a few days it ceases and aluminum pick-up by the water becomes negligible. Aluminum alloy tanks and piping have been used for storage and distribution of distilled and deionized water. At elevated temperature, ~200°C (392°F) and above, both distilled and deionized water cause very severe corrosion of most aluminum alloys. Special aluminum alloys containing iron and nickel as alloying elements have been developed for use in high purity water up to temperatures of 360°C (680°F).

Aluminum alloys are well suited for handling steam condensate. They are not adversely affected by carbon dioxide and oxygen or by chemical agents such as ammonia, hydrazine, morpholine, filming amines and sodium sulfite added to condensate in the relatively small concentrations needed to protect steel. Large aluminum tanks have been in use at power plants for storage of alkaline condensate (pH 9-9.5).

Laboratory tests indicate that the corrosivity of natural fresh waters is difficult to predict. When they do cause corrosion, the attack is generally of the pitting type. The tendency of fresh natural water to promote pitting of aluminum depends upon the nature and concentration of salts dissolved in them. Small quantities of soluble chloride and heavy metal salts in some natural water will promote pitting of aluminum, especially if the water pH is 6 or below. Alclad alloys such as alclad 3003 and alclad 6061 are highly resistant to the development of deep pits.

Waters that are handled in recirculating systems are generally corrosive to aluminum unless a suitable water treatment is used. Even if a water that in its natural state has little action on aluminum is used, the concentration of dissolved solids builds up as evaporation losses are made up or as contaminants are picked up from the system or the air and the corrosivity of the water could increase. Expert advise on suitable water treatments is available from a number of water treating concerns. See also Ref: (7) pp. 251, 252, 253, 254.

WAX. In laboratory tests, many waxes were protective to aluminum alloys. Steam traced aluminum alloy piping has been used to handle liquid and molten waxes. Molten waxes have been solidified in aluminum alloy pans. Aluminum alloy dip tanks have been used to treat crude rubber with molten wax. See also Ref: (1) p. 147, (3) pp. 220, 225.

WETTING AGENTS. (Alkyl and alkylaryl sulfonates in the form of their sodium salts). Aluminum alloy containers have been used to handle these compounds. See also Ref: (10) p. 100.

WHISKEY. In laboratory tests, alloys 1100 and 3003 were resistant to whiskey at ambient temperature but pronounced localized pitting occurred. The color of the whiskey was also affected. See also Ref: (1) p. 147, (3) p. 203, (6) p. 10.

WHITING. $CaCO_3$. (Naturally occurring calcium carbonate about 98% pure). Aluminum alloy bins and drums have been used for inter-plant and in-plant handling of whiting. See also Ref: (3) p. 76.

WINES. In laboratory tests, the corrosion effects of wines on aluminum alloys vary widely. Discoloration of some wines contacting aluminum alloys was also encountered. Aluminum alloy equipment such as piping, fittings, containers for transferring grape juice, unfermented wine, fermented wine, and fortified wine as well as grape pulp or must has been used in the wine industry. Coated pure aluminum tanks have been used for storage and shipment of wines. Wine has been packaged in coated aluminum alloy cans. See also Ref: (1) p. 147, (3) p. 202, (4) pp. 93, 94, 142.

WOOD. Wet wood has caused varying degrees of corrosion of contacting aluminum alloys in laboratory tests. The degree of corrosion varied with the type of wood tested. It is good engineering practice to apply protection where aluminum alloys will contact wood which may become wet. Aluminum alloy nails, screws, and bolts have been used in wood. See also Ref: (1) p. 147, (3) p. 231.

WOOD CREOSOTE. (A mixture of phenols, chiefly guaiacol and cresol.) In laboratory tests, wet wood treated with creosote did not accelerate corrosion of

(continued)

TABLE 5.2: ALUMINUM ALLOYS–ALUMINUM ASSOCIATION (continued)

contacting 3003 alloy under conditions of 100% relative humidity at 52°C (125°F). Aluminum alloy equipment including coils, heat exchangers, and tanks has been used to handle creosote. See also Ref: (1) p. 131, (3) pp. 117, 223.

WOOD PRESERVATIVES. In laboratory tests, wood preservatives were found to vary greatly in their corrosivity to aluminum alloys. Some caused less than 1 mpy attack while others, particularly those containing copper or mercury salts or zinc chloride, were very corrosive. Creosote, zinc napthanate and pentachlorophenol were found to be most compatible with aluminum alloys. None of the wood preservatives was inhibitive.

X

XYLENE. $C_6H_4(CH_3)_2$. In limited laboratory tests, 3003 alloy was resistant to xylene at the boiling temperature. Xylene has been handled in aluminum alloy piping, condensers, and pressure vessels. See also Ref: (1) p. 147, (3) pp. 104, 223, (7) p. 193.

Y

YEAST. Limited laboratory tests indicated that 1100 alloy was resistant to yeast at ambient temperature and 32°C (90°F). Production of yeast has been carried out in aluminum alloy vessels. Aluminum alloy equipment for brewing and distillation of yeast has been used. Yeast has been packaged in aluminum foil. See also Ref: (1) p. 147, (2) p. 889, (3) p. 210, (7) p. 193.

Z

ZINC ACETATE. $Zn(CH_3COO)_2 \cdot 2H_2O$. Alloys 3003 and 5154 were resistant to solid zinc acetate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to dilute (up to 10%) solutions of zinc acetate at ambient temperature. See also Ref: (3) p. 80.

ZINC BORATE. $3\ ZnO \cdot 2\ B_2O_3$. Alloys 3003 and 5154 were resistant to solid zinc borate in laboratory tests under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to dilute (up to 10%) solutions of zinc borate at ambient temperature. See also Ref: (3) p. 80.

ZINC CHLORIDE. $ZnCl_2$. Solid zinc chloride was corrosive to 3003 alloy in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, dilute (up to 10%) solutions of zinc chloride caused mild attack of 1100 alloy (~2 mpy) with evidence of localized pitting at ambient temperature. See also Ref: (1) p. 147, (2) p. 892, (3) p. 79, (7) p. 195.

ZINC CHROMATE. $Zn_2CrO_4(OH)_2 \cdot H_2O$. Alloys 3003 and 5154 were resistant to solid zinc chromate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. Zinc chromate has been used as an inhibitive pigment in organic coatings used on aluminum alloys. See also Ref: (3) p. 80, (4) pp. 95, 139, 141.

ZINC NAPHTHANATE. $Zn(C\text{-}H_{11}O_2)_2$. In laboratory tests, zinc naphthanate preservative treatment did not accelerate attack of aluminum alloys by contacting wet wood.

ZINC NITRATE. $Zn(NO_3)_2 \cdot 6H_2O$. Alloys 3003 and 5154 were resistant to solid zinc nitrate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to dilute aqueous solutions of zinc nitrate at ambient temperature. See also Ref: (1) p. 147, (3) p. 80.

ZINC OXIDE. ZnO. Alloys 3003 and 5154 were resistant to solid zinc oxide in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. See also Ref: (3) p. 79.

ZINC STEARATE. A mixture of the zinc salts of stearic and palmitic acids and usually with some excess of zinc oxide. Alloy 3003 and 5154 were resistant to solid zinc stearate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature.

ZINC SULFATE. $ZnSO_4 \cdot 7\ H_2O$. Alloys 3003 and 5154 were resistant to solid zinc sulfate in laboratory tests conducted under conditions of 100% relative humidity at ambient temperature. In other laboratory tests, 1100 alloy was resistant to aqueous solutions (up to 10%) of zinc sulfate at ambient temperature. See also Ref: (1) p. 147, (2) p. 896, (3) p. 79, (7) p. 195.

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Designations for Wrought Alloy Groups

		Alloy No.
Aluminum—99.00% minimum and greater		1xxx
	Major Alloying Element	
Aluminum alloys grouped by major alloying elements	Copper	2xxx
	Manganese	3xxx
	Silicon	4xxx
	Magnesium	5xxx
	Magnesium and Silicon	6xxx
	Zinc	7xxx
	Other Element	8xxx
	Unused Series	9xxx

Designations for Casting Alloy Groups

		Alloy No.
Aluminum—99.00% minimum and greater		1xx.x
	Major Alloying Element	
Aluminum alloys grouped by major alloying elements	Copper	2xx.x
	Silicon, with added Copper and/or Magnesium	3xx.x
	Silicon	4xx.x
	Magnesium	5xx.x
	Zinc	7xx.x
	Tin	8xx.x
	Other Element	6xx.x
	Unused Series	9xx.x

(continued)

TABLE 5.2: ALUMINUM ALLOYS—ALUMINUM ASSOCIATION (continued)

INHIBITORS

An inhibitor is a substance which, when added (usually in a small amount) to a liquid or chemical, reduces or prevents the corrosion of a metal which would otherwise occur. Some of the common inhibitors for aluminum and the media in which they have been used are:

INHIBITORS ARRANGED ACCORDING TO ENVIRONMENT

Environment	*Inhibitor*
Acid, hydrochloric, 1N	0.003 M aphenylacridine, βnaphthoquinone, thiourea, or 2-phenylquinoline
Acid, hydrochloric, 1 N	Tannic Acid or rosin
Acid, hydrochloric 0.25, 1 N (32F)	0.5 g/l acridine, 1.0 g/l thiourea, or nicotinic acid
Acid, hydrochloric, 2 N	0.06% acridine
Acid, nitric, 2-5%	0.05% hexamethylene tetramine
Acid, nitric, 10%	0.1% hexamethylene tetramine
Acid, nitric, 10%	0.1% alkali chromate
Acid, nitric, 20%	0.5% hexamethylene tetramine
Acid, nitric fuming	0.6% ammonium hexafluorophosphate
Acid, phosphoric, 20%	0.5% sodium chromate
Acid, phosphoric, 20-80%	1.0% sodium chromate
Acid, sulfuric, conc	5.0% sodium chromate
Acid sulfurous	Sodium metasilicate
Acids	Dibenzyl sulfonic acids; phenyl quinoline
Alcohol, anhydrous	Trace of H_2O
Alcohol, (antifreeze) (See also methyl and ethyl)	Sodium nitrite and sodium molybdate
Alkaline solutions (mild)	Sodium disilicate
Alkaline solutions, e.g. sodium carbonate	Agar
Alkaline, soda solutions	Sodium silicofluoride
Alkalies	Sodium chromate
Allyl alcohol	Albumins
Ammonia, condensing steam	H_2S; $CO_2 + H_2S$
Barium hydroxide	Sodium silicate
Brines	Sodium chromate
Bromoform; Chloroform Iodoform	Amines, Butylamine
Calcium chloride, sat.	Alkali silicates; sodium chromate
Carbon tetrachloride	0.2-0.5% formamide
Chlorinated aromatics	0.1-0.2% nitrochlorobenzene
Chlorine water	Sodium silicate
Detergents	Silicates (1%)
Ethanol, commercial	0.03% alkali carbonates, lactates, acetates or borates
Ethanol, hot	Potassium dichromate
Ethyl alcohol or ethylene glycol	1% ($NaNO_2$ + Na molybdate), 1% ($NaNO_2$ + Na tungstate), or 1% ($NaNo_2$ + Na selemate)
Ethyl formate	Aconitic, formic or malonic acids (0.5%)
Ethylene glycol	Sodium tungstate or sodium molybdate; Alkali borates or phosphates; 0.01%-1.0% sodium nitrate
Fruit and milk acids	Albumins, collagen
Glycol-water, 30:70	2% sodium cinnamate + 0.1% sodium tetrasilicate + phosphoric acid to pH = 9.5
Hydrogen peroxide	Alkali metal nitrates; Sodium metasilicate
Hydrogen peroxide, alkaline	Sodium silicate
Latex coagulation	Sodium fluosilicate
Lead paint pigments or lead soaps	Linoleates, laurates or ricinoleates
Methanol or ethylene glycol	0.01-2% benzotriazole + 0.1-2% Na molybdate or ursenate or arsinite + 0.5-2.5% buffer to pH 7.5-10.5
Methyl alcohol	Sodium chlorate + sodium nitrate
Methyl chloride	Water
Pineapple juice	Sugar
Potassium chloride	Sodium chromate
Seawater	0.75% sec. amyl stearate
Soap	Sodium silicate
Sodium acetate	Alkali silicates
Sodium carbonate	Bone glue; vegetable glue; chromate; gelatin; gum arabic
Sodium carbonate, dil	Sodium fluosilicate
Sodium carbonate, 1%	0.25% sodium silicate
Sodium carbonate, 10%	0.05% sodium silicate
Sodium chloride, 3.5%	1% sodium chromate
Sodium cyanide	Sodium metasilicate
Sodium hydroxide, 1%	Alkali silicates
Sodium hydroxide, 1%	3-4% potassium permanganate
Sodium hydroxide, 4%	18% glucose
Sodium hydroxide, 0.3 N (35C)	0.4% tragacanth gum
Sodium hydroxide, 0.5 N	0.2% agar-agar
Sodium hypochlorite contained in bleaches	Sodium silicate
Sodium phosphate, dibasic, tribasic	Sodium silicate
Sodium sulfide	Sulfur
Sodium sulfide	1% sodium metasilicate
Synthetic detergents	Sodium silicate
Trichloroethylene	0.02-0.05% formamide
Water, natural surface	Potassium chromate, dichromate; sodium chromate, dichromate
Water recirculating for air conditioning	0.1% Na_2CrO_4, pH = 7-9, or 0.1% Na metasilicate + 0.1% Na polyphosphate, pH = 8.5-9.5

TABLE 5.3: ALUMINUM BRONZES AND NICKEL-ALUMINUM BRONZES—AMPCO METAL

The AMPCO alloys recommended for process applications are essentially aluminum bronzes and nickel-aluminum bronzes. They can be produced in a wide range of forms—sand, centrifugal and shell mold castings; forgings; rolled sheet and plate; extruded and continuous cast rod, tube and shapes.

Applicability of AMPCO Alloys to Various Chemical Agents

Acetate Solvents (Pure)	R
Crude	R
Acetic Acid	
Crude	R
Vapors	RX
Acetic Anhydride	RX
Acetone	R
Acetylene (Wet)	NR
Alcohols	R
Aluminum Fluoride	RX
Aluminum Sulfate	R
Aluminum Hydroxide	R
Ammonia Gas	
Dry	RX
Wet	NR
Ammonium Chloride	NR
Ammonium Hydroxide	NR
Ammonium Nitrate	NR
Ammonium Phosphate	RX
Ammonium Sulfate	RX
Amyl Chloride	R
Asphalt	R
Barium Chloride	R
Beer	R
Beet Sugar Liquors	R
Benzene or Benzol	R
Borax	R
Boric Acid	R
Brine	R
Butane, Butylene, Butadiene	R
Butyric Acid	R
Calcium Bisulfite	RX
Calcium Hydroxide	RX
Calcium Hypochlorite	RX
Carbon Dioxide	
Dry	R
Wet	RX
Carbon Disulfide	RX
Carbon Tetrachloride	RX
Chlorinated Hydrocarbon	RX
Chlorine	
Dry	RX
Wet	NR
Chloroacetic Acid	RX
Chloroform	RX
Chromic Acid	NR
Citric Acid	R
Copper Sulfate	RX
Corn Starch Slurry	R
Diesel Oil, Light	R
Esters	R
Ethers	R
Ethylene Glycol	R
Ethyl Sulfate	R
Fatty Acids	RX
Ferric Chloride	NR
Ferric Sulfate	NR
Formaldehyde	R
Formic Acid	R
Freon	R
Furfural	R
Gasoline	R
Glucose	R
Glycerine	R
Hydrocarbon Gases	R
Hydrochloric Acid	
to 15%	RX
over 15%	NR
Hydrocyanic Acid	NR
Hydrofluoric Acid	RX
Hydrogen Fluoride (Dry)	R
Hydrogen	R
Hydrogen Sulfide	
Dry	RX
Wet	NR
Hydrogen Peroxide	NR
Ketones	RX
Lacquer and Lacquer Solvents	R
Lactic Acid	R
Magnesium Chloride	R
Magnesium Hydroxide	R
Magnesium Sulfate	R
Malt Beverages	R
Mercuric Chloride	NR
Mine Water (Sulfate)	RX
Molasses	R
Monochlorobenzene	RX
Naptha	RX
Natural Gas	R
Nickel Chloride	RX
Nickel Sulfate	RX
Nitric Acid	NR
Nitrogen (Dry)	R
Oleic Acid	R
Oxygen	RX
Paint Vehicles	
(except Soya-Oil)	RX
Palmitic Acid	RX
Petroleum Oils	
Sour	RX
Refined	R
Phenol	RX
Phosphoric Acid	RX
Pickling Acid	
(except Nitric Chromic)	R
Potassium Chloride	R
Potassium Cyanide	NR
Potassium Hydroxide	R
Potassium Sulfate	R
Propane	R
Shellac	R
Soaps	R
Soda Ash	
(Sodium Carbonate)	RX
Sodium Bicarbonate	R
Sodium Bisulfate	RX
Sodium Chloride	R
Sodium Cyanide	NR
Sodium Hydroxide	R
Sodium Nitrate	RX
Sodium Perborate	RX
Sodium Peroxide	NR
Sodium Phosphate	R
Sodium Silicate	R
Sodium Sulfate	
(Soda Cake)	R
Sodium Sulfide	NR
Sulfur (Molten)	NR
Sulfur Chloride (Wet)	NR
Sulfur Dioxide	
Dry	RX
Wet	NR
Sulfuric Acid (to 50%)	R
Sulfurous Acid	RX
Tannic Acid	R
Tartaric Acid	R
Toluene or Toluol	R
Tri-Chlorethylene	RX
Tri-Sodium Phosphate	RX
Turpentine	R
Varnish	R
Vegetable Oils	R
Water	
Fresh	R
Salt (includes Polluted Harbor)	R
Xylene	R
Zinc Chloride	RX
Zinc Sulfate	RX

These ratings may usually be interpreted as follows:

R — Generally suitable. Corrosion rates less than 2 mpy.
RX — Generally suitable however conditions such as aeration or temperature could restrict their use. Corrosion rates less than 20 mpy.
NR — Generally not suitable. Corrosion rates over 20 mpy.
In evaluating this data, it should be understood that these are results of specific tests and are indicative of those conditions under which the tests were run, thus are a basis for recommendation, but not for guarantee.

CORROSION IN BOILING SULFURIC ACID SOLUTION
No aeration — no agitation except boiling

MATERIAL	AVG. CORROSION RATE, INCHES PER YEAR			
	5% H_2SO_4 102° C (216° F)	10% H_2SO_4 105° C (221° F)	19% H_2SO_4 105° C (221° F)	50% H_2SO_4 123° C (253° F)
	23 hr. tests			20 hr. tests
ALUMINUM BRONZE (10% AL)	0.0019	0.0002	0.0012	0.0079
MONEL 400 ALLOY	0.0034	0.0024	0.0075	0.65
NICKEL 200 ALLOY	0.034	0.12	0.11	3.4
CHEMICAL LEAD	0.016	0.015	0.042	1.2

TABLE 5.4: ALUMINUM COATING–ALCOA

12-YEAR INSPECTION RESULTS OF ATMOSPHERIC EXPOSURE TESTS ON METALLIZED ALUMINUM COATED CARBON STEEL PANELS

PANEL TYPE		1	2	3	4
BASE METAL PREPARATION *		1	1	1	1
ALUMINUM COATING THICKNESS, inches		0.003	0.003	0.003	0.006
TYPE OF SEAL COAT **		None	WP+AV—1	WP+AV—2	None
TEST SITE LOCATION	ENVIRONMENT				
BRAZOS RIVER, TEXAS	SALT-AIR	Base metal not attacked. Sprayed metal intact but shows a very faint yellow gray stain on front of panels, with a very light gray stain and white rust on back.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat on front of panels shows dull gray blotches. Vinyl seal coat on back of panels is unaffected.	Same as Type 2.	Same as Type 1.
COLUMBUS, OHIO	URBAN	Base metal not attacked. Sprayed metal on front of panels shows many pinpoint nodes and a general dark gray deposit stain. Back of panels show a general dark gray stain.	Base metal not attacked. Sprayed metal intact. The vinyl seal coat shows a thin dark gray deposit stain on both the front and back of panels.	Base metal not attacked. Sprayed metal and vinyl seal coat unaffected on both front and back of panels.	Base metal not attacked. Sprayed metal on front and back of panels shows many pinpoint nodes and a general dark gray deposit stain.
EAST CHICAGO, INDIANA	INDUSTRIAL	Base metal not attacked. Sprayed metal on front of panels shows many pinpoint nodes and a general dark gray deposit stain. Back of panels show a dark gray deposit stain.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat on front of panels shows a general dark deposit stain. Back shows a thin deposit stain.	Same as Type 2.	Base metal not attacked. Sprayed metal on both front and back of panels shows many pinpoint nodes and a thick dark deposit stain.
KURE BEACH, NORTH CAROLINA (80-ft lot)	SEVERE MARINE	Base metal not attacked. Sprayed metal on front of panels shows dull blotches. Back of panels are less blotchy. Both sides show some low unbroken blisters.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat shows dull gray spots on front of panels. Seal coat on back of panels unaffected.	Same as Type 2.	Same as Type 1.
KURE BEACH, NORTH CAROLINA (800-ft lot)	SALT-AIR	Base metal not attacked. Sprayed metal on front of panels intact. Sprayed metal on back shows small to medium red rust stains.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat shows dull gray blotches on front side. Seal coat on back unaffected.	Same as Type 2.	Base metal not attacked. Sprayed metal on front and back of panels intact.
NEW YORK CITY AREA	INDUSTRIAL	Base metal not attacked. Sprayed metal on front of panels shows many pinpoint nodes and a general gray deposit stain. Sprayed metal on back intact.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat on front of panels is spotted with medium sized gray deposit stains. Seal coat on back unaffected.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat unaffected.	Base metal not attacked. Sprayed metal on front of panels shows many pinpoint nodes and general gray deposit stain. Sprayed metal on back of panels shows gray deposit stains.
POINT REYES, CALIFORNIA	SALT-AIR	Base metal not attacked. Sprayed metal on front of panels shows a general very light green stain over 10-25% of the surface, mostly near the edges.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat on front of panels shows light gray blotches. Seal coat on back unaffected.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat unaffected.	Same as Type 1.

* *Types of base metal preparation*

1. Coarse silica sand
2. Coarse silica and steel flash

** *Types of seal coat*

WP — Wash primer
AV — Aluminum vinyl
— 1 — One coat of specified seal coat
— 2 — Two coats of specified seal coat

(continued)

TABLE 5.4: ALUMINUM COATING–ALCOA **(continued)**

12-YEAR INSPECTION RESULTS OF ATMOSPHERIC EXPOSURE TESTS ON METALLIZED ALUMINUM COATED CARBON STEEL PANELS (cont'd)

PANEL TYPE		5	6	7	8
BASE METAL PREPARATION *		1	1	1	1
ALUMINUM COATING THICKNESS, inches		0.006	0.006	0.009	0.009
TYPE OF SEAL COAT **		WP+AV—1	WP+AV—2	None	WP+AV—1
TEST SITE LOCATION	ENVIRONMENT				
BRAZOS RIVER, TEXAS	SALT-AIR	Same as Type 2.	Same as Type 2.	Same as Type 1.	Same as Type 2.
COLUMBUS, OHIO	URBAN	Base metal not attacked. Sprayed metal intact. Vinyl seal coat shows a thin deposit stain on front of panels. Seal coat on back of panels is unaffected.	Same as Type 5.	Same as Type 4.	Same as Type 2.
EAST CHICAGO, INDIANA	INDUSTRIAL	Same as Type 2.	Same as Type 2.	Same as Type 4.	Same as Type 2.
KURE BEACH, NORTH CAROLINA (80-ft lot)	SEVERE MARINE	Same as Type 2.	Same as Type 2.	Same as Type 1.	Same as Type 2.
KURE BEACH, NORTH CAROLINA (800-ft lot)	SALT-AIR	Same as Type 2.	Same as Type 2.	Same as Type 4.	Same as Type 2.
NEW YORK CITY AREA	INDUSTRIAL	Base metal not attacked. Sprayed metal intact. Vinyl seal coat on front of panels shows a very light gray deposit stain. Seal coat on back of panels unaffected.	Same as Type 2.	Same as Type 4.	Same as Type 5.
POINT REYES, CALIFORNIA	SALT-AIR	Same as Type 2.	Same as Type 2.	Same as Type 1.	Same as Type 2.

* *Types of base metal preparation*

1. Coarse silica sand
2. Coarse silica and steel flash

** *Types of seal coat*

WP — Wash primer
AV — Aluminum vinyl
– 1 — One coat of specified seal coat
– 2 — Two coats of specified seal coat

(continued)

TABLE 5.4: ALUMINUM COATING–ALCOA **(continued)**

12-YEAR INSPECTION RESULTS OF ATMOSPHERIC EXPOSURE TESTS ON METALLIZED ALUMINUM COATED CARBON STEEL PANELS (cont'd)

PANEL TYPE		9	10	11	12	13
BASE METAL PREPARATION *		1	2	2	2	2
ALUMINUM COATING THICKNESS, inches		0.009	0.012	0.012	0.012	0.015
TYPE OF SEAL COAT **		WP+AV—2	None	WP+AV—1	WP+AV—2	None
TEST SITE LOCATION	ENVIRONMENT					
BRAZOS RIVER, TEXAS	SALT-AIR	Same as Type 2.	Same as Type 1.	Same as Type 2.	Same as Type 2.	Same as Type 1.
COLUMBUS, OHIO	URBAN	Same as Type 5.	Same as Type 4.	Not Tested	Not Tested	Not Tested
EAST CHICAGO, INDIANA	INDUSTRIAL	Same as Type 2.	Same as Type 4.	Not Tested	Not Tested	Not Tested
KURE BEACH, NORTH CAROLINA (80-ft lot)	SEVERE MARINE	Same as Type 2.	Same as Type 1.	Same as Type 2.	Same as Type 2.	Same as Type 1.
KURE BEACH, NORTH CAROLINA (800-ft lot)	SALT-AIR	Same as Type 2.	Same as Type 4.	Same as Type 2.	Same as Type 2.	Same as Type 4.
NEW YORK CITY AREA	INDUSTRIAL	Same as Type 2.	Same as Type 4.	Not Tested	Not Tested	Not Tested
POINT REYES, CALIFORNIA	SALT-AIR	Same as Type 2.	Base metal not attacked. Sprayed metal on front of panels shows a light green stain. Sprayed metal on back of panels shows a light gray-green stain over 30-35% of the surface.	Same as Type 2.	Same as Type 2.	Same as Type 10.

* *Types of base metal preparation*

1. Coarse silica sand
2. Coarse silica and steel flash

** *Types of seal coat*

WP — Wash primer
AV — Aluminum vinyl
– 1 — One coat of specified seal coat
– 2 — Two coats of specified seal coat

(continued)

TABLE 5.4: ALUMINUM COATING–ALCOA (continued)

12-YEAR INSPECTION RESULTS OF SEA WATER EXPOSURE TESTS ON METALLIZED ALUMINUM COATED CARBON STEEL PANELS

PANEL TYPE		1	2	3	4
BASE METAL PREPARATION *		2	2	2	2
ALUMINUM COATING THICKNESS, inches		0.003	0.003	0.006	0.006
TYPE OF SEAL COAT **		WP+CV—1	WP+CV—2	None	WP+CV—1
TEST SITE	ENVIRONMENT				
FREEPORT, TEXAS	TOTAL IMMERSION	Base metal shows red rust on 3-5% of the front and back of panels. Sprayed metal and vinyl seal coat dissipated in these same areas. Edges have been damaged mechanically.	Panels missing.	Base metal not attacked. Sprayed metal on front and back of panels shows a few small scattered blisters and red rust stains. Edges have been damaged mechanically.	Base metal not attacked. Sprayed metal intact on both sides. Vinyl seal coat unaffected on both sides. Edges have been damaged mechanically.
WRIGHTSVILLE BEACH, NORTH CAROLINA (below-low-tide)	TOTAL IMMERSION	Base metal not attacked. Sprayed metal shows a few small, unbroken blisters on both sides of panels. Vinyl sealer dissipated.	Same as Type 1.	Base metal not attacked. Sprayed metal shows a few medium, unbroken blisters on both sides of panels.	Same as Type 1.
WRIGHTSVILLE BEACH, NORTH CAROLINA (mean-tide)	ALTERNATE EXPOSURE TO ATMOSPHERE AND SEA WATER	Base metal not attacked. Sprayed metal intact. Vinyl seal coat dissipated.	Same as Type 1.	Base metal not attacked. Sprayed metal shows a few, unbroken blisters. Two blisters have broken open, but no corrosion of the base metal is apparent.	Same as Type 1.

PANEL TYPE		5	6	7	8
BASE METAL PREPARATION *		2	2	2	2
ALUMINUM COATING THICKNESS, inches		0.006	0.009	0.009	0.009
TYPE OF SEAL COAT **		WP+CV—2	None	WP+CV—1	WP+CV—2
TEST SITE	ENVIRONMENT				
FREEPORT, TEXAS	TOTAL IMMERSION	Same as Type 4.	Base metal not attacked. Sprayed metal shows a few blisters on both sides of the panels, with several broken open. Faint red rust stains appear on both sides. Edges have been damaged mechanically.	Same as Type 4.	Base metal not attacked. Sprayed metal shows a few small blisters on both sides of panels. Two spots show white rust. Edges have been damaged mechanically.
WRIGHTSVILLE BEACH, NORTH CAROLINA (below-low-tide)	TOTAL IMMERSION	Same as Type 1.	Same as Type 3.	Same as Type 1.	Same as Type 1.
WRIGHTSVILLE BEACH, NORTH CAROLINA (mean-tide)	ALTERNATE EXPOSURE TO ATMOSPHERE AND SEA WATER	Same as Type 1.	Base metal not attacked. Sprayed metal shows a few unbroken blisters.	Same as Type 1.	Base metal not attacked. Sprayed metal shows a few, unbroken blisters. Vinyl seal coat dissipated.

* *Type of base metal preparation*
2. Coarse silica sand and steel flash

** *Types of seal coat*
WP — Wash primer
CV — Clear vinyl
– 1 — One coat of specified seal coat
– 2 — Two coats of specified seal coat

(continued)

TABLE 5.4: ALUMINUM COATING–ALCOA (continued)

12-YEAR INSPECTION RESULTS OF SEA WATER EXPOSURE
TESTS ON METALLIZED ALUMINUM COATED CARBON STEEL PANELS (cont'd)

PANEL TYPE		9	10	11	12	13
BASE METAL PREPARATION *		2	2	2	2	2
ALUMINUM COATING THICKNESS, inches		0.012	0.012	0.012	0.015	0.018
TYPE OF SEAL COAT **		None	WP+CV—1	WP+CV—2	None	None
TEST SITE	ENVIRONMENT					
FREEPORT, TEXAS	TOTAL IMMERSION	Same as Type 6.	Same as Type 8.	Same as Type 4.	Same as Type 6.	Same as Type 6.
WRIGHTSVILLE BEACH, NORTH CAROLINA (below-low-tide)	TOTAL IMMERSION	Same as Type 3.	Same as Type 1.	Same as Type 1.	Same as Type 3.	Same as Type 3.
WRIGHTSVILLE BEACH, NORTH CAROLINA (mean-tide)	ALTERNATE EXPOSURE TO ATMOSPHERE AND SEA WATER	Same as Type 3.	Same as Type 1.	Same as Type 1.	Same as Type 3.	Same as Type 3.

* *Type of base metal preparation*
2. Coarse silica sand and steel flash

** *Types of seal coat*
WP — Wash primer
CV — Clear vinyl
–1 — One coat of specified seal coat
–2 — Two coats of specified seal coat

COMPOSITION AND DESCRIPTION OF SEAL COATS

Seal Coat	Composition		Description
Wash Primer	Resin component:		An air drying, two-part, acid-zinc chromate wash coat primer
	Pigment: Insoluble type, inert, zinc chromate	8.2%	
	Nonvolatile vehicle: Polyvinyl butyral	9.5%	
	Volatile vehicle: Butyl and isopropyl alcohol	82.3%	
	Acid component:		
	Phosphoric acid	16.0%	
	Ethyl (or isopropyl) alcohol plus water	Balance	
Mix four parts of the resin component with one part of the acid component to obtain final primer composition.			
Aluminum Vinyl	Pigment: Non-leafing aluminum flake	10%	A vinyl copolymer aluminum flakes, air-drying type of coating material
	Nonvolatile vehicle: Vinyl copolymer and plasticizer	20%	
	Volatile vehicle: Toluene and ketones	70%	
Clear Vinyl	Pigment: None		A clear, vinyl copolymer, air-drying coating material
	Nonvolatile vehicle: Vinyl chloride-acetate		
	Resin	16%	
	Plasticizer	1.4%	
	Volatile vehicle: Ketones	37.6%	
	Aromatic hydrocarbons (Toluene, benzol, xylol)	45.0%	

TABLE 5.5: ALUMINUM-ZINC COATING—BETHLEHEM STEEL

GALVALUME is the trade name for a patented sheet steel product having a coating of corrosion-resistant aluminum-zinc alloy applied by a continuous hot dipping process. The alloy coating of aluminum and zinc combines the best properties of both metals. It has the corrosion resistance, high-temperature oxidation resistance, and heat reflectivity characteristic of aluminum coatings, with the formability and galvanic protection of cut edges characteristic of zinc coatings. GALVALUME sheet, both bare and painted, is intended for applications where superior corrosion resistance is required, as in roofing, siding, pre-engineered buildings, appliances, air conditioner housings, and other uses. GALVALUME sheet is also used for applications where resistance to oxidation at elevated temperatures is important, such as fireplaces, toasters and automotive exhaust systems.

Atmospheric Corrosion Resistance: Based on 13-year atmospheric test results (see Figure 1), it is estimated that GALVALUME sheet will outlast galvanized by two to four times in marine, industrial and rural atmospheres. When compared to aluminum coated sheet steel, GALVALUME sheet has superior corrosion resistance at sheared edges.

Salt Spray Corrosion Resistance: With cut edges protected, the coating on GALVALUME sheet steel lasts five to ten times longer than the coating on galvanized (see Figure 2). In salt spray tests conducted with bare cut edges exposed, the corrosion resistance is typically three to four times that of galvanized (see Figure 2).

CORROSION LOSSES OF GALVALUME AND GALVANIZED SHEETS AFTER 13 YEARS' EXPOSURE IN THE ATMOSPHERE.

(AVERAGE TOP & BOTTOM SURFACES)

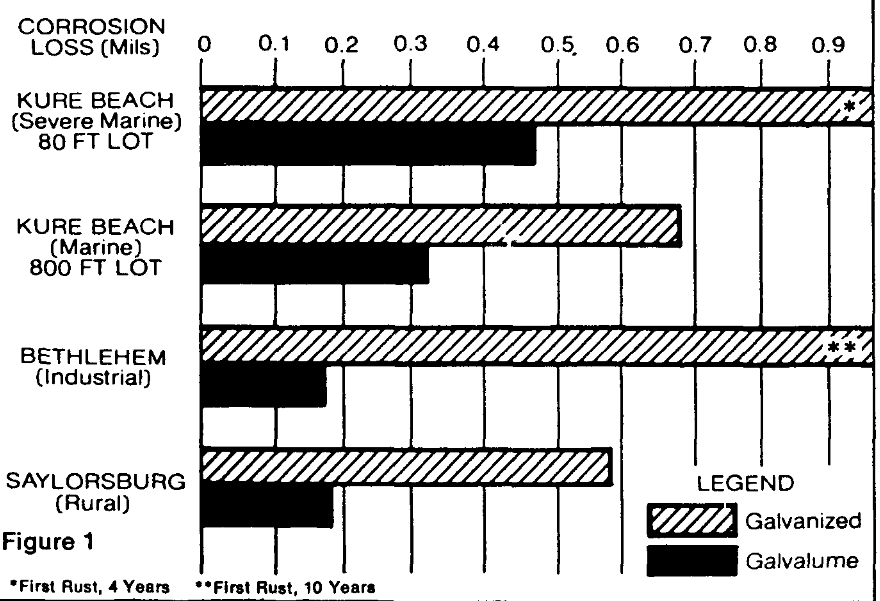


Figure 1

*First Rust, 4 Years **First Rust, 10 Years

HOURS OF EXPOSURE TO FIRST SIGNIFICANT RUST

ASTM B117 Salt Fog Test

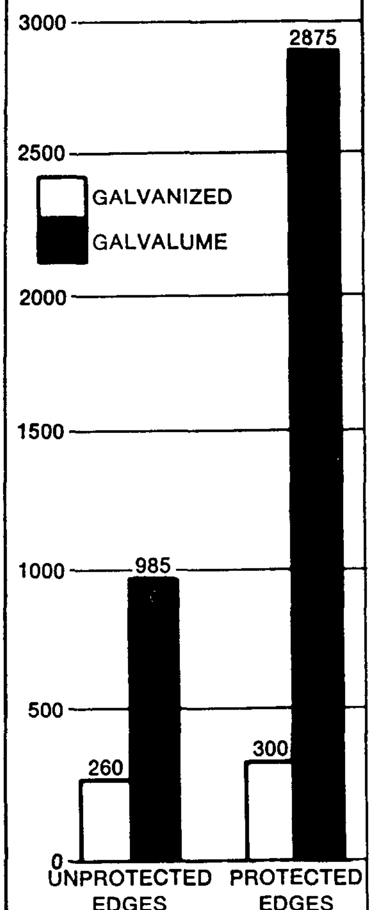


Figure 2

TABLE 5.6: BERYLLIUM COPPER ALLOY–BRUSH WELLMAN

Beryllium copper is the material of choice in an array of designs demanding corrosion resistance. From instrument springs and bellows exposed to hostile atmospheres, to bushings and tubular products used in harsh oil field environments, beryllium copper alloys are selected to solve corrosion problems. In combination with corrosion resistance, beryllium copper alloys are considered nonmagnetic and offer high electrical and thermal conductivity with high strength.

BRUSH ALLOY 25, a heat-treatable beryllium copper product contains 1.80 to 2.00% beryllium. BRUSH ALLOY 25 is resistant to hydrogen embrittlement, and not susceptible to either sulfide stress cracking or chloride stress cracking. Moreover, in marine and certain industrial environments this alloy outperforms stainless steel, titanium, and most copper based alloys. Beryllium copper is available in a wide range of forms, including strip, tube, rod, bar, extrusions, casting and master alloy, and forging billet.

GUIDE TO ROOM TEMPERATURE USE OF BERYLLIUM COPPER*

	Acceptable	Not Recommended
Atmosphere	Industrial Marine Rural	
Water	Fresh Brine Softened Sewage Soil	
Gas (dry)	Chlorine Oxygen/Ozone Carbon Dioxide Sulfur Dioxide Ammonia Fuel Gases	Acetylene
Organic Compounds	Alcohols Chlorinated Solvents Fuels Lubricating/Hydraulic oils	Pyridine
Inorganic Chemicals	Non-Oxidizing Acids acetic acid hydrochloric acid dilute sulfuric acid phosphoric acid Alkalies	Ammonium Hydroxide Oxidizing acids/salts chromic acid nitric acid ferric chloride Mercury

*Corrosion can be affected by temperature, concentration, velocity, and the presence of other chemicals.

Corrosion Resistance of Beryllium Copper in Sea Water

TEST MEDIA	Temperature, F	Specimen	Duration	Beryllium Content, Percent	Condition and Heat Treatment	CORROSION RATE *	
						mdd	ipy
Sea water in Long Island Sound	32-70	Strip, 0.050 x 0.625 x 8 in.	10 mos.	0	Phosphorus deoxidized copper	5.6	0.0009
				2.0	AT (quenched from 1470 and aged 3 hr at 570 F)	2.3	0.0004
					HT (quenched from 1470 F, cold rolled and aged 2 hr. at 525 F)	2.3	0.0004
Interrupted alternate immersion in sea water	140	Wire	96 hours	0		46.5	0.0075
				0.91	Not aged	46.5	0.0081
		Strip	96 hours	0		23.3	0.0037
				1.89	Not aged	19.4	0.0034
				2.74	Not aged	3.9	0.0007
				2.99	Not aged	7.8	0.0014
3% NaCl solution	59	Strip, 0.039 x 1.18 x 2.36 in.	7 weeks	0	Annealed ½ hr. at 1020 F	2.3	0.0004
				2.0	A (quenched from 1510 F)	4.3	0.0008
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	3.4	0.0006
				2.5	A (quenched from 1510 F)	2.0	0.0003
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	2.2	0.0004
				3.5	A (quenched from 1510 F)	2.2	0.0004
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	2.3	0.0004
	113	Strip, 0.039 x 1.18 x 2.36 in.	3 weeks	0	Annealed ½ hr. at 1020 F	3.3	0.0005
				1.5	A (quenched from 1510 F)	4.3	0.0008
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	3.2	0.0006
				2.0	A (quenched from 1510 F)	3.6	0.0006
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	3.0	0.0005
				2.5	A (quenched from 1510 F)	2.6	0.0005
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	2.8	0.0005
				3.5	AT (quenched from 1510 F and aged 3 hr. at 660 F)	2.8	0.0005
3% NaCl solution saturated with CuCl	Room	Strip, 0.039 x 1.18 x 2.36 in.	3 weeks	0	Annealed ½ hr. at 1020 F	112.1	0.0180
				1.5	A (quenched from 1510 F)	118.8	0.0207
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	107.3	0.0187
				2.0	A (quenched from 1510 F)	100.2	0.0175
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	78.4	0.0137
				2.5	A (quenched from 1510 F)	150.7	0.0263
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	154.9	0.0270
				3.5	A (quenched from 1510 F)	42.9	0.0075
					AT (quenched from 1510 F and aged 3 hr. at 660 F)	51.5	0.0090
Artificial sea water	68	Cast, 0.394 x 0.394 x 0.394 in.	15 days	0.49	As cast	30	0.0052
				1.00	As cast	6	0.0010
				2.05	As cast	3	0.0005
				5.05	As cast	4	0.0007
				9.96	As cast	4	0.0007
Artificial sea water	Room	Strip	168 hours	0	Electrolytic copper	16.9	0.0029
				2.12	H (cold rolled)	15.7	0.0027
					A (quenched from 1480 F)	14.6	0.0025
					AT (quenched from 1480 F and aged 3 hr. at 570 F)	16.2	0.0028

*mdd = mg/dm^2/day; ipy = in/yr

(continued)

TABLE 5.6: BERYLLIUM COPPER ALLOY—BRUSH WELLMAN (continued)

Effect of Immersion in Sulfuric Acid on 2% Beryllium Copper

TYPE OF TEST	Temperature, F.	Specimen	Duration	Beryllium Content, Percent	Condition and Heat Treatment	CORROSION RATE* mdd	CORROSION RATE* ipy
Alternate immersion in 10% solution, 1½ min. in solution and 1½ min. in air	140	Strip, 0.050 x 0.625 x 8 in.	......	0	Phosphorus deoxidized copper................	3780	0.609
				2.0	AT (quenched from 1470 F and aged 3 hr. at 570 F)	5115	0.892
					HT (quenched from 1470 F, cold rolled and aged 2 hr. at 525 F)	4880	0.852
Interrupted alternate immersion in 10% solution	140	Strip	96 hours	0		1240	0.199
				1.89	Not aged..............	1148	0.198
Continuous immersion in 10% solution	68	Cast, 0.394 x 0.394 x 3.94 in.	24 hours	2.05	As cast................	100	0.0174
Continuous immersion in 5% sulfuric acid	Room	Strip	24 hours	0	Electrolytic copper......	30	0.0052
				2.12	H (cold rolled)..........	25	0.0044
					A (quenched from 1480 F)	24	0.0042
					AT (quenched from 1480 F and aged 3 hr. at 570 F)	27	0.0047
Continuous immersion in 10% solution	Room	Strip	6 hours	2.1	Apparently rolled, annealed and aged	negligible	......
			24 hours	2.1	Same..................	31	0.0054
5% sulfuric acid + 3% potassium dichromate	Room	Strip	6 hours	2.1	Same..................	19,840	3.46
			24 hours	2.1	Same..................	18,600	3.24

*mdd = mg/dm²/day; ipy = in/yr

Influence of Beryllium Content in Varying Concentrations of Sodium Hydroxide

(Loss in mdd)

TEST CONDITIONS	Beryllium Content, Percent	1%	2.5%	4%	5%	7.5%	10%
Continuous immersion for 24 hours at 68 F on cast specimens (not age hardened)	0.49	120	210	...	139	40	30
	1.00	60	200	...	130	61	21
	2.05	70	188	...	121	78	30
	5.05	90	210	...	139	100	21
	9.96	80	118	...	50	20	30
Continuous immersion for 24 hours at room temperature on strip specimens as follows:							
Electrolytic copper................	0	...	...	9.4	...	...	...
Beryllium copper:							
H (cold rolled)..................	2.12	...	...	10.6	...	...	...
A (quenched from 1480 F).........	2.12	...	...	7.7	...	...	...
AT (quenched from 1480 F) and aged 3 hr. at 570 F)........	2.12	...	...	11.6	...	...	...

Effect of Immersion in Hydrochloric on 2% Beryllium Copper

TYPE OF TEST	Temperature, F	Specimen	Duration	Beryllium Content, Percent	Condition and Heat Treatment	CORROSION RATE* mdd	CORROSION RATE* ipy
Alternate immersion, 1½ min. in solution and 1½ min. in air in 10% HCl	70-75	Strip, 0.050 x 0.625 x 8 in.	......	0	Phosphorus deoxidized copper	453	0.073
				2.0	AT (quenched from 1470 F and aged 3 hr. at 570 F)	332	0.058
					HT (quenched from 1470 F, cold rolled, and aged 2 hr. at 525 F)	332	0.058
Interrupted alternate immersion in 10% HCl	140	Strip	96 hours	0		147	0.024
				1.89	Not aged..............	182	0.031
Continuous immersion in 3% HCl	Room	Strip, 0.039 x 1.18 x 2.36 in.	7 days	0	Annealed..............	1079	0.174
				2.0	Annealed..............	568	0.099
			2 days	2.0	A (quenched from 1470 F)	629	0.110
					AT (quenched from 1470 F and aged at 660 F)	707	0.123
				2.5	A (quenched from 1470 F)	400	0.070
					AT (quenched from 1470 F and aged at 660 F)	449	0.078
Continuous immersion in 1% HCl	Room	Strip, 0.039 x 1.18 x 2.36 in.	7 days	2.0	A (quenched from 1470 F)	402	0.070
					AT (quenched from 1470 F and aged at 660 F)	656	0.115
				2.5	A (quenched from 1470 F)	368	0.064
					AT (quenched from 1470 F and aged at 660 F)	585	0.102
Continuous immersion in 1% HCl	68	Cast, 0.394 x 0.394 x 3.94 in.	24 hours	2.05	As cast................	50	0.009
Continuous immersion in 10% HCl	68	Cast, 0.394 x 0.394 x 3.94 in.	24 hours	2.05	As cast................	90	0.016
Continuous immersion in 3.5% HCl	Room	Strip	24 hours	0	Electrolytic copper......	56	0.010
				2.12	H (cold rolled)..........	42	0.007
					A (quenched from 1480 F)	43	0.007
					AT (quenched from 1480 F and aged 3 hr. at 570 F)	45	0.008

*mdd = mg/dm²/day; ipy = in/yr

Influence of Beryllium Content in Varying Concentrations of Acetic Acid

(Loss in mdd)

TEST CONDITIONS	Beryllium Content, Percent	1%	2.5%	5.0%	7.5%	10%
Continuous immersion for 24 hours at 68 F on cast specimens (not age hardened)	0.49	18	20	20	30	40
	1.00	5	20	80	20	30
	2.05	8	20	30	30	40
	5.05	5	30	20	30	20
	9.96	16	20	10	70	10

(continued)

TABLE 5.6: BERYLLIUM COPPER ALLOY—BRUSH WELLMAN (continued)

Influence of Beryllium Content in Varying Concentrations of Ammonium Hydroxide

(Loss in mdd)

TEST CONDITIONS*	Beryllium Content, Percent	CONCENTRATION 1%	2.5%	3.5%	5%	7.5%	10%
Continuous immersion for 24 hours at 68 F on cast specimens (not age hardened)	0.49	910	830	...	660	720	710
	1.00	680	850	...	530	550	530
	2.05	730	540	...	560	550	540
	5.05	540	390	...	820	380	370
	9.96	420	510	...	510	330	290
Continuous immersion for 24 hours at room temperature on strip specimens as follows:[30]							
Electrolytic copper.................	0	...	...	88	...	...	...
Beryllium copper:							
H (cold rolled)...................	2.12	...	...	60	...	...	...
A (quenched from 1480 F).........	2.12	...	...	60	...	...	...
AT (quenched from 1480 F and aged 3 hr. at 570 F).	2.12	...	..	62	...	...	...

Influence of Beryllium Content in Varying Concentrations of Nitric Acid

(Loss in mdd)

TEST CONDITIONS	Composition*	CONCENTRATION 1%	2.5%	3%	5%	6.3%	7.5%	10%
Continuous immersion for 18 days at room temperature on strip specimens, 0.039 x 1.18 x 2.36 in., in annealed condition	100% Cu	...	...	312	...	...	...	...
	1.5% Be	...	...	269	...	...	...	...
	2.0% Be	...	...	285	...	...	...	...
	2.5% Be	...	...	253	...	...	...	...
	3.0% Be	...	...	177	...	...	...	...
	3.5% Be	...	...	251	...	...	...	...
	10% Sn	...	...	215	...	...	...	...
	12% Sn	...	...	253	...	...	...	...
	14% Sn	...	...	189	...	...	...	...
	6% Al	...	...	184	...	...	...	...
	8% Al	...	...	226	...	...	...	...
Continuous immersion for 24 hours at 68 F on cast specimens (not age hardened)	0.49% Be	170	120	...	150	...	170	210
	1.00% Be	90	90	...	90	...	150	110
	2.05% Be	200	150	...	80	...	150	120
	5.05% Be	6500	12,500	...	24,000	...	28,500	31,500
	9.96% Be	13,500	40,000	...	71,500	...	94,500	94,500
Continuous immersion for 24 hours at 68 F on drawn specimens, 0.32 in. diam. x 0.60 in. long (not age hardened)	100% Cu	170	270	...	1070	...	750	500
	2.3% Be	190	370	...	500	...	1210	1320
	10% Al	3410	8530	...	8170	...	11,580	11,050
Continuous immersion for 24 hours at room temperature on strip specimens as follows:								
Electrolytic copper............	10% Cu	...	...	...	...	1695	...	...
Beryllium copper:								
H (cold rolled).............	2.12% Be	...	...	...	...	1681	...	...
A (quenched from 1480 F)...	2.12% Be	...	...	...	...	1748	...	...
AT (quenched from 1480 F and aged 3 hr. at 570 F).	2.12% Be	...	...	...	...	1928	.	...

* Balance copper.

Corrosion Rates in Phosphoric Acid and Vapor Containing Phosphoric Acid

MATERIAL TESTED	Corrosion Rate Units	3-14% H_3PO_4 Containing Small Quantity of Fluorine Compounds At 150 F	70-80% H_3PO_4 Containing Small Quantity of Fluorine Compounds At 185-212 F	70-80% H_3PO_4 (Dripping) Containing Small Quantities of Fluorine Compounds in a Mist of H_3PO_4 At 203-230 F	75-80% H_3PO_4 At 167 F	85-95% H_3PO_4 (Dripping) Containing Small Quantities of Fluorine Compounds in a Mist of H_3PO_4 At 212-239 F	85-95% H_3PO_4 Containing a Small Amount of Fluorine Compounds At 165-185 F	Elemental Phosphorus in Storage At 149-158 F	Vapor Containing a Small Quantity of H_3PO_4 as a Mist and Traces of Fluorine Compounds At 185-212 F
Beryllium Copper.....	mdd	12.6	50.2	3368	37.7	354	36.5	6.8	263
(2.02 Be, 0.21 Ni)...	ipy	0.0022	0.0088	0.5900	0.0066	0.0620	0.0064	0.0012	0.0460
Phosphor Bronze-C...	mdd	11.1	68.1	4950	40.8	693	52.0	6.8	538
(8% Sn)..........	ipy	0.0018	0.0110	0.8000	0.0066	0.1120	0.0084	0.0011	0.0870
Copper.............	mdd	5.6	83.9	4039	62.1	515	136.8	7.5	398
(99.9% Cu)........	ipy	0.0009	0.0135	0.6500	0.0100	0.0830	0.0220	0.0012	0.0640
Aluminum Bronze	mdd	....	....	....	1451	....	....	....	1709
(5% Al)..........	ipy	....	....	....	0.2550	....	....	....	0.3000
High Brass..........	mdd	25.9	142	578	106	802	118	4.1	318
(35% Zn)..........	ipy	0.0044	0.0240	0.980	0.0180	0.1360	0.0200	0.0007	0.0540
Cupro-Nickel.........	mdd	17.3	48.4	4378	148	272	43.2	5.6	272
(20% Ni, 5% Zn)...	ipy	0.0028	0.0080	0.7100	0.0240	0.0440	0.0070	0.0009	0.0440
Silicon Bronze........	mdd	29.7	41.6	416	32.1	262	32.7	7.1	190
(3.1% Si, 1.1% Mn)	ipy	0.0050	0.0070	0.0700	0.0054	0.0440	0.0055	0.0012	0.0320
Monel...............	mdd	17.2	369	....	148	461	86.1	4.9	274
(2.9% Cu).........	ipy	0.0028	0.0600	....	0.0240	0.0750	0.0140	0.0008	0.0445
Mild Steel..........	mdd	170	Excessive	....	18,720	....	45,500	21.9	197
(0.24% C).........	ipy	0.0310	Excessive	....	3.4200	....	8.3100	0.0040	0.0360

(continued)

TABLE 5.6: BERYLLIUM COPPER ALLOY—BRUSH WELLMAN (continued)

Corrosion Resistance of Beryllium Copper Summarized

Approximate Service Ratings (see note)

Good	Limited	Poor
Acetic acid, 0.1% (RT)	Acetic acid, 2.5-10% (RT)	Aluminum, molten
Alcohols	Bromine, moist (RT)	Ammonia, moist
Alum	Chlorine, moist (RT)	Ammonium hydroxide
Ammonia, dry	Fluorine, moist (RT)	Bismuth, molten
Atmosphere, rural	Hydrochloric acid, 0-5% (RT)	Bismuth-lead eutectic, molten
marine	Mercury (200-700 F)	Bromine, moist (ET)
industrial	Mine water	Cadmium, molten
Boric acid	Phosphoric acid, 3-95% (RT-212 F)	Chlorine, moist (ET)
Brines	Sea water (140 F)	Chromic acid
Bromine, dry	Sodium chloride, 3% + copper chloride	Ferric chloride
Calcium chloride	Sodium hydroxide, 1-10% (RT)	Fluorine, moist (ET)
Carbon dioxide, dry or moist	Sulfur dioxide, moist	Gallium, molten
Carbon tetrachloride	Sulfuric acid, 0-10% (RT)	Hydrochloric acid, 10% (140 F)
Chloride, dry	Zinc, molten	Hydrochloric acid, over 5% (RT)
Citric acid		Hydrogen sulfide, moist
Fluorine, dry		Indium, molten
Freon		Lead, molten
Fresh water		Lithium, molten
Gasoline		Nitric acid
Hydrocarbons		Sulfuric acid, 10% (140 F)
Hydrogen sulfide, dry		Sulfuric acid, 5% + potassium dichromate, 3%
Ketones		Thallium molten
Mercury (RT-200 F)		Tin, molten
Oxalic acid		
Phosphorus (150 F)		
Potassium, molten (up to 1112 F)		
Sea water (RT)		
Sodium chloride		
Sodium, molten (up to 1112 F)		
Sodium-potassium alloys, molten (up to 1112 F)		
Steam		
Sulfur dioxide, dry		
Tannic acid		
Trichlorethylene		

RT—room temperature ET—elevated temperature

Note: These ratings, based upon laboratory and field tests, are offered only as a guide, since corrosion rates are affected by agitation, temperature, aeration, concentrations, etc. Ratings based upon laboratory tests have the following significance:

Rating	Rate of attack, ipy
Good	less than 0.001
Limited	0.001 to 0.010
Poor	more than 0.010

CHEMICAL COMPOSITION

Brush Alloy No.	Copper No.	Beryllium %	Cobalt %	Lead %	Cobalt + Nickel %	Cobalt + Nickel + Iron %	Silver %	Copper
25 190	C 172	1.80-2.00	-	-	0.20 Min.	0.6 Max.	-	Balance
M25	C 173	1.80-2.00	-	0.20-0.6	0.20 Min.	0.6 Max.	-	Balance
165	C 170	1.60-1.79	-	-	0.20 Min.	0.6 Max.	-	Balance
10	C 175	0.40-0.7	2.4-2.7	-	-	-	-	Balance
50	C 176	0.25-0.50	1.4-1.7	-	-	-	0.90-1	Balance

*Trace elements may exist in these alloys; however they do not exceed 0.5% in total.

TABLE 5.7: COBALT-BASE ALLOYS—CABOT STELLITE

Cobalt-Base Alloys	Forms	Nominal Chemical Composition, Weight Percent Cr	W	C	Ni	Mo	Fe	Si	B	Others
Co-Cr-W-C Type										
STELLITE alloy No. 1	**A,B,F**	30	12	2.5						
STELLITE alloy No. 4	**A**	33	14	1.0						
STELLITE alloy No. 6	**All**	28	4	1.1						
STELLITE alloy No. 12	**All**	29	8	1.3						
STELLITE alloy No. 20	**A,F**	32	17	2.5						
Co-Cr-W/Mo-Ni/Fe-C Type										
STELLITE alloy No. 21	**A,B,C,F,G**	27		0.2	2.8	5				
STELLITE alloy No. 238	**B**	26		0.1		3	20			
STELLITE alloy No. 306	**C**	25	1.5	0.5	6		5	1		5Nb, 1Mn
STELLITE alloy No. 694	**G**	28	19	0.9	5					1 V
STELLITE alloy No. 2006	**A,B,F**	31		1.3	8	8	18	1		
STELLITE alloy No. 2012	**A,B,F**	33		1.7	8	10	15	1.5		
STELLITE alloy F	**A,F**	25	12	2.0	22					

Code:

A—Bare Cast Rod
B—Covered Electrodes
C—Tube Wire—(Sub-Arc)
D—Tube Wire—(Open Arc)
E—Tube Wire (Gas Metal Arc)
F—Powder
G—Solid Wire

Comparative Corrosion Data*

Alloy	**Media** / **Concentration and Temperature**	Gas Tungsten Arc Deposits: Acetic Acid 30% Boiling	Formic Acid 80% Boiling	Nitric Acid 65%,150°F (66°C)	Phosphoric Acid 50%,150°F (66°C)	Sulfuric Acid 5%,150°F (66°C)
STELLITE alloy No. 1		G	—	S	E	E
STELLITE alloy No. 4		E	—	E	E	E
STELLITE alloy No. 6		E	E	U	E	E
STELLITE alloy No. 12		G	E	E	E	E
STELLITE alloy No. 20		G	—	U	E	U
STELLITE alloy No. 21		E	E	E	E	E
STELLITE alloy No. 238		E	—	E	E	E
STELLITE alloy No. 306		G	—	E	E	S
STELLITE alloy No. 694		E	—	E	E	E
STELLITE alloy No. 2006		E	E	G	E	E
STELLITE alloy No. 2012		E	E	G	E	E
STELLITE alloy F		E	—	U	E	S

*Five 24-hr. test periods. Determined in laboratory tests. It is recommended that samples be tested under actual plant conditions.

Code:

E—Less than 5 mpy (<0.13 mm/y)
G—5 mpy (0.13 mm/y) to 20 mpy (0.51 mm/y)
S—Over 20 mpy (>0.51 mm/y) to 50 mpy (1.27 mm/y)
U—More than 50 mpy (>1.27 mm/y)

TABLE 5.8: COBALT-BASE ALLOY—CABOT WROUGHT PRODUCTS

HAYNES alloy No. 25 is a cobalt-base alloy which combines good formability, wear and corrosion resistance with excellent high-temperature properties to 1900°F (1038°C).

CORROSION RESISTANCE OF HAYNES ALLOY NO. 25

All results are expressed in mils (mm) penetration per year. Acid strengths are given in percent by weight. In some instances, no measurable penetration could be observed. These instances are noted by the word, "Nil." All data are steady-state as calculated from a minimum of five 24 hr test periods.

TYPICAL PENETRATION RATES IN CORROSIVE MEDIA, Mils (mm) Per Year

	ACETIC ACID			CHROMIC ACID			FORMIC ACID					
	10%	50%	99%	2%	10%	20%	10%	20%	30%	40%	60%	89%
Room	Nil	Nil	Nil	Nil	Nil	Nil	Nil	0.1 (<0.01)	—	0.1 (<0.01)	0.1 (<0.01)	0.1 (<0.01)
150 deg. F (66 deg. C)	Nil	Nil	Nil	Nil	5.0 (0.13)	21 (0.53)	Nil	0.1 (<0.01)	—	Nil	Nil	0.1 (<0.01)
Boiling	0.1 (<0.01)	0.1 (<0.01)	Nil	3.0 (0.08)	41 (1.04)	165 (4.19)	8.0 (0.20)	10 (0.25)	—	15 (0.38)	20 (0.51)	6.0 (0.15)

	CUPRIC CHLORIDE					FERRIC CHLORIDE			
	2%	2% + 5% NaCl	5% + 10% NaCl	10%	10% + 10% NaCl	2%	2% + 5% NaCl	5% + 10% NaCl	10%
Room	Nil	—	—	0.2 (<0.01)	—	Nil	—	—	Nil
150 deg. F (66 deg. C)	—	Nil	Nil	—	Nil	—	Nil	Nil	—
Boiling	—	0.1 (<0.01)	0.5 (<0.02)	—	—	—	Nil	—	—

	HYDROCHLORIC ACID								WET CHLORINE
	1%	2%	5%	10%	15%	20%	25%	37%	
Room	0.1 (<0.01)	0.1 (<0.01)	24 (0.61)	25 (0.64)	29 (0.74)	6.0 (0.15)	4.0 (0.10)	2.0 (0.05)	0.1 (<0.01)
150 deg. F (66 deg. C)	Nil	0.1 (<0.01)	474 (12.0)	420 (10.7)	552 (14.0)	268 (6.81)	144 (3.66)	68 (1.73)	—
Boiling	400 (10.2)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	—	—	—

	HYDROCHLORIC — NITRIC ACID MIXTURES	
	11.8% HCl + 13.3% HNO_3 (by weight) 30% vol. 15% vol.	15.2% HCl + 17.2% HNO_3 (by weight) 40% vol. 20% vol.
160 deg. F (71 deg. C)	2.0 (0.05)	15 (0.38)
190 deg. F (88 deg. C)	11 (0.28)	33 (0.84)

	NITRIC ACID							
	10%	20%	30%	40%	50%	60%	65%	70%
Room	Nil	Nil	Nil	Nil	Nil	Nil	—	Nil
150 deg. F (66 deg. C)	Nil	Nil	0.3 (<0.01)	0.5 (<0.02)	0.8 (0.02)	2.0 (0.05)	—	2.0 (0.05)
Boiling	0.5 (<0.02)	2.0 (0.05)	4.0 (0.10)	9.0 (0.23)	18* (0.46)	34* (0.86)	41* (1.04)	46* (1.17)

	PHOSPHORIC ACID				HYDROFLUORIC ACID			SODIUM HYDROXIDE		
	10%	30%	50%	85%	5%	25%	45%	5%	25%	50%
Room	Nil	Nil	Nil	Nil	5.0 (0.13)	12 (0.30)	20 (0.51)	Nil	Nil	Nil
150 deg. F (66 deg. C)	0.1 (<0.01)	Nil	0.1 (<0.01)	0.1 (<0.01)	—	—	—	Nil	Nil	Nil
Boiling	0.2 (<0.01)	2.0 (0.05)	4.0 (0.10)	562 (14.3)	—	—	—	Nil	—	—

	SULFURIC ACID										
	2%	5%	10%	25%	50%	60%	77%	80%	85%	90%	96%
Room	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
150 deg. F (66 deg. C)	Nil	Nil	Nil	11 (0.28)	30 (0.76)	29 (0.74)	55 (1.40)	61 (1.55)	91 (2.31)	123 (3.12)	104 (2.64)
Boiling	49 (1.24)	52 (1.32)	92 (2.34)	203 (5.16)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	735 (18.7)	318 (8.08)

*The rates for the fifth (24-hour) test period, not steady state rates.

TABLE 5.9: COBALT-BASE ALLOYS—WALL COLMONOY

The name "Wallex" designates a line of cobalt-base hard-surfacing alloys. All of them resist corrosion well, but they vary in their ability to resist abrasion and impact, and in the way they can be applied. Wallex alloys would seldom be recommended for protection against corrosion alone. In most cases, they are chosen for their ability to fight the twin hazards of corrosion and abrasion. The specific alloy choice depends on a careful analysis of the extent of the problem presented by each hazard.

Wallex No. 1 and **Wallex No. 6**, containing chromium and tungsten, are virtually unaffected by the most commonly used corrosive chemicals, and by atmospheric corrosion. **Wallex Nos. 40** and **50**, containing chromium and tungsten, but also nickel and boron, are slightly less corrosion-resistant, but have the advantage that they can be produced in powder form for ease and efficiency of application, using the Colmonoy Spraywelder gun (or Fusewelder torch).

CORROSION RESISTANCE OF WALLEX ALLOYS IN VARIOUS MEDIA

Corrosive Media	Concentration	Temp.	PENETRATION RATE: Mils per year Wallex No. 1	Wallex No. 6	Wallex 40 & 50
Acetic Acid	10%	RT	Nil	Nil	Nil
	10%	Boil	Nil	Nil	Nil
	50%	RT	0.2	0.2	NR
	50%	150°F	0.2	0.2	1.0
	50%	Boil	2.0	0.4	NR
Chromic Acid	10%	RT	Nil	Nil	Nil
	10%	150°F	1.0	28.0	NR
	10%	Boil	High	High	NR
Chlorinated Water	Sat.	RT	Nil	High	NR
Cupric Chloride	2%	RT	2.0	0.7	Nil
	10%	RT	0.5	0.5	NR
	10%	Boil	High	High	NR
Ferric Chloride	2%	RT	3.0	2.0	Nil
	10%	RT	1.0	6.0	NR
	10%	Boil	High	High	NR
Ferric Sulphate	10%	RT	Nil	0.5	Nil
	10%	Boil	Nil	1.0	NR
Hydrochloric Acid	2%	RT	9.0	0.1	39.0
	2%	150°F	169.0	120.0	NR
	10%	RT	10.0	9.0	NR
	10%	Boil	High	High	NR
	20%	RT	26.0	16.0	NR
	Conc.	Boil	High	High	NR
Nitric Acid	10%	RT	Nil	Nil	3.0
	10%	Boil	0.1	Nil	NR
	40%	RT	0.1	Nil	NR
	Conc.	RT	0.2	0.1	NR
	Conc.	Boil	High	High	NR
Phosphoric Acid	10%	RT	Nil	Nil	Nil
	10%	150°F	0.2	Nil	Nil
	10%	Boil	0.6	Nil	63.0
	40%	Boil	High	0.1	NR
Sodium Hydroxide	5%	Boil	0.5	Nil	Nil
	10%	Boil	High	2.0	NR
Sulfuric Acid	2%	RT	0.1	0.1	157.0
	2%	150°F	23.0	Nil	NR
	10%	RT	Nil	Nil	NR
	10%	Boil	High	High	NR
	50%	RT	0.2	0.1	NR
	90%	RT	0.3	Nil	NR

NOTES: NR means either *Not Recommended* or *Not Rated* (i.e. unknown).
RT means *Room Temperature.*
Generally, a corrosion rate greater than 3.0 mils per year should call for caution.
Whenever possible, it is advisable to make individual tests on specific applications.

TABLE 5.10: COLUMBIUM—CABOT KBI

Corrosion Resistance of Columbium

S = normally no attack
V = variable, depending on purity
X = not resistant

Columbium has good resistance to many corrosive media, such as sulfuric, nitric, and hydrochloric acids, within certain defined limits. The accompanying table summarizes corrosion resistance of the metal.

The following tests have been conducted with reagent grade chemicals, actual field testing could differ because of impurities. Field testing is highly recommended.

Gases	
Air	230° C (446° F) Reaction begins; 388° C (730° F) Accelerated reaction begins
Nitrogen	300° C (572° F) Reaction begins
Hydrogen	204° C (400° F) Reaction begins
Fluorine	Attacked
Chlorine	200° C (392° F) Reaction begins
Steam	399° C (750° F) Fair resistance
Metals — molten	
Lithium, magnesium, potassium, sodium	982° C (1800° F) maximum
Aluminum	Attacked
Lead	849° C (1560° F) maximum
Mercury	599° C (1110° F) maximum
Bismuth	538° C (1000° F) maximum

Chemical	Temperature 20° C / 68° F	60° C / 140° F	100° C / 212° F
Acetic acid (10%)	S	S	S
Acetic acid (Glac. and anh.)	S	S	S
Acetone	S	S	S
Acetylene	S	S	S
Alcohols (most)	S	S	S
Aliphatic esters			
Aliphatic halogen compounds-chloroform	S	S	S
Alum	S	S	S
Aluminum chloride	S	S	S
Ammonia anhydrous	S	S	S
Ammonium chloride	S	S	S
Amyl acetate and chloride	S	S	S
Aniline and compounds	S	S	S
Aqua regia	V	X	X
Benzoic acid	S	S	S
Boric acid	S	S	S
Brines, saturated	S	S	S
Bromine, moist	S	S	V
Calcium chloride	S	S	S
Carbon disulfide	S	S	S
Carbonic acid	S	S	S
Chlorine, dry	S	S	S
Chlorine, wet	S	S	S
Chlorides of Na, K, Mg	S	S	S
Chromic acid (80%)	S	S	V
Citric acid	S	S	S
Copper salts (most)	S	S	S
Cyclohexane	S	S	S
Detergent, synthetic	S	S	S
Emulsifiers	X	X	X
Ether	S	S	S
Fatty acids (C=C6)	S	S	S
Ferric chloride	S	S	S
Ferric sulfate	S	S	S
Fluorine	X	X	X
Formaldehyde	S	S	S
Formic acid	S	S	S
Glycerine	S	S	S
Glycols	S	S	S
Hexamine	S	S	S
Hydrochloric acid (10%)	S	V	X
Hydrochloric acid (conc.)	V	X	X
Hydrofluoric acid	X	X	X
Hydrogen peroxide	V	X	X
Hydrogen sulfide	S	S	S
Ketones	S	S	S
Lactic acid (100%)	S	S	S
Maleic acid	S	S	S
Mercuric chloride	S	V	V
Naphthalene	S	S	S
Nickel salts	S	S	S
Nitric acid (25%)	S	S	S
Nitric acid (50%)	S	S	V
Nitric acid (95%)	V	V	X
Oils, essential	S	S	S
Oils, mineral	S	S	S
Oils, vegetable and animal	S	S	S
Oxalic acid	X	X	X
Oxygen	S	S	V
Perchloric acid	S	S	S
Phenol	S	S	S
Phosphoric acid (25%)	S	V	X
Phosphoric acid (50%)	S	V	X
Phosphoric acid (95%)	V	V	X
Potassium hydroxide	X	X	X
Pyridine and compounds	S	S	S
Seawater	S	S	S
Silicic acid	S	S	S
Silver nitrate	S	S	S
Sodium carbonate	S	S	S
Sodium hydroxide	X	X	X
Sodium hyprochlorite	X	X	X
Sodium silicate	X	X	X
Sodium sulfide	S	S	S
Starch	S	S	S
Sugar and syrups	S	S	S
Sulfates of Na, K, Mg, Ca	S	S	S
Sulfites of Na, K, Mg, Ca	S	S	S
Sulfonic acids	S	S	S
Sulfur	S	S	S
Sulfur dioxide, dry	S	S	S
Sulfur dioxide, wet	S	S	V
Sulfur trioxide	X	X	X
Sulfuric acid (20%)	S	S	S
Sulfuric acid (50%)	V	X	X
Sulfuric acid (70%)	V	X	X
Sulfuric acid (95%)	X	X	X
Tallow	S	S	S
Tannic acid (10%)	S	S	S
Tartaric acid	S	S	S
Vinegar	S	S	S
Yeast	S	S	S
Zinc chloride	S	S	S

TABLE 5.11: COLUMBIUM–TELEDYNE WAH CHANG ALBANY

Corrosion Data for Columbium in Aqueous Media

Solutions	Concentration (Weight %)	Temperature (°C)	Corrosion Rate mm/y (mpy) <
Acid Solutions			
Hydrochloric Acid	1	boiling	nil
Hydrochloric Acid (aerated)	15	RT-60	nil
Hydrochloric Acid (aerated)	15	100	0.025 (1.0)
Hydrochloric Acid (aerated)	30	35	0.025 (1.0)
Hydrochloric Acid (aerated)	30	60	0.05 (2.0)
Hydrochloric Acid (aerated)	30	100	0.125 (5.0)
Hydrochloric Acid	37	RT	0.025 (1.0)
Hydrochloric Acid	37	60	0.25 (10)
Hydrochloric Acid	37% with Cl_2	60	0.5 (20)
Hydrochloric Acid	10% with 0.1% $FeCl_3$	boiling	0.025 (1.0)
Hydrochloric Acid	10% with 0.6% $FeCl_3$	boiling	0.125 (5.0)
Hydrochloric Acid	10% with 35% $FeCl_2$ and 2% $FeCl_3$	boiling	0.05 (2.0)
Nitric Acid	65	RT	nil
Nitric Acid	70	250	0.025 (1.0)
Phosphoric Acid	60	boiling	0.5 (20)
Phosphoric Acid	85	RT	0.0025 (0.1)
Phosphoric Acid	85	88	0.05 (2.0)
Phosphoric Acid	85	100	0.125 (5.0)
Phosphoric Acid	85	boiling	3.75 (150)
Phosphoric Acid	85% with 4% HNO_3	88	0.025 (1.0)
Phosphoric Acid	40-50% with 5 ppm F^-	boiling	0.25 (10)
Sulfuric Acid	5-40	RT	nil
Sulfuric Acid	98	RT	Embrittle
Sulfuric Acid	10	boiling	0.125 (5.0)
Sulfuric Acid	25	boiling	0.25 (10)
Sulfuric Acid	40	boiling	0.5 (20)
Sulfuric Acid	40% with 2% $FeCl_3$	boiling	0.25 (10)
Sulfuric Acid	60	boiling	1.25 (50)
Sulfuric Acid	60% with 0.1-1% $FeCl_3$	boiling	0.5 (20)
Sulfuric Acid	20% with 7% HCl and 100 ppm F^-	boiling	0.25 (10)
Sulfuric Acid	50% with 20% HNO_3	50-80	nil
Sulfuric Acid	50% with 20% HNO_3	boiling	0.25 (10)
Organic Acid			
Acetic Acid	5-99.7	boiling	nil
Citric Acid	10	boiling	0.025 (1.0)
Formaldehyde	37	boiling	0.0025 (0.1)
Formic Acid	10	boiling	nil
Lactic Acid	10-85	boiling	0.025 (1.0)
Oxalic Acid	10	boiling	1.25 (50)
Tartaric Acid	20	RT-boiling	nil
Trichloroacetic	50	boiling	nil
Trichloroethylene	99	boiling	nil
Alkaline			
NaOH	1-40	RT	0.125 (5.0)
NaOH	1-10	98	Embrittle
KOH	5-40	RT	Embrittle
KOH	1-5	98	Embrittle
NH_4OH		RT	nil
Salts			
$AlCl_3$	25	boiling	0.005 (0.2)
$Al_2(SO_4)_3$	25	boiling	nil
$AlK(SO_4)_2$	10	boiling	nil
$CaCl_2$	70	boiling	nil
$Cu(NO_3)_2$	40	boiling	nil
$FeCl_3$	10	RT-boiling	nil
$HgCl_2$	saturated	boiling	0.0025 (0.1)
K_2CO_3	1-10	RT	0.025 (1.0)
K_2CO_3	10-20	98	Embrittle
K_3PO_4	10	RT	0.025 (1.0)
$MgCl_2$	47	boiling	0.025 (1.0)
$NaCl_2$	saturated and pH = 1	boiling	0.025 (1.0)
Na_2CO_3	10	RT	0.025 (1.0)
Na_2CO_3	10	boiling	0.5 (20)
Na_2HSO_4	40	boiling	0.125 (5.0)
NaOCl	6	50	1.25 (50)
Na_3PO_4	5-10	RT	0.025 (1.0)
Na_3PO_4	2.5	98	Embrittle
NH_2SO_3H	10	boiling	0.025 (1.0)
$NiCl_3$	30	boiling	nil
$ZnCl_2$	40-70	boiling	nil
Miscellaneous			
Bromine	liquid	20	nil
Bromine	vapor	20	0.025 (1.0)
Chrome Plating Solution	25% CrO_3, 12% H_2SO_4 H_2O	92	0.125 (5.0)
Chrome Plating Solution	17% CrO_3, 2% Na_2SiF_6, trace H_2SO_4 H_2O	92	0.125 (5.0)
H_2O_2	30	RT	0.025 (1.0)
H_2O_2	30	boiling	0.5 (20)

TABLE 5.12: COPPER ALLOYS—REVERE

relative corrosion resistance of common copper alloys to various types of environments

ALLOY	Coppers alloys C10100–C15000	Red Brass alloy C23000	Admiralty alloy C44300	Aluminum Brass alloy C68700	Phosphor Bronze alloy C51000	Aluminum Bronze alloy C60800	Silicon Bronze alloy C65500	Muntz Metal alloy C28000	Copper Nickel alloys C70600–C71500	Nickel Silver alloy C75200
CORRODENT										
waters										
Fresh	A	A	A	A	A	A	A	B–C*	A	A
Sea	B	B	B	A	A	A	B	C*	A	A
inorganic salts										
Neutral Salts	A–B	A–B	A–B	A–B	A–B	A–B	A–B	C*	A	A–B
Acid Salts	B–C	B–C	B–C	B–C	B–C	B–C	B–C	D*	B–C	B–C
Alkaline Salts	A–B	A–B	A–B	A–B	A–B	A–B	A–B	C*	A	A
Oxidizing Salts	C–D	C–D	C–D	C–D	C–D	C–D	C–D	D	C–D	C–D
Mercury Salts	D	D	D	D	D	D	D	D	D	D
acids										
Mineral	D	D	D	D	D	D	D	D	D	D
Organic	A–B	B–C	B–C	B–C	A–B	B	B	*C–D	A–B	B–C
organic compounds										
Alcohols, Hydro-carbons, Esters	A	A	A	A	A	A	A	A	A	A
sulfur compounds										
Dry	B	B	A	A	B	B	B	A	B	A
Moist	D	D	C	C	D	D	D	B	C	C
ammonia										
Dry	A	A	A	A	A	A	A	A	A	A
Moist	D	D	D	D	D	D	D	D	C	D
Ammonium Salts	D	D	D	D	D	D	D	D	C	D
atmospheres										
Rural	A	A	A	A	A	A	A	A	A	A
Industrial	A	A	A	A	A	A	A	B*	A	A
Marine	A	A	A	A	A	A	A	B*	A	A

A=Alloys given an "A" rating have a proven history of excellent performance in these environments.
B=Alloys which have a proven history of good corrosion resistance in the specific environment.
*Tends to dezincify; use other alloys.
C=The alloy has fair resistance to the specific environment.
D=The alloy is not suitable for use in this environment.

trade name	uns alloy no.	form	approximate composition, per cent: copper Cu	zinc Zn	lead Pb	nickel Ni	tin Sn	silicon Si	density lb. per cu in.
Oxygen Free (OF) ■	C10200	sheet tube	99.95 □ 99.95 □						0.323
Silver Bearing▲	C11400	sheet rod	99.90 □ 99.90 □	10-15 oz. silver per ton					0.322
Red Brass, 85%	C23000	sheet tube	85.0 85.0	15.0 15.0					0.316
Cartridge Brass, 70%	C26000	sheet rod tube	70.0 70.0 70.0	30.0 30.0 30.0					0.308
Muntz Metal*†	C28000	sheet	60.0	40.0					0.303
Admiralty Metal (Arsenical)	C44300	tube	71.0	28.0	As 0.05		1.0		0.308
Naval Brass	C46400	sheet rod	60.0 60.0	39.25 39.25			0.75 0.75		0.304
Free Cutting Naval Brass	C48500	rod	60.0	37.5	1.75		0.75		0.305
Revalon* (Aluminum Brass)	C68700	tube	76.0	22.0	As 0.05		Al 2.0		0.301
Copper-Nickel, 10%	C70600	sheet	88.5			10.0	Fe 1.5		0.323
Copper-Nickel, 10%	C70600	tube	88.5			10.0	Fe 1.5		0.323
Copper-Nickel, 30%	C71500	sheet tube	70.0 70.0			30.0 30.0	Fe 0.5		0.323
Copper-Nickel Tin Bronze	C72500	sheet	88.2			9.5	2.3		0.321
Nickel Silver, 18% (A)	C75200	sheet	65.0	17.0		18.0			0.316
Herculoy* 420 (Type A)	C65500	sheet	96.0				Mn 1.0	3.0	0.308
Herculoy* 421 (Type B)	C65100	sheet	98.0				Mn 0.25	1.75	0.316
Phosphor Bronze, 5% (A)	C51000	sheet rod	95.0 95.0				5.0 5.0		0.320 0.320
Aluminum Bronze, 5%	C60800	tube	95.0		As 0.035		Al 5.0		0.295

□ Minimum
▲ Alloy numbers C11300, C11500 and C11600 are also available. Properties are approximately the same as shown for Alloy C11400.
*Leaded Muntz Metal, Revere Alloy C36500, containing 0.40-0.90% lead for improved machinability, is supplied for plate applications.
■Available as 99.99% copper—Oxygen-Free Electronic Grade Alloy C10100.

TABLE 5.13: COPPER AND COPPER ALLOYS—ARCO METALS, AMERICAN BRASS

TYPICAL INDUSTRIAL USES OF COPPER AND COPPER ALLOYS

This section is not intended to cover all uses of copper and its alloys but is limited to the listing of a few typical applications where corrosion resistance is important.

BOATS AND SHIPS	Screws and fastenings	EVERDUR 655, EVERDUR 651
	Bolts	TOBIN BRONZE 4641, EVERDUR 655 EVERDUR 651, EVERDUR 637
	Hardware	EVERDUR 655, BRASS, BRONZE, NICKEL SILVER
	Water tanks	COPPER, EVERDUR 655
	Shafts	TOBIN BRONZE 4641, TEMPALOY 630
	Trim	BRASS, NICKEL SILVER
	Piping, Fresh Water	COPPER, RED BRASS
	Piping, Salt Water	ARSENICAL ADMIRALTY, CUPRO NICKEL, 10% 706; 30% 715
	Condenser tubes	ARSENICAL ADMIRALTY, AMBRALOY 687, CUPRO NICKEL, 10% 706; 20% 710; 30% 715
	Tube sheets	LEADED MUNTZ METAL 365, NAVAL BRASS 464, CUPRO NICKEL, 10% 706; 30% 715
BREWERIES	Piping	COPPER, RED BRASS
	Brew kettles	COPPER, EVERDUR 655
	Attemperator coils	COPPER, CUPRO NICKEL, 10% 706
	Lauter tubs	COPPER, EVERDUR 655
	Hot water tanks	COPPER, EVERDUR 655
BUILDING CONSTRUCTION	Roofs	COPPER
	Flashings	COPPER
	Gutters and downspouts	COPPER
	Piping for water, low-pressure steam, refrigeration, air conditioning	COPPER RED BRASS
	Hot water tanks	EVERDUR 655, COPPER, CUPRO NICKEL, 10% 706
	Architectural trim	COPPER, COMMERCIAL BRONZE, RED BRASS, MUNTZ METAL, ARCHITECTURAL BRONZE, NICKEL SILVER
	Hardware	BRASS, BRONZE, NICKEL SILVER
	Wire screens	COPPER, COMMERCIAL BRONZE
DISTILLERIES	Piping	COPPER, RED BRASS
	Mash kettles	COPPER
	Stills	COPPER
	Condensers	COPPER, ARSENICAL ADMIRALTY
GAS INDUSTRY	Service lines	COPPER
	Gas cooler tubes	ARSENICAL ADMIRALTY
OIL REFINERIES	Condenser and heat exchanger tubes	ARSENICAL ADMIRALTY, CUPRO NICKEL, 30% 715; 20% 710 AMBRALOY 687, RED BRASS
	Tube sheets	LEADED MUNTZ METAL 365, NAVAL BRASS 464, CUPRO NICKEL, 30% 715, AMBRALOY 630, AMBRALOY 614
	Electrical conduit	EVERDUR 651
	Baffle plates	MUNTZ METAL, NAVAL BRASS 464
	Pipe and sludge lines	RED BRASS
	Pump liners	RED BRASS
ORGANIC CHEMICALS	Pipe lines	COPPER, RED BRASS
	Condenser and heat exchanger tubes	COPPER, ARSENICAL ADMIRALTY, CUPRO NICKEL, 30% 715; 20% 710
	Tube sheets	LEADED MUNTZ METAL 365, NAVAL BRASS 464, CUPRO NICKEL, 30% 715, AMBRALOY 614
	Stills and evaporators	COPPER, EVERDUR 655
POWER PLANTS	Condenser and heat exchanger tubes	ARSENICAL COPPER, ARSENICAL ADMIRALTY, AMBRALOY 687, CUPRO NICKEL, 10% 706; 20% 710; 30% 715
	Tube sheets	LEADED MUNTZ METAL 365, NAVAL BRASS 464, ARSENICAL ADMIRALTY, CUPRO NICKEL, 10% 706; 30% 715 AMBRALOY 614
	Salt water piping	CUPRO NICKEL, 10% 706; 30% 715
PULP AND PAPER MILLS	Water piping	COPPER, RED BRASS
	Stock lines	COPPER, EVERDUR 655
	Wire for Fourdrinier Screens	BRASS, PHOSPHOR BRONZE
	Slotted screen plates	PHOSPHOR BRONZE, AMBRALOY 612
	Paper machine rolls of various kinds	RED BRASS
	Cylinder rods	PHOSPHOR BRONZE, EVERDUR 655 COMMERCIAL BRONZE
	Winding wire	EVERDUR 651, PHOSPHOR BRONZE 507
SALINE WATER CONVERSION	Tubes for Heat Exchangers and Condensers	ARSENICAL ADMIRALTY, CUPRO NICKEL, 30% 715; 20% 710; 10% 706, AMBRALOY 687
	Tube sheets	LEADED MUNTZ METAL 365, NAVAL BRASS 464, ARSENICAL ADMIRALTY, CUPRO NICKEL, 10% 706; 30% 715, AMBRALOY 614
	Shells	PHOSPHORIZED COPPER 122, EVERDUR 655, CUPRO NICKEL, 10% 706
	Baffles	MUNTZ METAL 280, NAVAL BRASS 464, ARSENICAL ADMIRALTY, CUPRO NICKEL, 10% 706
SALT MANUFACTURE	Tubes for heaters and evaporators	COPPER, ARSENICAL ADMIRALTY, CUPRO NICKEL, 30% 715; 20% 710; 10% 706

(continued)

TABLE 5.13: COPPER AND COPPER ALLOYS—ARCO METALS, AMERICAN BRASS (continued)

SEWAGE TREATMENT PLANTS	**Piping**	COPPER, RED BRASS
	Slotted screens	EVERDUR 655
	Electrical conduit	EVERDUR 651
	Anchor bolts and manhole steps	EVERDUR 655, EVERDUR 651
	Valve and gate stems	EVERDUR 655, AMBRALOY 630, TOBIN BRONZE 4641, LEADED SILICON BRASS 697
	Gates and gate frames	EVERDUR 655
	Weirs	EVERDUR 655
SUGAR PROCESSING	**Evaporator tubes**	COPPER, RED BRASS, ARSENICAL ADMIRALTY, CUPRO NICKEL, 10% 706
	Calandrias, syrup tanks, mixers	EVERDUR 655
	Crystallizing pans	COPPER
	Melting tanks	COPPER
	Heat exchanger tubes	ARSENICAL ADMIRALTY
	Heat exchanger tube sheets	NAVAL BRASS 464
TEXTILES	**Piping**	COPPER, RED BRASS
	Printing rolls	COPPER
	Electrical conduit	EVERDUR 651
WATER WORKS	**Piping**	COPPER, RED BRASS
	Screens and screen frames	EVERDUR 655
	Anchor bolts and manhole steps	EVERDUR 655, EVERDUR 651
	Valve and gate stems	EVERDUR 655, AMBRALOY 630, TOBIN BRONZE 4641, LEADED SILICON BRASS 697

CORROSION RATING CHARTS

A – The metal should be suitable under most conditions of use.

B – The metal offers good corrosion resistance. It may be considered in place of a metal with an "A" rating when some property other than corrosion resistance governs its use.

C – The metal offers fair corrosion resistance.

D – The metal is not suitable.

	COPPER		LOW-ZINC BRASS		HIGH-ZINC BRASS			SPECIAL BRASS			PHOSPHOR BRONZE		ALUMINUM BRONZE	COPPER-SILICON ALLOYS		CUPRO NICKEL		NICKEL SILVER
	ELECTROLYTIC TOUGH PITCH 110	PHOSPHORIZED 122	COMMERCIAL BRONZE 220	RED BRASS 230	CARTRIDGE BRASS 260	ARCHITECTURAL BRONZE 385	MUNTZ METAL 280	TOBIN BRONZE 4641	ARSENICAL ADMIRALTY 443	AMBRALOY-687	PHOSPHOR BRONZE, (A) 510	PHOSPHOR BRONZE (D) 524	AMBRALOY 630	EVERDUR 655	EVERDUR 651	CUPRO NICKEL, 10% 706	CUPRO NICKEL, 30% 715	NICKEL SILVER 18% 752
Acetic Acid	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Acetic Anhydride	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Acetone	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Acetylene*	D	D	D	D	D	A	A	A	D	D	D	D	D	D	D	D	D	D
Alcohols	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Alum	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	A	B
Alumina	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Aluminum Chloride	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Aluminum Hydroxide	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Aluminum Sulfate	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	A	B
Ammonia, absolutely dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ammonia, moist	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	C	D
Ammonium Hydroxide	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	C	D
Ammonium Chloride	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	C	D
Ammonium Nitrate	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	C	D
Ammonium Sulfate	C	C	C	C	D	D	D	D	D	D	C	C	C	C	C	C	B	C
Amyl Acetate	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Amyl Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Aniline	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Aniline Dyes	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Asphalt	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Atmosphere, Industrial	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Atmosphere, Marine	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Atmosphere, Rural	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Barium Carbonate	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Barium Chloride	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Barium Hydroxide	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Barium Sulfate	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Barium Sulfide	C	C	C	C	B	B	B	B	B	B	C	C	C	C	C	C	B	B
Beer**	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Beet Sugar Syrups	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A

(continued)

TABLE 5.13: COPPER AND COPPER ALLOYS—ARCO METALS, AMERICAN BRASS (continued)

	COPPER		LOW-ZINC BRASS		HIGH-ZINC BRASS			SPECIAL BRASS			PHOSPHOR BRONZE		ALUMINUM BRONZE	COPPER-SILICON ALLOYS		CUPRO NICKEL		NICKEL SILVER
	ELECTROLYTIC TOUGH PITCH 110	PHOSPHOR-IZED 122	COMMERCIAL BRONZE 220	RED BRASS 230	CARTRIDGE BRASS 260	ARCHITECTURAL BRONZE 385	MUNTZ METAL 280	TOBIN BRONZE 464	ARSENICAL ADMIRALTY 443	AMBRALOY 687	PHOSPHOR BRONZE, (A) 510	PHOSPHOR BRONZE (D) 524	AMBRALOY 630	EVERDUR 655	EVERDUR 651	CUPRO NICKEL, 10% 706	CUPRO NICKEL, 30% 715	NICKEL SILVER, 18% 752
Benzine	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Benzoic Acid	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Benzol	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Black Liquor, Sulfate Process	C	C	C	C	D	D	D	D	D	C	C	C	C	C	C	C	B	C
Bleaching Powder, Wet	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	B	B
Borax	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Bordeaux Mixture	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Boric Acid	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Brines	B	B	B	B	D	D	D	C	B	B	B	A	B	B	B	A	A	A
Bromine, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Bromine, Moist	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Butane	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Butyl Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Butyric Acid	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Calcium Bisulfite	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	B	B
Calcium Chloride	B	B	B	B	D	D	D	C	B	B	B	A	B	B	B	A	A	A
Calcium Hydroxide	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Calcium Hypochlorite	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	B	B
Cane Sugar Syrups	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Carbolic Acid	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Carbon Dioxide, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Carbon Dioxide, Moist	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	B	B	B
Carbonated Water	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	B	B	B
Carbonated Beverages**	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	B	B	B
Carbon Disulfide	B	B	B	B	A	A	A	A	A	A	B	B	B	B	B	B	B	B
Carbon Tetrachloride, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Carbon Tetrachloride, Moist††	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	A	B
Castor Oil	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Chlorine, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Chlorine, Moist	C	C	C	C	D	D	D	D	C	C	C	C	C	C	C	C	B	C
Chloracetic Acid	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Chloroform, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Chromic Acid	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Cider**	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Citric Acid**	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Coffee**	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Copper Chloride	C	C	C	C	D	D	D	D	C	C	C	C	C	C	C	C	C	C
Copper Nitrate	C	C	C	C	D	D	D	D	C	C	C	C	C	C	C	C	C	C
Copper Sulfate	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	B	B
Corn Oil**	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Cottonseed Oil**	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Creosote	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Crude Oil	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	B	A	B
Ethers	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ethyl Acetate	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Ethyl Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ethyl Chloride	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	B	B	B
Ethylene Glycol	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Ferric Chloride	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Ferric Sulfate	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Ferrous Chloride	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	B	B
Ferrous Sulfate	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	B	B
Formaldehyde	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Formic Acid	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Freon	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Fruit Juices**	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Fuel Oil	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Furfural	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Gasoline	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Gelatine**	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Glucose**	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Glue	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A

(continued)

TABLE 5.13: COPPER AND COPPER ALLOYS—ARCO METALS, AMERICAN BRASS (continued)

	COPPER		LOW-ZINC BRASS		HIGH-ZINC BRASS			SPECIAL BRASS			PHOSPHOR BRONZE		ALUMINUM BRONZE	COPPER-SILICON ALLOYS		CUPRO NICKEL		NICKEL SILVER
	ELECTROLYTIC TOUGH PITCH 110	PHOSPHOR-IZED 122	COMMERCIAL BRONZE 220	RED BRASS 230	CARTRIDGE BRASS 260	ARCHITECTURAL BRONZE 385	MUNTZ METAL 280	TOBIN BRONZE 4641	ARSENICAL ADMIRALTY 443	AMBRALOY 687	PHOSPHOR BRONZE, (A) 510	PHOSPHOR BRONZE (D) 524	AMBRALOY 630	EVERDUR 655	EVERDUR 651	CUPRO NICKEL, 10% 706	CUPRO NICKEL, 30% 715	NICKEL SILVER, 18% 752
Glycerine	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Hydrobromic Acid	C	C	C	C	D	D	D	D	C	C	C	C	C	C	C	C	C	C
Hydrocarbons, Pure	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Hydrochloric Acid	C	C	C	C	D	D	D	D	C	C	C	C	C	C	C	C	C	C
Hydrocyanic Acid	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Hydrofluoric Acid	C	C	C	C	D	D	D	D	D	D	C	C	C	C	C	C	B	C
Hydrofluosilicic Acid	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	B	B
Hydrogen	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Hydrogen Peroxide	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	B	B	B
Hydrogen Sulfide, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Hydrogen Sulfide, Moist	D	D	D	D	C	C	C	C	C	C	D	D	C	D	D	D	C	C
Kerosene	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Lacquers	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Lacquer Solvents	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Lactic Acid**	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Lime	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Lime-Sulfur	C	C	C	C	B	B	B	B	B	B	C	C	C	C	C	C	B	B
Linseed Oil	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Magnesium Chloride	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Magnesium Hydroxide	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Magnesium Sulfate	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Mercury	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Mercury Salts	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Methyl Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Methyl Chloride, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Milk**	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Mine Water	C	C	C	C	D	D	D	D	C	C	C	C	C	C	C	C	C	C
Natural Gas	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Nitric Acid	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Nitrogen	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Oleic Acid	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Oxalic Acid	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Oxygen	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Palmitic Acid	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	B	B	B
Paraffin	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Phosphoric Acid	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Potassium Carbonate	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Potassium Chloride	B	B	B	B	D	D	D	C	B	B	B	A	B	B	B	A	A	A
Potassium Chromate	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Potassium Cyanide	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Potassium Dichromate, Acid	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Potassium Hydroxide	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	A	A	A
Potassium Sulfate	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Propane	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Rosin	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sea Water	B	B	B	B	C	C	C	B	A	A	B	A	A	B	B	A	A	A
Sewage	A	A	A	A	C	C	C	B	A	A	A	A	A	A	A	A	A	A
Silver Salts	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Soap Solutions	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Sodium Bicarbonate	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	A	A	A
Sodium Bisulfate	B	B	B	B	D	D	D	C	B	B	B	B	B	B	B	A	A	A
Sodium Bisulfite	B	B	B	B	D	D	D	C	B	B	B	B	B	B	B	A	A	A
Sodium Carbonate	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Sodium Chloride	B	B	B	B	D	D	D	C	B	B	B	A	B	B	B	A	A	A
Sodium Chromate	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium Cyanide	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Sodium Dichromate, Acid	D	D	D	D	D	D	D	D	D	D	D	D	D	B	D	D	D	D
Sodium Hydroxide	B	B	B	B	C	C	C	C	B	B	B	B	B	D	B	A	A	A
Sodium Hypochlorite	C	C	C	C	D	D	D	D	C	C	C	C	C	C	C	C	B	B
Sodium Nitrate	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	A	A	A

(continued)

TABLE 5.13: COPPER AND COPPER ALLOYS—ARCO METALS, AMERICAN BRASS (continued)

	COPPER: Electrolytic Tough Pitch 110	COPPER: Phosphorized 122	LOW-ZINC BRASS: Commercial Bronze 220	LOW-ZINC BRASS: Red Brass 230	HIGH-ZINC BRASS: Cartridge Brass 260	HIGH-ZINC BRASS: Architectural Bronze 385	HIGH-ZINC BRASS: Muntz Metal 280	SPECIAL BRASS: Tobin Bronze 4641	SPECIAL BRASS: Arsenical Admiralty 443	SPECIAL BRASS: Ambraloy 687	PHOSPHOR BRONZE: Phosphor Bronze, (A) 510	PHOSPHOR BRONZE: Phosphor Bronze (D) 524	ALUMINUM BRONZE: Ambraloy 630	COPPER-SILICON ALLOYS: Everdur 655	COPPER-SILICON ALLOYS: Everdur 651	CUPRO NICKEL: Cupro Nickel, 10% 706	CUPRO NICKEL: Cupro Nickel, 30% 715	NICKEL SILVER: Nickel Silver, 18% 752
Sodium Peroxide	C	C	C	C	D	D	D	D	C	C	C	C	C	C	C	B	B	B
Sodium Phosphate	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Sodium Silicate	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Sodium Sulfate	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Sodium Sulfide	C	C	C	C	B	B	B	B	B	B	C	C	C	C	C	C	B	B
Sodium Sulfite	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	B	B
Sodium Thiosulfate	C	C	C	C	B	B	B	B	B	B	C	C	C	C	C	C	B	B
Steam	A	A	A	A	C	C	C	A	A	A	A	A	A	B	B	A	A	A
Stearic Acid	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	B	B	B
Sugar Solutions	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Sulfur, Dry	B	B	B	B	A	A	A	A	A	B	B	B	B	B	B	B	A	B
Sulfur, Molten	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Sulfur Chloride, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sulfur Dioxide, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sulfur Dioxide, Moist	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	C	C	C
Sulfur Trioxide, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sulfuric Acid††	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Sulfurous Acid	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	C	C	C
Tannic Acid	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Tar	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Tartaric Acid**	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Toluene	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Trichloracetic Acid	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Trichlorethylene, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Trichlorethylene, Moist	B	B	B	B	C	C	C	C	B	B	B	B	B	B	B	B	A	B
Turpentine	A	A	A	A	B	B	B	B	A	A	A	A	A	A	A	A	A	A
Varnish	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Vinegar**	B	B	B	B	D	D	D	D	C	C	B	B	B	B	B	B	B	B
Water, Potable	A	A	A	A	C	C	C	C	A	A	A	A	A	A	A	A	A	A
Zinc Chloride	C	C	C	C	D	D	D	D	C	C	C	C	C	C	C	C	C	C
Zinc Sulfate	B	B	B	B	D	D	D	D	B	B	B	B	B	B	B	B	B	B

*Copper and copper alloys are not attacked by dry gases at room temperature or lower. Acetylene forms an explosive compound with copper when moist and alloys containing more than 65% copper should not be used with the wet gas under pressure. Moist carbon dioxide is corrosive to brasses high in zinc but may be handled by other copper alloys. Tin coatings are highly resistant to moist carbon dioxide. Moist chlorine gas is corrosive to all copper alloys. Sulfur dioxide and sulfur trioxide in the presence of moisture form sulfurous and sulfuric acid, respectively. Copper, Red Brass, Everdur, Phosphor Bronze and Cupro Nickel, 30% 715 should be considered for handling these gases when moist.

**Copper and its alloys are resistant to corrosion by most foods and beverages. However, consideration must be given to the possibility that such products handled in equipment made of copper or its alloys may dissolve traces of copper in amounts sufficient to discolor the product or alter its taste. In such cases it is recommended that the metal be tin-coated.

†Copper alloys are resistant to most organic solvents such as the acetates, alcohols, aldehydes, ketones, petroleum solvents and ether. Organic acids in aqueous solution may be handled by copper and most copper alloys but corrosion will be accelerated if air is present. Binary copper-zinc alloys containing more than 15% zinc may be attacked by dezincification corrosion. Copper alloys may be definitely corroded by chloride hydrocarbons, such as carbon tetrachloride and trichloroethylene, at the boiling point in the presence of moisture unless the hydrocarbons are stabilized by a neutralizer. Of the copper alloys, Cupro Nickel, 30% 715 and tin-coated metal offer the best resistance to moist chloride hydrocarbons.

††Copper and copper alloys are rapidly corroded by oxidizing acids such as nitric and chromic. Corrosion by other acids is generally dependent on the presence of oxygen or some other oxidizing agent in the solution. Brasses containing not more than 15% zinc, and special brasses, can be used with many acids, but, in general, high-zinc brasses should not be used with acids due to the danger of rapid corrosion by dezincification. Copper, Red Brass, Phosphor Bronze, Everdur, Aluminum Bronze and Cupro Nickel offer good resistance to corrosion by hot and cold dilute sulfuric acid and to corrosion by cold concentrated sulfuric acid. Intermediate concentrations of sulfuric acid sometimes are less corrosive to copper alloys than either concentrated acid or dilute acid. Concentrated sulfuric acid may be corrosive at elevated temperatures due to breakdown of the acid with the formation of metallic sulfides and sulfur dioxide gas causing localized pitting attack. Tests indicate that the copper alloys may be corroded by pitting attack by 90 to 95% sulfuric acid at about 122°F (50°C), by 80% acid at about 160°F (71°C) and by 60% acid at about 212°F (100°C).

(continued)

TABLE 5.13: COPPER AND COPPER ALLOYS—ARCO METALS, AMERICAN BRASS (continued)

RATINGS OF ALLOYS LISTED IN BRACKETS ARE IDENTICAL WITH RATINGS OF FOLLOWING LISTINGS IN CHART

Certified OFHC Copper 101
OFHC Copper 102
Boron Deoxidized Copper 109
Silver Bearing Copper 113
Silver Bearing Copper 114
Silver Bearing Copper 116
DLP Copper 120
Phosphorized Copper 122
Phosphorized Arsenical Copper 142
Tellurium Copper 1452
OFHC Sulfur Copper 147
Amzirc (Zirconium Copper) 150
Hitenso 162
Hitenso 1622
Hitenso 165
Chromium Copper 182
Leaded Copper 187
Deoxidized Leaded Copper 1870
Anaconda Copper 189
Gilding 210
Phosphor Bronze 505
Phosphor Bronze 507
Silicon Tin Bronze 5072
Calsun Bronze 607
Leaded Nickel Copper 7021
— **see COPPER**

Commercial Bronze 226
Leaded Commercial Bronze 314
High Strength Commercial Bronze 316
Ambronze 405
Ambronze 413
— **see COMMERCIAL BRONZE 220**

Hardware Bronze 320
Ambronze 422
Ambronze 425
Ambronze 430
Trumpet Brass 435
Silicon Red Brass 6941
Leaded Silicon Brass 6942
— **see RED BRASS 230**

Low Brass 240
Yellow Brass 268
Leaded Tube Brass 330
Leaded Tube Brass 3301
Leaded Tube Brass 331
Free Cutting Tube Brass 332
Low Leaded Brass 335
Medium Leaded Brass 340
High Leaded Brass 342
Manganese Brass 667
— **see CARTRIDGE BRASS 260**

Yellow Brass 274
High Leaded Brass 353
High Leaded Brass 3531
High Leaded Brass 3532
Extra High Leaded Brass 356
Free Cutting Brass 360
Leaded Muntz Metal 365
Free Cutting Muntz Metal 3711
Free Cutting Muntz Metal 3712
Free Cutting Muntz Metal 3713
Forging Brass 377
— **see MUNTZ METAL 280**

Naval Brass 462
Naval Brass 464
Leaded Naval Brass 482
Leaded Naval Brass 485
Manganese Brass 675
Leaded Manganese Brass 676
Anaconda (Low Fuming) Bronze 681
— **see TOBIN BRONZE 4641**

Ambraloy 614
Tempaloy 630
— **see AMBRALOY 630**

Cupro Nickel, 5% 709
— **see CUPRO NICKEL, 10% 706**

Cupro Nickel, 20% 710**
— **see CUPRO NICKEL, 30% 715**

Phosphor Bronze (A) 5090
Free Cutting Phosphor Bronze 544
— **see PHOSPHOR BRONZE, (A) 510**

Phosphor Bronze (C) 521
— **see PHOSPHOR BRONZE, (D) 524**

Everdur 6421
Everdur 661
— **see EVERDUR 655**

Nickel Silver, 10% 745*
Nickel Silver, 12% 757*
Nickel Silver, 18% 7641
Nickel Silver, 12% 770*
Nickel Silver, 13% 776*
Leaded Nickel Silver, 10% 796*
— **see NICKEL SILVER 18% 752**

*Slightly less corrosion resistant than Nickel Silver, 18% 752.
**Slightly less corrosion resistant than Cupro Nickel, 30% 715.

TABLE 5.14: LEAD AND LEAD ALLOYS—LEAD INDUSTRIES ASSOCIATION

Corrosion of Chemical Lead in Phosphoric Acid at 70°F (21°C)

Solution	Corrosion rate-mpy (a)
20% H_3PO_4 (com'l)	3.4
30% H_3PO_4 (com'l)	4.9
40% H_3PO_4 (com'l)	5.7
50% H_3PO_4 (com'l)	6.4
85% H_3PO_4 (com'l)	1.6
80% H_3PO_4 (pure)	12.8

(a) mils per year (= mdd × 0.127)

Corrosion of Lead in Nitric Acid

Solution	Corrosion rate-mpy (a) 75°F (24°C)	122°F (50°C)
1% HNO_3	140	600
5% HNO_3	1650	1850
10% HNO_3	3400	3490

(a) mils per year (= mdd × 0.127)

Corrosion of Lead in Hydrochloric Acid at 75°F (24°C)

Solution	Chemical lead mpy (a)	6% antimonial lead mpy (a)
1% HCl	24	33
5% HCl	16	20
10% HCl	22	43
15% HCl	31	150
20% HCl	74	160
25% HCl	190	200
35% HCl (b)	350	540

(a) mils per year (= mdd × 0.127)
(b) concentrated HCl commercially available

Corrosion of Lead in Hydrochloric Acid–Ferric Chloride Mixtures at 75°F (24°C)

Solution	Chemical lead mpy (a)	6% antimonial lead mpy (a)
5% HCl + 5% Fe Cl_3	28	37
10% HCl + 5% Fe Cl_3	41	76
15% HCl + 5% Fe Cl_3	88	160
20% HCl + 5% Fe Cl_3	150	190

Effect of Sulfuric Acid on the Corrosion of Lead by Fluosilicic Acid at 113°F (45°C)

Solution	Chemical lead mpy	6% antimonial lead mpy
5% H_2SiF_6	53	77
5% H_2SiF_6 + 5% H_2SO_4	9	14
10% H_2SiF_6	64	115
10% H_2SiF_6 + 1% H_2SO_4	88	76
1% H_2SiF_6 + 10% H_2SO_4	4	9

Corrosion of Chemical Lead with Sulfuric-Nitric Mixed Acids

Solution	Corrison rate-mpy 75°F (24°C)	122°F (50°C)
78% H_2SO_4 + 0% HNO_3	1	2
78% H_2SO_4 + 1% HNO_3	3	12
78% H_2SO_4 + 3.5% HNO_3	3.6	18
78% H_2SO_4 + 7.5% HNO_3	4	35

Effect of Nitric Acid in Sulfuric Acid on the Corrosion of Lead at 245°F (118°C)

Solution	Chemical lead mpy	6% antimonal lead mpy
54% H_2SO_4 + 0% HNO_3	7.4	14
54% H_2SO_4 + 1% HNO_3	5.9	22
54% H_2SO_4 + 5% HNO_3	8.4	114

Corrosion of Lead in Hydrochloric Acid–Sulfuric Acid Mixtures

Solution	Chemical lead mpy (a) 75°F (24°C)	Chemical lead mpy (a) 150°F (66°C)	6% antimonial lead mpy (a) 75°F (24°C)	6% antimonial lead mpy (a) 150°F (66°C)
1% HCl + 9% H_2SO_4	5	9	5	12
3% HCl + 7% H_2SO_4	14	32	21	41
5% HCl + 5% H_2SO_4	14	42	21	65
7% HCl + 3% H_2SO_4	16	45	22	74
9% HCl + 1% H_2SO_4	18	47	30	84
5% HCl + 25% H_2SO_4	10	22	22	34
10% HCl + 20% H_2SO_4	17	42	80	58
15% HCl + 15% H_2SO_4	41	74	90	180
20% HCl + 10% H_2SO_4	86	120	110	180
25% HCl + 5% H_2SO_4	140	160	150	210
5% HCl + 45% H_2SO_4	62	—	53	—
10% HCl + 40% H_2SO_4	65	—	84	—
15% HCl + 35% H_2SO_4	66	—	120	—
20% HCl + 30% H_2SO_4	84	—	130	—
25% HCl + 25% H_2SO_4	120	—	210	—

(a) mils per year (= mdd × 0.127)

(continued)

TABLE 5.14: LEAD AND LEAD ALLOYS–LEAD INDUSTRIES ASSOCIATION (continued)

Corrosion of Lead in Chemical Processes

Sulfation of oils with 25% sulfuric acid (66° Be)–140°F (60°C)	Temperature °F	°C	Corrosion rate mpy (a)
Castor			3
Tallow			12
Olive			3
Cod liver			6
Neatsfoot			11
Fish			11
Vegetable			23
Peanut			18
Sulfonation with 93% sulfuric acid (66° Be)			
Naphthalene	330	166	45
Phenol	248	120	3
Washing and Neutralization of Sulfated and Sulfonated Compounds			
Sulfated vegetable oil + water wash-neutralized with sodium hydroxide	140	60	9
Naphthalene sulfonic acid + water wash-neutralized with caustic soda pH3	158	70	39
Washing tallow with 2% by wt 60° Be sulfuric acid	250	121	5
Storage of liquid alkyl detergent			0.3
Storage of 50% chlorosulfonic acid-50% sulfur trioxide			0.6
Mixing tank and crystallizer-saturated ammonium sulfate-5% sulfuric acid solution	116	47	1 to 5
Splitting			
Olive oil and 0.5% sulfuric acid (66° Be)	190	88	11
Storage of split fatty acids			Liquid 0.8
Storage of split fatty acids			Liquid level 12
Extraction of Aluminium Sulfate from Alumina			
Bauxite + sulfuric acid-boiling			Liquid 16
Bauxite + sulfuric acid-boiling			Vapor 5
Alum evaporator	240	116	3
Tank for dissolving alum paper mill	120	49	16
Storage of 24% alum solution			0.6
Dorr Settling Tank			
19.5 sulfuric acid, 20% ferrous sulfate, 10% titanium oxide as $TiSO_4$	158	70	10
Evaporator			
Nickel sulfate solution	212	100	6
Zinc sulfate solution	225	107	6
Ammonium Sulfate Production			
Solution–saturated ammonium sulfate + 5% sulfuric acid	116	47	Mixing tank 1
Solution–saturated ammonium sulfate + 5% sulfuric acid	116	47	Crystallizer 5
Acid Washing			
Lube oil–treatment with 25% sulfuric acid	220	104	25
Sludge oil + 15% sulfuric acid–steam treatment			20
Benzol (crude)–treatment with 3% sulfuric acid washed with water, neutralized with lime	140	60	6
Tar oil–treatment with 25% sulfuric acid, washed with water, neutralized with sodium hydroxide	170	77	24
Wet acid gases from regeneration of sulfuric acid	250	121	6
Polymerization			
Polymerization of butenes with 72% sulfuric acid	175	80	0.5
Polymerization of butenes with 72% sulfuric acid	175	80	14 pits

(continued)

TABLE 5.14: LEAD AND LEAD ALLOYS—LEAD INDUSTRIES ASSOCIATION (continued)

Corrosion of Lead in Chemical Processes (Continued)

Viscose Rayon Spinning Bath	Temperature °F	°C	Corrosion rate mpy (a)
Evaporator-6% sulfuric acid, 17% sodium sulfate, 30% other inorganic sulfates	104	40	5
Evaporator-Concentrated bath of 20% sulfuric acid 30% sodium sulfate	130	55	4
Vapors from spin bath evaporator	120	49	5
Spinning bath drippings	115	46	8
Storage-reclaimed spinning bath liquor			2
Pickling Solution			
Brass and copper-sulfuric acid + 5% cupric sulfate	160	71	5

(a) mils per year (= mdd × 0.127)

Corrosion of Lead in Various Chemical Solutions

Solution	Temperature °F	°C	Corrosion rate mpy (a)
33% sulfuric acid + 6.7% sodium chloride	75	24	6
33% sulfuric acid + 6.7% sodium chloride	140	60	12
33% sulfuric acid + 6.7% sodium chloride	176	80	36
Sulfurous acid (3% SO_2)	75	24	1
Sodium sulfate (saturated)	75	24	1
Sodium sulfide (10%)	75	24	1
Triethanolamine	140	60	18
Phthalic anhydride	190	88	17
Calcium acid sulfite	75	24	1
Sodium chloride (0.25 to 6%)	46	8	0.2–1.2
Potassium nitrate (0.5 to 10%)	46	8	0.9–3.0
Calcium carbonate	46	8	0.3
Calcium bicarbonate	46	8	0.2
Sodium carbonate	46	8	0.6
Magnesium sulfate	46	8	0.3

Corrosion Rate of Lead in Chemical Environments

A < 2 mils/year	Negligible corrosion—Lead recommended for use.
B < 20/mpy	Practically resistant—Lead recommended for use.
C is 20-50 mpy	Lead may be used where this effect on service life can be tolerated.
D > 50myp	Corrosion rate too high to merit any consideration of lead.

Chemical	Temp °F	Concen-tration %	Corrosion class
Abietic acid	75	—	D
Acetaldehyde	75	—	A
Acetaldehyde	75–212	—	B
Acetanilide	75	—	A
Acetic acid	75	Glacial	B
Acetic acid	75	—	C
Acetic anhydride	75	—	A
Acetoacetic acid	75	—	B
Acetone	75–212	10–90	A
Acetone cyanohydrin	75–212	—	B
Acetophenetidine	75	—	B
Acetophenone	75–212	—	B
Acetotoluidide	75	—	B
Acetyl acetone	75–212	—	B
Acetyl chloride	75	—	A
Acetyl thiophene	75–212	—	B
Acetylene, dry	75	—	A
Acetylene tetrachloride	70	Liquid	B
Acridine	75–125	10	B
Acrolein	75–125	10	B
Acrylonitrile	75–212	—	A
Adipic acid	75–212	—	A
Alcohol, ethyl	75–212	10–100	A
Alcohol, methyl	75–212	10–100	A

(continued)

TABLE 5.14: LEAD AND LEAD ALLOYS—LEAD INDUSTRIES ASSOCIATION (continued)

Corrosion Rate of Lead in Chemical Environments (Continued)

Chemical	Temp °F	Concentration %	Corrosion class
Alkanesulfonic acid	75	—	D
Alkyl aryl sulfonates	75-212	—	B
Alkyl naphthalene sulfonic acid	200	—	C
Allyl alcohol	75	—	B
Allyl chloride	75	—	C
Allyl sulfide	75	—	D
Aluminum acetate	75-212	10-20	A
Aluminum chlorate	75-212	—	B
Aluminum chloride	75	0-10	B
Aluminum ethylate	75-212	—	B
Aluminum fluoride	75-212	10-20	B
Aluminum fluorosulfate	75	15	A
Aluminum fluosilicate	75-212	—	B
Aluminum formate	75	—	B
Aluminum formate	212	—	D
Aluminum hydroxide	75-212	10	B
Aluminum nitrate	75	10	B
Aluminum potassium sulfate	75-212	10-20	A
Aluminum potassium sulfate	75-212	20-100	B
Aluminum sodium sulfate	75-212	10	B
Aluminum sulfate	75-245	—	A
Aminoazobenzene	75	—	C
Aminobenzene sulfonic acid	75-212	—	B
Aminobenzoic acid	75-200	—	B
Aminophenol	75-212	—	B
Aminosalicylic acid	212-300	—	C
Ammonia	75-212	10-30	B
Ammonium acetate	77	3.85	B
Ammonium azide	75	—	B
Ammonium bicarbonate	75-212	10	B
Ammonium bifluoride	75	10	B
Ammonium bisulfite	75-125	—	A
Ammonium carbamate	75-300	—	A
Ammonium carbonate	75-212	10	B
Ammonium chloride	75	0-10	B
Ammonium citrate	212	—	D
Ammonium diphosphate	75-212	10	B
Ammonium fluoride	75	0-20	B
Ammonium fluosilicate	75-125	20	B
Ammonium formate	212	10	C
Ammonium hydroxide	80	3.5-40	A
Ammonium hydroxylamine	68-212	34	B
Ammonium metaphosphate	75	10	B
Ammonium nitrate	75-120	10-30	D
Ammonium oxalate	75	10-30	D
Ammonium persulfate	75-212	10-30	B
Ammonium phosphate	150	—	A
Ammonium picrate	75-212	10	B
Ammonium polysulfide	75-212	10	B
Ammonium sulfamate	75-212	10	B
Ammonium sulfate	75	—	B
Ammonium sulfide	75-212	10	C
Ammonium sulfite	75-212	10-40	B
Ammonium thiocyanate + NH_4OH	75	—	A
Ammonium tungstate	75	10	D
Amyl acetate	75	80-100	B
Amyl chloride	75	—	D
Amyl laurate	75-212	—	B
Amyl phenol	392	—	D
Amyl propionate	75-212	—	B

Chemical	Temp °F	Concentration %	Corrosion class
Aniline	68	—	A
Aniline hydrochloride	75	10	D
Aniline sulfate	75-212	—	B
Aniline sulfite	75-212	—	B
Anthracene	75-212	—	B
Anthraquinone	75-212	—	B
Anthraquinone sulfonic acid	75-212	10-30	B
Antimony chloride	75	—	C
Antimony pentachloride	75-212	90-100	B
Antimony sulfate	212	—	C
Antimony trifluoride	75-212	50-70	A
Arabic acid	75-212	—	B
Arachidic acid	75	—	B
Arsenic acid	75	10	B
Arsenic trichloride	212-300	—	B
Arsenic trioxide	75-212	—	B
Ascorbic acid	75	—	D
Azobenzene	75-212	—	B
Barium carbonate	75	—	D
Barium chlorate	75-212	20	B
Barium chloride	75-212	10	B
Barium cyanide	75	10-70	D
Barium hydroxide	75	10	D
Barium nitrate	75-212	10-30	B
Barium peroxide	75	10	D
Barium polysulfide	212	—	D
Barium sulfate	75-212	—	B
Barium sulfide	75	10	B
Benzaldehyde	75	10-100	D
Benzaldehyde sulfonic acid	75-212	—	B
Benzamide	75-212	—	B
Benzanthrone	75-212	—	B
Benzene	75	—	B
Benzene hexachloride	75	—	B
Benzene sulfonic acid	75	10-100	B
Benzene sulfonic acid	212	—	D
Benzidine	212	—	B
Benzidine disulfonic acid 2.2	75-212	—	B
Benzidine 3 sulfonic acid	75-212	—	B
Benzilic acid	75-212	10-100	B
Benzobenzoic acid	75-212	—	B
Benzocathecol	75-212	—	B
Benzoic acid	75	—	D
Benzol	75	100	A
Benzonitrile	75-212	—	A
Benzophenone	75-212	—	A
Benzotrichloride	75-212	—	B
Benzotrifluoride	75-212	—	B
Benzoyl chloride	212	—	C
Benzoyl peroxide	75-212	—	B
Benzyl acetate	75-212	—	B
Benzyl alcohol	75-212	—	B
Benzylbutyl phthalate	75-212	—	B
Benzyl cellulose	75-212	—	B
Benzyl chloride	75-212	—	B
Benzyl ethyl aniline	75-212	—	B
Benzylphenol	75-212	—	B
Benzylphenol salicylate	75-212	—	B
Benzylsulfonilic acid	75-212	—	B
Beryllium chloride	212	—	D

(continued)

TABLE 5.14: LEAD AND LEAD ALLOYS—LEAD INDUSTRIES ASSOCIATION (continued)

Corrosion Rate of Lead in Chemical Environments (Continued)

Chemical	Temp °F	Concen-tration %	Corrosion class
Beryllium fluoride	75-212	—	B
Beryllium sulfate	75-212	10-50	B
Boric acid	75-300	10-100	B
Bornyl acetate	75-212	—	B
Bornyl chloride	75-212	—	B
Bornyl formate	75-212	—	B
Boron trichloride	75-212	—	B
Boron trifluoride	75-400	—	A
Bromic acid	75-212	10-30	B
Bromine	75	—	B
Bromobenzene	75-212	—	B
Bromoform	75-212	—	B
Butane	75	—	A
Butanediols	75	—	B
Butyl acetate	75	—	B
Butyl benzoate	75-212	—	B
Butyl butyrate	75-212	—	B
Butyl glycolate	75-212	—	B
Butyl mercaptan	75	—	C
Butyl oxalate	75	—	B
Butyl phenols	75	—	C
Butyl phthalates	75-212	—	B
Butyl stearate	75-212	—	B
Butyl urethane	75-212	—	B
Butyric acid	75	10-100	D
Butyric aldehydes	75-212	—	B
Butyrolactone	75-212	—	B
Cadmium cyanide	75	—	D
Cadmium sulfate	75-212	10-30	A
Calcium acetate	75	20	B
Calcium acid phosphate	75	10-30	B
Calcium benzoate	75-212	—	B
Calcium bicarbonate	75	—	C
Calcium bisulfite	75	—	B
Calcium bromide	75-212	30	B
Calcium carbonate	75	20	D
Calcium chlorate	75	10-30	B
Calcium chloride	75	20	A
Calcium chromate	75-212	10	B
Calcium dihydrogen sulfite + SO_2	75	5	A
Calcium disulfide	75	—	B
Calcium fluoride	75-212	—	B
Calcium gluconate	75-212	—	B
Calcium hydroxide	75	10	D
Calcium lactate	212	10	B
Calcium nitrate	75	10	D
Calcium oxalate	75-212	10	B
Calcium phosphate	212	10	B
Calcium pyridine sulfonate + H_2SO_4	75	20	A
Calcium stearate	75-212	10	B
Calcium sulfaminate	75-212	—	A
Calcium sulfate	75-212	10	B
Calcium sulfide	212	—	C
Calcium sulfite	75-212	10	B
Camphene	75-212	—	B
Camphor	212	—	A
Camphor sulfonic acid	75	20-100	C
Capric acid	75-212	—	B
Caprolactone	75-212	—	B
Capronaldehyde	75	—	A
Capronaldehyde	125-212	—	B
Carbazole	75-212	—	B
Carbitol	75-212	—	B
Carbon disulfide	75-212	—	A
Carbon fluorides	75-212	—	B
Carbon tetrabromide	212	—	C
Carbon tetrachloride (dry)	BP	100	A
Carbonic acid	75	—	D
Carnallite	75-212	—	A
Carotene	75-212	—	A
Cellosolves	75-212	—	A
Cellulose acetate	75	—	A
Cellulose acetobutyrate	75-212	—	B
Cellulose nitrate	75-212	—	B
Cellulose tripropionate	75-212	—	B
Cerium fluoride	75-212	—	B
Cerium sulfate	212	—	C
Cesium chloride	75-212	—	B
Cesium hydroxide	75	10	D
Cetyl alcohol	75	—	B
Cetyl alcohol	212	—	C
Chloroacetic acid	75	—	B
Chloral	75-212	—	B
Chloramine	75	10-30	B
Chloranil	75-212	—	B
Chloranthraquinone	75-212	—	B
Chlordane	75-212	—	B
Chlorethane sulfonic acid	212	—	C
Chloric acid	75	10	D
Chlorine	100	—	B
Chlorine dioxide	43	Gas	B
Chloroacetaldehyde	75	—	B
Chloroacetone	75-212	—	B
Chloroacetyl chloride	75	—	B
Chloro-alkyl ethers	75-212	—	B
Chloroaminobenzoic acid	75-212	—	B
Chloroaniline	75-212	—	B
Chlorobenzene + SO_2	65	—	A
Chlorobenzotrifluoride	75-212	—	B
Chlorobenzoyl chloride	75-212	—	B
Chlorobromomethane	75	—	B
Chlorobromopropane	75-212	—	B
Chlorobutane	75	—	B
Chloroethylbenzene	75-212	—	B
Chloroform	75-BP	—	B
Chlorohydrin	75-212	—	B
Chloromethonic ester	75-212	—	B
Chloronaphthalene	75-212	—	B
Chloronitrobenzene	75-212	—	B
Chlorophenohydroxy acetic acid	75-212	—	B
Chlorophenol	75	—	C
Chloroquinine	75	—	C
Chlorosilanes	75-212	—	B
Chlorosulfonic acid	75	—	C
Chlorosulfonic acid + 50% SO_3	66	40	C
Chlorotoluene	75-212	—	B
Chlorotoluene sulfonic acid	75	—	C
Chlorotoluidine	75-212	—	B
Chlorotrifluoro ethylene	75-212	—	B
Chloroxylenols	75	—	C

(continued)

TABLE 5.14: LEAD AND LEAD ALLOYS—LEAD INDUSTRIES ASSOCIATION (continued)

Corrosion Rate of Lead in Chemical Environments (Continued)

Chemical	Temp °F	Concentration %	Corrosion class
Chloroxylols	75-212	—	B
Cholesterol	75-212	—	B
Chromic acid	75	—	B
Chromic chloride	75-212	—	B
Chromic fluoride	75-212	—	B
Chromic hydroxide	75-212	—	B
Chromic phosphate	75-212	—	B
Chromic sulfate	75-212	10	B
Chromium potassium sulfate	75-212	10	B
Chromium sulfate (basic)	75-212	20-50	B
Chromyl chlorides	75-212	—	B
Citric acid	75-175	10-30	B
Citric acid	75	50-100	D
Cobalt sulfate	75	10-30	B
Copper chloride	75	10-40	D
Copper sulfate	75-212	10-70	B
M - cresol + 10% water	77	Liquid	B
M - cresol + 10% water	BP	Vapor	D
O - cresol + 10% water	77	Liquid	B
O - cresol + 10%water	BP	Vapor	D
Cresote	75	90	D
Cresylic acid	75	90	D
Cresylic acid	75	100	B
Crotonaldehyde	75-212	—	B
Crotonic acid	75	—	D
Cumaldehyde	75-212	—	B
Cumene	75-212	—	B
Cumene hydroperoxide	75	—	D
Cyanamide	75-212	—	B
Cyanoacetic acid	75	—	D
Cyanogen gas	75	—	D
Cyclohexane	75	—	B
Cyclohexanol	75	—	B
Cyclohexanol esters	75-212	—	B
Cyclohexanone	75	—	B
Cyclohexene	75-212	—	B
Cyclohexylamine	75	—	D
Cyclopentane	75-212	—	B
DDT	75	—	B
Dialkyl sulfates	75-212	—	B
Dibenzyl	75-212	—	B
Dibutyl phthalate	75-212	—	B
Dibutyl thioglycolate	75-212	—	B
Dibutyl thiourea	75-212	—	B
Dichlorobenzene	75-212	10-100	B
Dichlorodifluoro-methane-(Freon-12)	75-212	90	A
Dichlorodiphenyldichloroethane (DDD)	75-212	—	B
Dichloroethylene	75-212	—	A
Diethanolamine	75	—	B
Diethyl ether	75	—	B
Diethylamine	75	—	D
Diethylaniline	75-212	—	B
Diethylene glycol	75-125	—	B
Difluoroethane	75-212	—	B
Diglycolic acid	75	—	D
Dihydroxydiphenylsulfone	75-212	—	B
Diisobutyl	75-212	—	B
Dimethyl ether	75-212	—	B
Dioxane	75-212	—	B
Diphenyl	75-212	—	B
Diphenyl chloride	75-212	—	B
Diphenylamine	75-212	—	A
Diphenylene oxide	75-212	—	B
Diphenylpropane	75-212	—	B
Epichlorohydrin	75	—	A
Ethane	75-212	—	A
Ether	75	—	B
Ethyl acetate	75-175	—	B
Ethyl benzene	75-212	—	B
Ethyl butyrate	75-212	—	B
Ethyl cellulose	75-212	—	B
Ethyl chloride	75-212	—	B
Ethyl ether	75-212	—	B
Ethyl formate	212	—	C
Ethyl lactate	75-212	—	B
Ethyl mercaptan	212	—	D
Ethyl stearate	75-212	—	B
Ethyl sulfonic acid	75	—	B
Ethyl sulfonic acid	212	—	C
Ethylene	75-212	—	A
Ethylene bromide	212	—	B
Ethylene chlorohydrin	75	90	A
Ethylene chlorohydrin	125-212	100	B
Ethylene cyanohydrin	75	—	A
Ethylene cyanohydrin	125-212	100	B
Ethylene dibromide	75	90	D
Ethylene dichloride	75-212	—	B
Ethylene glycol	20	50	B
Ethylene oxide	75	—	B
2-Ethylhexoic acid	160	96	C
Ferric ammonium sulfate	75-212	10-20	A
Ferric chloride	75	20-30	D
Ferric ferrocyanide	150-200	—	A
Ferric sulfate	75-175	10-20	A
Ferrous ammonium sulfate	75	10	B
Ferrous chloride	75	10-30	C
Ferrous sulfate	75-212	10	B
Fluoboric acid	75	30	C
Fluocarboxylic acid	75	—	D
Fluorine	75-212	—	A
Fluosilicic acid	113	10	D
Formaldehyde	75-125	20-100	B
Formamide	75-212	—	B
Formic acid	75-212	10-100	D
Furfural	75-212	—	B
Gluconic acid	75	10-100	B
Glutamic acid	75	—	D
Glycerol	75	—	B
Glycerophosphoric acid	75	—	B
Glycol monoether	75-212	—	B
Glycolic acid	75	10-100	B
Glycolic acid	212	10	D
Heptachlorobutene	75	—	B
Heptane	75-212	—	A
Hexachlorobutadiene	75-212	—	A
Hexachlorobutene	75	—	B
Hexachloroethane	75-212	—	B
Hexamethylene tetramine	75-212	10-40	B
Hydrazine	75	20-100	D
Hydriodic acid	75	10-50	D

(continued)

TABLE 5.14: LEAD AND LEAD ALLOYS—LEAD INDUSTRIES ASSOCIATION (continued)

Corrosion Rate of Lead in Chemical Environments (Continued)

Chemical	Temp °F	Concen-tration %	Corrosion class
Hydrobromic acid	75	10–70	D
Hydrochloric acid (See Table)	75	0–10	C
Hydrofluoric acid	75	2–10	B
Hydrogen bromide (Anh HBr)	212	—	D
Hydrogen chloride (Anh HCl)	75	100	A
Hydrogen peroxide	75	10–30	D
Hydrogen sulfide	75	90–100	B
Hydroquinine	75–212	10	B
Hydroxyacetic acid	75	—	A
Hypochlorous acid	75	—	D
Iodine	75	—	D
Iodoform	75–212	10	B
Isobutyl chloride	75	—	B
Isobutyl phosphate	75	—	B
Isopropanol	75	—	A
Lactic acid	75	10–100	D
Lead acetate	75	10–30	D
Lead arsenate	75–212	—	B
Lead azide	75–212	—	B
Lead chloride	75–212	—	B
Lead chromate	75–212	—	B
Lead dioxide	75–212	—	B
Lead nitrate	75–212	—	B
Lead oxide	75–212	—	B
Lead peroxide	75–212	—	B
Lead sulfate	75–212	—	B
Lithium chloride	75–212	10	B
Lithium hydroxide	75	—	D
Lithium hypochlorite	75–175	10	A
Lithopone	75	—	A
Magnesium carbonate	75	10	D
Magnesium chloride	75	0–10	C
Magnesium chloride	75	10–100	D
Magnesium hydroxide	75	10–30	D
Magnesium sulfate	75–212	10–60	B
Maleic anhydride	80	10	C
Malic acid	212	—	B
Mercuric chloride	75	10	C
Mercuric sulfate	75–212	10	B
Mercurous nitrate	75	—	D
Mercury	75	100	D
Methanol	86	—	B
Methyl ethyl ketone	75–212	10–100	B
Methyl isobutyl ketone	75–212	10–100	B
Methylene chloride	75–212	—	B
Monochloroacetic acid	75	20–100	D
Monochlorobenzene	75	90	D
Monoethanolamine	340	—	C
Naphthalene	75	10–100	B
Naphthalene sulfonic acid + H_2SO_4	190	—	B
Nickel ammonium sulfate	75–212	10	B
Nickel nitrate	75–212	—	B
Nickel sulfate	75–212	10–30	B
Nitric acid (See table)			
Nitrobenzene	75–125	—	B
Nitrocellulose	75	—	A
Nitrochlorobenzene	75	—	D
Nitroglycerine	75	—	C
Nitrophenol	75	—	D
Nitrosyl chloride	75	—	B
Nitrosylsulfuric acid	75–175	—	B
Nitrotoluene	75	—	B
Nitrous acid	75	—	D
Oleic acid	75	—	D
Oxalic acid	75	20–100	D
Oxalic acid + 1.5–3% H_2SO_4	125	20–50	A
Pentachlorethane	175	—	B
Perchloroethylene	75	100	B
Persulfuric acid	212	—	C
Phenol	75	90	B
Phenolsulfonic acid	75–212	30	B
Phenyl isocyanate	75	—	B
Phosgene	75–212	—	B
Phosphoric acid	75–200	—	B
Phosphorous acid	80	33	A
Phosphorous chloride	75–300	—	B
Phosphorous oxychloride	75	—	B
Phosphorous pentachloride	75	—	A
Phosphorous pentachloride	125–300	—	B
Phosphorous tribromide	75	—	A
Phosphorous trichloride (dry)	75	10	B
Phthalic anhydride	180	5.25	B
Picric acid	68	25	C
Potassium aluminium sulfate	79	—	A
Potassium bicarbonate	75	10–30	D
Potassium bifluoride	75–175	10	B
Potassium bisulfate	75–212	10	B
Potassium bisulfite	75–212	10–20	C
Potassium bromide	75–212	10–50	B
Potassium carbonate	75	10–50	C
Potassium chlorate	75	10	B
Potassium chlorate	212	10	D
Potassium chloride	47	0.25–8.0	B
Potassium chromate	75–212	10–40	B
Potassium cyanide	75	10–30	D
Potassium dichromate	75–212	10–60	B
Potassium ferricyanide	75–212	10–60	B
Potassium fluoride	75–175	20	B
Potassium hydroxide	75–140	0–50	B
Potassium hypochlorite	75	10	B
Potassium iodate	75–BP	2–10	B
Potassium iodide	75	30	D
Potassium metabisulfite	175	10–30	B
Potassium nitrate	46	0.5–10	B
Potassium permanganate	75	10–40	C
Potassium peroxide	75	10	D
Potassium persulfate	75	10	D
Potassium sulfate	75–212	10–20	B
Potassium sulfite	75	10	B
Propionic acid	75	10–70	D
Pyridine	75–212	10	B
Pyridine sulfate	75	10	B
Pyridine sulfonic acid	75	20	A
Pyrogallic acid	75	—	B
Quinine	75–212	—	B
Quinine bisulfate	75–212	10	B
Quinine tartrate	75–212	—	B
Quinizarin	75–212	—	B
Quinoline	75–212	—	B
Quinone	75–212	10	B

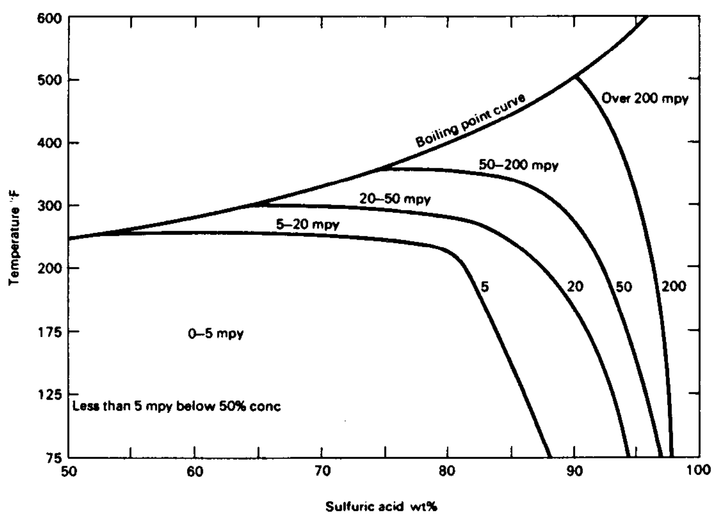
(continued)

TABLE 5.14: LEAD AND LEAD ALLOYS—LEAD INDUSTRIES ASSOCIATION (continued)

Corrosion Rate of Lead in Chemical Environments (Continued)

Chemical	Temp °F	Concentration %	Corrosion class
Saccharin solutions	75–212	—	B
Salicylic acid	75–212	—	B
Selenious acid + H_2SO_4 + HNO_3	200	—	A
Silver nitrate	75	10–60	D
Sodium acetate	77	4	B
Sodium acid fluoride	75	10	B
Sodium aluminate	75	10	D
Sodium bicarbonate	75	10	B
Sodium bifluoride	75	—	B
Sodium bisulfate	75–212	10–30	B
Sodium bisulfite	75–212	10	B
Sodium carbonate	75	10	B
Sodium carbonate	125	20	D
Sodium chloride	77	0.5–24	A
Sodium chlorite	75	10	B
Sodium chromate	75–212	10	B
Sodium cyanide	75	10	B
Sodium hydrogen fluoride	160	8	B
Sodium hydrosulfite	75	10–20	A
Sodium hydroxide	79	0–30	B
Sodium hypochlorite	75	1	C
Sodium hyposulfite	75	10	B
Sodium nitrate	75	10	D
Sodium nitrite	75–212	10–60	B
Sodium perborate	75	10	D
Sodium percarbonate	75	—	D
Sodium peroxide	75	10	D
Sodium persulfate	75	10	B
Sodium phosphate	75–212	10–100	B
Sodium phosphate (tri basic)	75	10–20	D
Sodium silicate	75	—	B
Sodium sulfate	75	2–20	A
Sodium sulfide	75–212	10–30	A
Sodium sulfite	75–212	10–30	B
Sodium tartrate	75	—	D
Stannic chloride	75	20	D
Stannic tetrachloride (dry)	75	100	B
Stannous bisulfate	75–212	10	B
Stannous chloride	75	10–50	D
Succinic acid	75–212	10–50	B
Sulfamic acid	72	3–20	B
Sulfur dioxide	75–400	90	B
Sulfur trioxide	75	90	B
Sulfuric acid (See figure)			
Sulfurous acid	140	—	A
Sulfuryl chloride	75	—	B
Tanning mixtures	70	—	B
Tannic acid	75	20–100	D
Tartaric acid	75	30–70	B
Tetraphosphoric acid	75	10–100	D
Thionyl chloride	75–300	—	B
Thiophosphoryl chloride	75	—	B
Tetrachlorethane	145	—	A
Titanium sulfate	75–212	10–30	B
Titanium tetrachloride	75	—	B
Toluene	75–212	—	A
Toluene-sulfochloride	75	—	A
Thrichloroethylene	80	—	B
Trichloronitromethane	75	—	C
Triethanolamine	140	0.4	B
Triphenyl phosphite	80	—	A
Turpentine	75	—	B
Vinyl chloride	75	10	D
Zinc carbonate	75	—	B
Zinc fluosilicate	70	30–36	D
Zinc hydrosulfite	75	—	B
Zinc sulfate	95	—	B
Zinc chloride	175	25	B

Corrosion Rate of Lead in Sulfuric Acid



Note: mdd × 0·127 = mpy

TABLE 5.15: MAGNESIUM–DOW CHEMICAL

In the table the concentration of the chemical is shown in percent. Values of 100% refer to the pure substance in dry or liquid form. Concentrations less than 100% refer to water solutions of the chemical. The other column in the table indicates whether or not a test under actual operating conditions is warranted. A "Yes" in this column means that magnesium is basically resistant to the chemical or that laboratory tests have shown enough promise to warrant testing under actual service conditions.

Suitability of Testing Magnesium in Various Substances

CHEMICAL	CONCENTRATION (%)	SERVICE TEST WARRANTED
Acetaldehyde	Any	No
Acetic Acid	Any	No
Acetone	Any	Yes
Acetylene	100	Yes
Alcohol, Butyl	100	Yes
Alcohol, Ethyl	100	Yes
Alcohol, Isopropyl	100	Yes
Alcohol, Methyl	100	No
Alcohol, Propyl	100	Yes
Ammonia (Gas or Liquid)	100	Yes
Ammonium Salts (Most)	Any	No
Ammonium Hydroxide	Any	Yes
Aniline	100	Yes
Anthracene	100	Yes
Arsenates (Most)	Any	Yes
Benzaldehyde	Any	No
Benzene	100	Yes
Bichromates	Any	Yes
Boric Acid	1-5	No
Brake Fluids (Most)	100	Yes
Bromides (Most)	Any	No
Bromobenzene	100	Yes
Butter	100	No
Butylphenols	100	Yes
Calcium Arsenate	Any	Yes
Calcium Carbonate	100	Yes
Calcium Chloride	Any	No
Calcium Hydroxide	100	Yes
Camphor	100	Yes
Carbon Bisulphide	100	Yes
Carbon Dioxide (Dry)	100	Yes
Carbon Monoxide	100	Yes
Carbon Tetrachloride	100	Yes
Carbonated Water	Any	No
Castor Oil	100	Yes
Cellulose	100	Yes
Cement	100	Yes
Chlorides (Most)	Any	No
Chlorine	100	No
Chlorobenzenes	100	Yes
Chloroform	100	Yes
Chlorophenols	Any	No
Chlorophenylphenol	100	Yes
Chromates (Most)	Any	Yes
Chromic Acid	Any	Yes
Citronella Oil	100	Yes
Cod Liver Oil (Crude)	—	Yes
Copals	100	Yes
Coumarin	100	Yes
Cresol	100	Yes
Cyanides (Most)	Any	Yes
Dichlorohydrin	100	Yes
Dichlorophenol	100	Yes
Dichromates (See Bichromates)		
Diethanolamine	100	Yes
Diethyl Aniline	100	Yes
Diethyl Benzene	100	Yes
Diethylene Glycol Solutions	Any	Yes, may need inhibitors
Diphenyl	100	Yes
Diphenylamine	100	Yes
Diphenylmethane	100	Yes
Diphenyl Oxide	100	Yes
Dipropylene Glycol	100	Yes
Divinylbenzene	100	Yes
Dry Cleaning Fluids	100	Yes
Ethers	100	Yes
Ethanolamine (Mono)	100	Yes
Ethyl Acetate	100	Yes
Ethyl Benzene	100	Yes
Ethyl Bromide	100	No
Ethylcellulose	100	Yes
Ethyl Chloride	100	Yes
Ethyl Salicylate	100	Yes
Ethylene (Gas)	100	Yes
Ethylene Dibromide	100	Yes
Ethylene Glycol Solutions	Any	Yes, may need inhibitors
Fats, Cooking (Acid-free)	100	Yes
Fatty Acids	Any	No
Ferric Chloride	Any	No
Fluorides (Most)	Any	Yes
Fluosilicic Acid	Any	No
Formaldehyde	Any	Yes
Fruit Juices and Acids	Any	No
Fuel Oil	100	Yes
Gasohol (10% Ethanol)	100	Yes, if inhibited
Gasohol (10% Methanol)	100	Yes, if inhibited
Gasoline (Lead-free)	100	Yes, if inhibited
Gasoline (Leaded)	100	Yes, if inhibited
Gelatine	Any	Yes
Glycerine C.P.	100	Yes
Grease (Acid-free)	100	Yes
Heavy Metal Salts (Most)	Any	No
Hexamine	3	Yes
Hydrochloric Acid	Any	No
Hydrofluoric Acid	5-60	Yes
Hydrogen Peroxide	Any	No
Hydrogen Sulfide	100	Yes
Iodides	Any	No
Iodine Crystals (Dry)	100	Yes
Isopropyl Acetate	100	Yes
Isopropyl Benzene	100	Yes
Isopropyl Bromide	Any	No
Kerosene	100	Yes
Lanolin	100	Yes
Lard	100	Yes
Lead Arsenate	Any	Yes
Lead Oxide	Any	No
Linseed Oil	100	Yes
Magnesium Arsenate	Any	Yes
Magnesium Carbonate	100	Yes
Magnesium Chloride	Any	No
Mercury Salts	Any	No
Methane (Gas)	100	Yes
Methyl Bromide	Any	No
Methyl Cellulose	100	Yes
Methyl Chloride	100	Yes
Methylene Chloride	100	Yes
Methyl Salicylate	100	Yes
Milk (Fresh and Sour)	100	No
Mineral Acids	Any	No
Monobromobenzene	100	Yes
Monochlorobenzene	100	Yes
Naphtha	100	Yes
Naphthalene	100	Yes
Nicotine Sulphate	40	Yes
Nitrates (All)	Any	No
Nitrous Gases	100	No
Nitric Acid	Any	No
Nitroglycerin	Any	No
Oil, Animal — (Acid- and Chloride-free)	Any	Yes
Oil, Mineral (Chloride-free)	100	Yes
Oil, Vegetable (Chloride-free)	100	Yes
Oleic Acid	100	Yes
Olive Oil	100	Yes
Organic Acids (Most)	Any	No
Orthochlorophenol	100	No
Orthodichlorobenzene	100	Yes
Orthophenylphenol	100	Yes
Oxygen	100	Yes
Paraphenylphenol	100	Yes
Paradichlorobenzene	100	Yes
Pentachlorophenol	100	Yes
Perchloroethylene	100	Yes
Permanganates (Most)	Any	Yes
Phenol	100	Yes
Phenyl Ethyl Acetate	100	Yes
Phenylphenols	100	Yes
Phosphates (Most)	Any	Yes
Phosphoric Acid	Any	No
Polypropylene Glycols	100	Yes
Potassium Fluoride	Any	Yes
Potassium Hydroxide	Any	Yes
Potassium Nitrite	Any	No
Potassium Permanganate	Any	Yes
Propylene Glycol U.S.P.	100	Yes
Propylene Oxide	100	Yes, may need inhibitors
Pyridine (Acid Free)	100	Yes
Pyrogallol	Any	No
Rubber & Rubber Cements	100	Yes
Sea Water	100	No
Sodium Bromate	Any	No
Sodium Bromide	Any	No
Sodium Carbonate	Any	Yes
Sodium Chloride	Any	No
Sodium Cyanide	Any	Yes
Sodium Dichromate	Any	Yes
Sodium Fluoride	Any	Yes
Sodium Hydroxide	Any	Yes
Sodium Phosphate (Tribasic)	Any	Yes
Sodium Silicate	Any	Yes
Sodium Sulfide	3	Yes
Sodium Tetraborate	3	Yes
Steam	100	No
Stearic Acid (Dry)	100	Yes
Styrene Polymer	100	Yes
Sugar Solutions (Acid-Free)	Any	Yes
Sulphates (Most)	Any	No
Sulphur	100	Yes
Sulphur Dioxide (Dry)	100	Yes
Sulphur Chloride	Any	No
Sulphuric Acid	Any	No
Sulphurous Acid	Any	No
Tannic Acid	3	No
Tanning Solutions	Any	No
Tar, Crude & Its Fractions	100	Yes
Tartaric Acid	Any	No
Tetrahydro-naphthalene	100	Yes
Titanium Tetrachloride	100	Yes
Toluene (Toluol)	100	Yes
Trichlorbenzene	100	Yes
Trichloroethylene	100	Yes
Trichlorophenol	100	Yes
Tung Oil	100	Yes
Turpentine	100	Yes
Urea	100	Yes
Urea in Aqueous Solution (Cold)	Any	Yes
Urea in Aqueous Solution (Warm)	Any	No
Vinegar	Any	No
Vinylidine Chloride	100	Yes
Vinyl Toluene	100	Yes
Water, Boiling	100	No
Water, Distilled	100	Yes
Water, Rain	100	Yes
Waxes (Acid-free)	100	Yes
Xylol	100	Yes

TABLE 5.16: NICKEL AND HIGH-NICKEL ALLOYS—HUNTINGTON ALLOYS

A = Acceptable G-E = Good to excellent
NR = Not Recommended X = Check for specific data

Alloy type	Alloy	Description	Nominal chemical composition, % (Major elements): Nickel (+ Cobalt)	Iron	Chromium	Other	Corrosion resistance: Sulfuric acid	Hydrochloric acid	Hydrofluoric acid	Phosphoric acid	Nitric acid	Organic acid	Alkalies	Salts	Seawater	Chloride cracking
pure nickel	Nickel 200 †	Commercially pure wrought nickel, good mechanical properties, excellent resistance to many corrosives.	99.5	—	—		A	A	G-E	A	NR	G-E	G-E	G-E	G-E	G-E
nickel-copper	MONEL alloy 400	High strength, good weldability, excellent corrosion resistance over wide range of temperatures and conditions.	66.5	1.2	—	Cu 31.5	G-E	A	G-E	G-E	NR	G-E	G-E	G-E	G-E	G-E
	MONEL alloy R-405	Similar to MONEL alloy 400. Controlled sulfur added for improved machining characteristics.	66.5	1.2	—	Cu 31.5 S 0.04	G-E	A	G-E	G-E	NR	G-E	G-E	G-E	G-E	G-E
	MONEL alloy K-500	Age-hardened version of MONEL alloy 400 for increased strength and hardness.	66.5	1.0	—	Cu 29.5 Al 2.7	G-E	A	G-E	G-E	NR	G-E	G-E	G-E	G-E	G-E
nickel-chromium	INCONEL alloy 600	High nickel, high chromium content for resistance to oxidizing and reducing environments; for severely corrosive environments at elevated temperatures.	76.0	8.0	15.5		A	NR	A	A	A	G-E	G-E	G-E	A	G-E
	INCONEL alloy 601	Excellent high-temperature properties, resistance to oxidizing, carburizing, and sulfur-containing atmospheres.	60.5	14.1	23.0	Al 1.4	A	NR	A	A	A	G-E	G-E	G-E	A	G-E
	INCONEL alloy 617	Optimum high-temperature mechanical stability, oxidation and corrosion resistance. Excellent cyclic oxidation and carburization resistance at 2000 F (1095 C). Good stress rupture properties above 1800 F. (980 C).	52.0	1.5	22.0	Co 12.5 Mo 9.0 Al 1.2	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E
	INCONEL alloy 625	High strength and toughness from cryogenic temperatures to 1800 F, (980 C), good oxidation resistance, exceptional fatigue strength, and good resistance to many corrosives.	61.0	2.5	21.5	Mo 9.0 Cb & Ta 3.6	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E
	INCONEL alloy 690	A high-chromium modification of INCONEL alloy 600. Good resistance to oxidizing chemicals and sulfur-containing gases. High mechanical properties.	60.0	9.5	30.0	C 0.03	A	NR	NR	G-E	G-E	G-E	G-E	G-E	A	G-E
	INCONEL alloy 718	Excellent strength from −423 F to 1300 F (—253 C to 705 C). Age hardenable and may be welded in fully aged condition. Excellent oxidation resistance up to 1800 F. (980 C).	52.5	18.5	19.0	Mo 3.0 Cb & Ta 5.1	A	A	X	A	NR*	G-E	G-E	G-E	G-E	G-E
	INCONEL alloy X-750	Age-hardenable alloy with good corrosion and oxidation resistance. Excellent relaxation resistance.	73.0	7.0	15.5	Ti 2.5	A	NR	X	A	NR*	G-E	G-E	G-E	A	G-E
	HUNTINGTON alloy G	Excellent corrosion resistance in many media. Resists pitting, crevice corrosion, and intergranular corrosion.	44.0	19.5	22.2	Mo 6.5 Cu 2.0 Cb & Ta 2.1	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E
	HUNTINGTON alloy HX	Excellent oxidation resistance and elevated temperature strength.	48	18.5	21.8	Mo 9.0	A	NR	A	NR	A	A	A	A	G-E	G-E

† Nickel 201, low carbon version recommended for temperatures above 600 F (315 C)

* Age hardened

(continued)

TABLE 5.16: NICKEL AND HIGH-NICKEL ALLOYS—HUNTINGTON ALLOYS (continued)

A = Acceptable G-E = Good to excellent NR = Not Recommended X = Check for specific data

Alloy type	Alloy	Description	Nominal chemical composition, % (Major elements)				Corrosion resistance									
			Nickel (+ Cobalt)	Iron	Chromium	Other	Sulfuric acid	Hydrochloric acid	Hydrofluoric acid	Phosphoric acid	Nitric acid	Organic acid	Alkalies	Salts	Seawater	Chloride cracking
nickel-iron-chromium	INCOLOY alloy 800	Strong and resistant to oxidation and carburization at elevated temperatures. Resists sulfur attack, internal oxidation, scaling and corrosion in wide variety of atmospheres.	32.5	46.0	21.0		A	NR	X	A	G-E	G-E	A	A	A	G-E
	INCOLOY alloy 800H	Similar to alloy 800 with better high-temperature strength. Higher design strength values for use above 1150 F (620 C). Improved creep and stress-to-rupture properties in 1100 F to 1800 F (595 C to 980 C) range.	32.5	46.0	21.0	C 0.05 to 0.10	A	NR	X	A	G-E	G-E	A	A	A	G-E
	INCOLOY alloy 825	Excellent resistance to wide variety of corrosives. Resists pitting and intergranular type corrosion, reducing acids and oxidizing chemicals.	42.0	30.0	21.5	Mo 3.0 Cu 2.2	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E
	INCOLOY alloy 925	Age hardenable alloy provides high strength up to 1000F (540C) comparable to alloy 825 in corrosion resistance.	42	32	21	Mo 3 Cu 2.2 Ti 2.1	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E
	HUNTINGTON alloy 904L	An austenitic nickel-iron-chromium alloy with additions of molybdenum and copper. Resists general corrosion, pitting, and crevice corrosion in a wide range of reducing and oxidizing environments.	25.5	45.0	21.0	Mo 4.7 Cu 1.5 C 0.02	G-E	A	G-E	G-E	A	G-E	G-E	G-E	G-E	A
	HUNTINGTON alloy HA-330	A nickel-iron chromium alloy with good high-temperature strength and corrosion resistance. Provides good resistance to oxidation and carburization.	35.5	44.0	18.5		A	NR	X	A	G-E	G-E	A	A	A	G-E

TABLE 5.17: NICKEL-BASE ALLOY—TELEDYNE ALLVAC

ALLCORR is a single phase, non-age hardenable, corrosion resistant alloy for service in highly corrosive environments. It is a nickel-base alloy containing nominally 31% chromium, 10% molybdenum, and 2% tungsten. It is characterized by the following properties:

- high resistance to general corrosion
- high resistance to pitting and crevice corrosion
- high resistance to intergranular corrosion
- high resistance to stress corrosion cracking
- high strength and ductility
- good weldability
- good hot and cold workability
- good machinability

Corrosion rates in mils per year (micrometers per year)

TEST SOLUTION*	ALLCORR	HASTELLOY C-276	HASTELLOY B-2	INCONEL 625	INCOLOY 825	CARPENTER 20Cb3	316 STAINLESS
90°C = 194°F* 1% HCl	0-6 (0-150)	0-6 (0-150)	0-6 (0-150)	12-24 (300-600)	12-24 (300-600)	24-60 (600-1,500)	24-60 (600-1,500)
100°C = 212°F* 10% H_2SO_4	0-6 (0-150)	12-24 (300-600)	0-6 (0-150)	24-60 (600-1,500)	12-24 (300-600)	12-24 (300-600)	>200 (>5,000)
100°C = 212°F* 50% H_3PO_4	0-6 (0-150)	0-6 (0-150)	0-6 (0-150)	6-12 (150-300)	0-6 (0-150)	12-24 (300-600)	12-24 (300-600)
122°C = 251°F* Boiling 65% HNO_3	6-12 (150-300)	60-200 (1,500-5,000)	>50,000 (>1,250,000)	24-60 (600-1,500)	6-12 (150-300)	24-60 (600-1,500)	12-24 (300-600)
118°C = 245°F* Boiling 100% Acetic Acid	0-6 (0-150)	0-6 (0-150)	0-6 (0-150)	0-6 (0-150)	60-200 (1,500-5,000)	6-12 (150-300)	0-6 (0-150)
100°C = 212°F* 50% Formic Acid	0-6 (0-150)	0-6 (0-150)	0-6 (0-150)	6-12 (150-300)	12-24 (300-600)	6-12 (150-300)	6-12 (150-300)
100°C = 212°F* 10% Oxalic Acid	0-6 (0-150)	6-12 (150-300)	0-6 (0-150)	0-6 (0-150)	12-24 (300-600)	12-24 (300-600)	24-60 (600-1,500)
50°C = 122°F** 9-10% $FeCl_3$	0-6 (0-150)	0-6 (0-150)	>200 (>5,000)	12-24 (300-600)	>1,000 (>25,000)	>1,000 (>25,000)	>1,000 (>25,000)
Boiling 5% $FeCl_3$ + 10% NaCl	0-6 (0-150)	0-6 (0-150)	>1,000 (>25,000)	>1,000 (>25,000)	>200 (>5,000)	>1,000 (>25,000)	>1,000 (>25,000)
Boiling 50% H_2SO_4 + 3% $Fe_2(SO_4)_3$ ASTM A262 Solution	6-12 (150-300)	>200 (>5,000)	>200 (>5,000)	24-60 (600-1,500)	12-24 (300-600)	12-24 (300-600)	24-60 (600-1,500)
Boiling* 50% NaOH	0-6 (0-150)	12-24 (300-600)	0-6 (0-150)	0-6 (0-150)	12-24 (300-600)	24-60 (600-1,500)	>200 (>5,000)

*Materials Technology Institute of the Chemical Process Industries, Inc.
**Crevice corrosion, but reported as average corrosion rate

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS

ALLOY CHARACTERISTICS

HASTELLOY® alloy B-2—An improved wrought version of HASTELLOY alloy B. Alloy B-2 has the same excellent corrosion resistance as alloy B, but with improved resistance to knife-line and heat-affected zone attack. This alloy resists the formation of grain-boundary carbide precipitates in the weld heat-affected zone, thus making it suitable for most chemical process applications in the as-welded condition. Alloy B-2 also has excellent resistance to pitting and stress-corrosion cracking. It is particularly well suited for equipment handling hydrogen chloride gas, and hydrochloric, sulfuric, acetic, and phosphoric acids.

HASTELLOY alloy C-276—An improved wrought version of HASTELLOY alloy C with vastly improved fabricability. It has outstanding resistance to a wide variety of chemical process environments including strong oxidizers, i.e., ferric and cupric chlorides, hot contaminated mineral acids, solvents, chlorine and chloride-contaminated media (organic and inorganic), dry chlorine, formic and acetic acids, acetic anhydride, sea water and brine solutions. It is one of the few materials that resists the corrosive effects of wet chlorine gas, hypochlorite and chlorine dioxide solutions. Alloy C-276 resists the formation of grain-boundary precipitates in the weld heat-affected zone thus making it applicable for most chemical process uses in the as-welded condition. It has excellent resistance to pitting and stress-corrosion cracking.

HASTELLOY alloy C-4—A new nickel-chromium-molybdenum alloy with improved high-temperature stability as evidenced by high ductility and corrosion resistance even after long-time aging in the 1200 to 1900 deg. F (649 to 1038 deg. C) range. This alloy resists the formation of grain-boundary precipitates in the weld heat-affected zone, thus making it suitable for most chemical process applications in the as-welded condition. Alloy C-4 also has excellent resistance to stress-corrosion cracking and to oxidizing atmospheres up to 1900 deg. F (1038 deg. C).

HASTELLOY alloy G—A columbium-stabilized, nickel-base alloy with excellent resistance to hot sulfuric and phosphoric acids. Alloy G will withstand the corrosive affects of both oxidizing and reducing agents and can handle both acid and alkaline solutions. It resists pitting and has exceptional resistance to stress-corrosion cracking.

HASTELLOY alloy X—A heat-resistant, nickel-base alloy ideally suited for chemical plant equipment. It has good high-temperature strength and exceptional resistance to oxidizing atmospheres.

CABOT® alloy No. 625 has high strength and toughness from cryogenic temperatures to 2000 deg. F (1093 deg. C). Its fatigue strength is exceptional. This alloy derives its strength from the stiffening effect of molybdenum and columbium on its nickel-chromium matrix. In addition to good oxidation resistance, the alloy also resists corrosive attack by many other media; it is virtually immune to chloride-ion, stress-corrosion cracking.

Aqueous Corrosion Data for CABOT Alloy No. 625

Media	Concentration, Percent by Weight	Test Temp., F (C)	Average Corrosion Rate Per Year, mils	mm	Remarks
Acetic Acid	10	Boiling	0.6	<0.02	Average of four-24 hr. periods.
	99	Boiling	0.4	0.01	Average of four-24 hr. periods.
ASTM G-28 Test*		Boiling	17	0.43	120-hr. test. As received.
		Boiling	17	0.43	120-hr. test. Aged 1 hr at 1100F(593C).
		Boiling	17	0.43	120-hr. test. Aged 1 hr. at 1200F (649C).
		Boiling	19	0.48	120-hr. test. Aged 1 hr. at 1300F(704C)
		Boiling	21	0.53	120-hr. test. Aged 1 hr. at 1400F(760C).
		Boiling	17	0.43	120-hr. test. Aged 1 hr. at 1500F(816C).
		Boiling	17	0.43	120-hr. test. Aged 1 hr. at 1600F(871C).
		Boiling	17	0.43	120-hr. test. Aged 1 hr. at 1700F(927C).
Formic Acid	40	Boiling	7.3	0.19	Average of four 24-hr. periods.
	88	Boiling	9.3	0.24	Average of four 24-hr periods.
Hydrochloric Acid	2.5	Room	Nil	Nil	100-hr. test.
	2.5	158 (70)	0.5	<0.02	100-hr. test.
	2.5	Boiling	472	12	100-hr. test.
	5	158 (70)	34	0.86	Average of four 24-hr. tests.
Nitric Acid	10	Boiling	0.7	<0.02	24-hr. test.
	65	Boiling	20	0.51	Average of five 48-hr. periods
Phosphoric Acid	55	Boiling	6.3	0.16	Average of four 24-hr. periods
	70	240 (116)	12	0.30	96-hr. test
	70	300 (149)	11	0.28	96-hr test
	85	Boiling	67	1.7	Average of four 24-hr. periods
ASTM Synthetic Sea Water		68 (20)	Nil	Nil	96-hr. test.
		95 (35)	Nil	Nil	96-hr. test
		122 (50)	0.1	<0.003	96-hr. test.
		149 (65)	0.1	<0.003	96-hr. test.
		176 (80)	Nil	Nil	96-hr. test.
		194 (90)	Nil	Nil	96-hr. test.
Simulated Scrubber Environment**		Room	Nil	Nil	24-hr. test without crevice.
		Room	Nil	Nil	24-hr. test with crevice.
		122 (50)	Nil	Nil	24-hr. test without crevice.
		122 (50)	3.8	0.10	24-hr. test with crevice.
		158 (70)	0.4	0.01	24-hr. test without crevice.
		158 (70)	11	0.28	24-hr. test with crevice
		Boiling	1664	42	24-hr. test without crevice.
		Boiling	1195	30	24-hr. test with crevice.
Sodium Chloride	3	Room	Nil	Nil	96-hr. test with crevice.
	3	122 (50)	Nil	Nil	96-hr. test with crevice.
	3	158 (70)	Nil	Nil	96-hr. test with crevice.
	4	Room	Nil	Nil	24-hr. test.
	4	158 (70)	Nil	Nil	24-hr. test.
	4	Boiling	Nil	Nil	24-hr. test.
Sodium Hydroxide	10	151 (66)	Nil	Nil	96-hr. test.
	10	199 (93)	Nil	Nil	96-hr. test.
	10	Boiling	0.1	<0.003	96-hr. test.
	30	151 (66)	Nil	Nil	96-hr. test.
	30	199 (93)	Nil	Nil	96-hr. test.
	30	Boiling	Nil	Nil	96-hr. test.
	50	151 (66)	0.1	<0.003	96-hr. test.
	50	199 (93)	0.4	0.01	96-hr. test.
	50	Boiling	2.4	0.06	96-hr. test.
Sulfuric Acid	10	Boiling	37	0.94	Average of four 24-hr. periods.
	30	Boiling	231	5.9	Average of four 24-hr. periods.
	50	Boiling	960	24	Average of four 24-hr. periods.
Wet Chlorine		Room	0.1	<0.003	48-hr. test.
		122 (50)	81	2.1	48-hr. test.
		158 (70)	186	4.7	48-hr. test.

*50% H_2SO_4 (weight percent) and 42g/l of ferric sulfate.

**7% H_2SO_4, 3% HCl (volume percentages); 1% $CuCl_2$ and 1% Fe Cl_3 (weight percentages).

Nil—No measurable penetration could be calculated.

COMPARATIVE RESISTANCE OF HASTELLOY ALLOYS TO VARIOUS CORROSIVE MEDIA

KEY

E	**Excellent**	**Less than 2 mils (0.05mm) penetration per year**
G	**Good**	**2 to 10 mils (0.05 to 0.25mm) penetration per year**
S	**Satisfactory**	**Over 10 to 20 mils (>0.25 to 0.51mm) penetration per year**
B	**Borderline**	**Over 20 to 50 mils (>0.51 to 1.27mm) penetration per year**
U	**Unsatisfactory**	**More than 50 mils (1.27mm) penetration per year**
—	**No Data**	

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Acetaldehyde	98	135	57	—	E	—	—	plus 2 percent low boiling material, 129 day test in top of tower
Acetic Acid	2.5M	212	100	—	—	-E	E	immersed; aeration; lab test 41.6 days
Acetic Acid	2.5M	385	196	—	E	E	E	rack vertically resting on bottom, lab test 8.1 days, aeration
Acetic Acid	3	40-72	4-22	E	—	—	—	plus HCl to pH of 2.0 in streptomycin purification
Acetic Acid	4.5	347	175	—	E	—	—	plus 56 percent butane, 2 percent water, 10 percent nitrogen, 1 percent carbon dioxide, 27 percent other organics. Alloy C <0.1 mpy
Acetic Acid	10	75	24	E	—	—	—	plus HCl to pH of 2.0 in streptomycin purification
Acetic Acid	10	100-140	38-60	E	—	—	—	also HCl in starch conversion
Acetic Acid	10	214	101	G	—	—	E	immersed, comparison of heat transfer conditions with simple immersion test. Corrodent renewed every 48 hrs., total time: 95 hrs.
Acetic Acid	10	300	149	E	—	—	—	plus propionic and higher acids, 2 to 3 percent hardwood tar creosote oils
Acetic Acid	12	250	121	E	—	—	—	plus 1.5 to 4 percent formic acid
Acetic Acid	17	210	99	E	—	—	—	plus 1 percent formic acid
Acetic Acid	20	210	99	—	E	—	—	30 percent H_2O, balance acetaldehyde. Alloy C = 0.7 mpy
Acetic Acid	20	210	99	—	E	—	—	plus 50 percent acetaldehyde, test at top of tower
Acetic Acid	20.8	Boiling	Boiling	—	E	—	—	plus 0.02 percent salicylates 192-hr. test under reflux
Acetic Acid	21	239	115	—	G	—	—	plus 1 percent formic acid, 78 percent water. Alloy C = 8 mpy (violent agitation of solution)
Acetic Acid	23.4	212	100	—	E	—	—	plus 0.011 percent salicylic acid, 1380-hr. test in vapors
Acetic Acid	24	230	110	—	E	—	—	some chloride contamination. Alloy C = 0.6 mpy
Acetic Acid	25	220	104	—	E	—	—	plus 1.5 percent formic acid, 99-129-day test
Acetic Acid	25	220	104	—	E	—	—	plus 4 percent formic acid
Acetic Acid	30 30	100 110	38 43	— —	E E	— —	— —	plus 0.5 percent acetaldehyde, 129-day test, top of fractionating column. plus 3 percent acetaldehyde, 129-day test at bottom of tower
Acetic Acid	30	275	135	—	S	—	—	plus 8 percent formic acid. Alloy C = 12 mpy
Acetic Acid	30-40	230	110	—	E	—	—	plus 5.2 percent formic acid. Alloy C = 0.5 mpy
Acetic Acid	30-50	220	104	—	G	—	—	plus 2-10 percent formic acid and total 5 percent methyl formate, acetaldehyde, methyl acetate, ethyl acetate, acetone, methyl alcohol. Alloy C = 7 mpy
Acetic Acid	33	270	132	—	E	—	E	1.5 percent formic acid, 5902 hrs.
Acetic Acid	40	347	175	—	E	—	—	plus 20 percent butane, 5 percent pentane, 8 percent ethyl acetate, 5 percent methyl ethyl ketone, 6 percent propionic acid, esters, and ketones. Alloy C = 0.7 mpy
Acetic Acid	44	212	100	U	E	—	—	plus 34 percent amyl alcohol, trace of chlorides 792-hr. test. Alloy C = 1.0 mpy
Acetic Acid	45	183	84	—	E	—	—	plus 40 percent vinyl acetate, 13 percent acetaldehyde, 2 percent anhydrides. Alloy C = nil mpy
Acetic Acid	45-50	223	106	—	G	—	S	15 percent methyl formate, 2 percent formic acid, 3148 hrs.
Acetic Acid	45-50	225	107	—	G	—	B	5 percent methyl formate, 2 percent formic acid, 2328 hrs.
Acetic Acid	50	75	24	E	—	—	—	plus 50 percent H_2SO_4, vapor and liquid phase
Acetic Acid	50	158	70	—	E	—	—	Alloy C = nil mpy
Acetic Acid	50	356	180	—	E	—	—	plus 20 percent water, 12 percent esters, 10 percent CO, 8 percent hydrocarbons. Alloy C = 0.4 mpy
Acetic Acid	50	216	102	G	—	—	E	immersed, comparison of heat transfer conditions with simple immersion test. Corrodent renewed every 48 hrs., total time: 96 hrs.

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

M — Molar

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Acetic Acid	51	275	135	—	E	—	—	plus 30 percent propionic acid, 11.5 percent acetic anhydride, 7.5 percent propionic anhydride. Alloy C = 0.2 mpy
Acetic Acid	55.5	219	104	—	E	—	—	plus 0.016 percent salicylic acid, 1380-hr. test in vapors
Acetic Acid	57	100	38	—	E	—	—	plus 30.3 percent H_2SO_4, 12.3 percent H_2O, liquid and vapor phase
Acetic Acid	60	B.P.	B.P.	—	G	—	—	plus 10 percent salicylates, 1 percent naphtha. Alloy C = 4.6 mpy
Acetic Acid	60	221	105	—	E	—	—	plus 2 percent formic acid, 38 percent water. Alloy C = 1.2 mpy
Acetic Acid	60	356	180	—	E	—	—	plus 18 percent hydrocarbons, 9 percent esters, 8 percent CO, 5 percent water. Alloy C = 2 mpy
Acetic Acid	67	212	100	—	E	—	—	Alloy C = 0.7 mpy, 9504-hr. test.
Acetic Acid	67	273	134	—	E	—	—	plus 33 percent propionic acid. Alloy C = 0.2 mpy
Acetic Acid	72	267	131	G	G	—	—	tests for selection of material for an acetic acid recovery column for an acetaldehyde unit, 91 hrs.
Acetic Acid	75	258	126	—	E	—	—	plus 20 percent organics and 5 percent water. Alloy C = 0.3 mpy
Acetic Acid	80	195	91	G	G	—	—	plus 2-3 percent formic acid, 3-5 percent propionic acid, ethylacetate, small amount water (ethylacetate-acetic acid azeotrope distillation process). Alloy C = 4.0 mpy, 1126-hr. test.
Acetic Acid	85	167-257	75-125	—	E	—	—	plus ½ percent acetaldehyde, 5 percent water. Extensive aeration. Alloy C = 1.4 mpy
Acetic Acid	85	237-273	114-134	—	E	—	—	in acetic anhydride purification. Plus 10 percent acetic anhydride, 5 percent water, acetone, acetonitride, amines, etc. Alloy C = 0.1 mpy
Acetic Acid	89	257	125	U	S	—	—	plus 11 percent manganous acetate, 0.15 MnO_2, 58 ppm Cl^-, a trace of formic acid.
Acetic Acid	89	255	124	—	S	—	—	manganese acetate = 10.73 percent, manganese dioxide = 0.15 percent, water = 0.06 percent, 50 ppm Cl^-
Acetic Acid	90	225	107	—	E	—	—	plus 10 percent manganese acetate. Alloy C = 3 mpy
Acetic Acid	90	275	135	—	E	—	—	plus 10 percent propionic acid. Alloy C = 1 mpy
Acetic Acid	91.5	230-257	110-125	—	E	—	—	plus 2.5 percent formic acid 6 percent water. Alloy C = 0.3 mpy
Acetic Acid	91.6	250	121	—	E	—	—	plus 0.86 percent salicylic acid, 7.46 percent water, 891-hr. test in vapors
Acetic Acid	91.6	260	127	—	E	—	—	plus 8.4 percent salicylic acid, 891-hr. test in vapors
Acetic Acid	91.8	246	119	—	E	—	—	plus 0.95 percent salicylic acid, 1530-hr. test in vapors
Acetic Acid	94	257	125	—	E	—	—	plus 5 percent high boiling esters, 1 percent formic acid. Alloy C = 0.3 mpy, 11,160-hr. test
Acetic Acid	94.9	248	120	—	E	—	—	plus 2.1 percent propionic acid, 1.0 percent formic acid. Alloy C = 0.04 mpy
Acetic Acid	95	240	116	—	E	—	—	plus 5 percent high boiler.
Acetic Acid	95	252	122	—	E	—	—	plus 5 percent propionic acid. Alloy C = 0.6 mpy
Acetic Acid	96	170-284	77-140	—	E	—	—	plus 2 percent propionic acid, 1 percent butyric acid, 1 percent nitric acid. Alloy C = 0.9 mpy
Acetic Acid	96.4	248	120	—	E	—	—	plus 3.1 percent propionic acid, 0.5 percent acetic anhydride. Alloy C = 2 mpy
Acetic Acid	96.5-98	255	124	—	E	—	—	plus 1.5 percent formic acid, and 1.5 percent water. Alloy C = 0.3 mpy
Acetic Acid	97	248	120	—	E	—	—	plus 0.1 percent propionic acid, 0.6 percent formic acid. Alloy C = 0.5 mpy
Acetic Acid	99	272	133	—	E	—	—	plus 0.5 percent formic acid, 0.048 mpy for Alloy C in 5324-hr. test
Acetic Acid	99.5	234	112	—	E	—	—	plus 0.05 percent salicylic acid, 1022-hr. test in vapors
Acetic Acid	99.6	244	118	E	—	—	E	immersed, comparison of heat transfer conditions with simple immersion test. Corrodent renewed every 48 hrs, total time: 96 hrs.
Acetic Acid	99.6-99.9 (anhydrous)	216	102	—	E	—	—	0.7 mpy, plus 60 ppm sodium dichromate

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Acetic Acid	99.7	253	123	—	G	—	—	plus 1 percent manganese acetate, 2 percent water. Alloy C = 2 mpy
Acetic Acid	99.8	245	118	—	E	—	—	traces of water and propionic acid. Alloy C = 1 mpy
Acetic Acid	99.9	255	124	U	S	—	—	plus 0.02 percent formic acid and trace $KMnO_4$
Acetic Acid	99.9	Boiling	Boiling	—	E	—	—	360 hrs.
Acetic Acid	Conc.	90-190	32-88	U	E	—	—	plus peracetic acid.
Acetic Acid	All All	75 B.P.	24 B.P.	E S	E E	— —	— —	aerated or air free
Acetic Acid, Glacial	—	675	357	E	E	—	—	in vapors and catalyst during manufacture of acetic anhydride by pyrolysis. Alloy C = 0.1 mpy
Acetic Acid, Glacial	—	1247	675	E	E	—	—	vapor velocity, 175 ft./sec., 1776-hr. test. Spool exposed in inlet leg of reactor coil in acetic anhydride (99 percent acetic acid plus catalyst). Alloy C = 0.1 mpy
Acetic Acid Vapor	100	125-B.P.	52-B.P.	—	E	—	—	
Acetic Anhydride	50	297	147	—	E	—	—	plus 40 percent ethylene diamine tetra-acetic acid and 10 percent acetic acid
Acetic Anhydride	60	284	140	E	E	—	—	plus 40 percent acetic anhydride. Alloy C = nil mpy
Acetic Anhydride	95	252	122	—	E	—	—	plus 5 pecent acetic acid
Acetic Anhydride	95	266	130	—	E	—	—	$KMnO_4$ added for quality control
Acetic Anhydride	99	310	154	—	E	—	—	plus 1 percent acetic acid and violent agitation
Acetic Anhydride	100	273	134	—	E	—	—	Alloy C = 0.04 mpy
Acetic Anhydride	All	to B.P.	to B.P.	S	E	—	—	
Acetone	—	—	—	—	E	—	—	activated carbon used for absorbing plus traces of methylene chloride. Alloy C = 0.1 mpy
Acetone	60	176	80	G	—	—	—	plus 30 percent methyl acetate, 10 percent acetaldehyde pH 5-6.
Acetone	All	to B.P.	to B.P.	E	E	—	—	
Acetonitrite	4	376	191	G	—	—	—	in isopropyl chloride solution.
Acetophenone	67	302	150	E	—	—	—	plus 33 percent phenol.
Acetylene Tetrachloride (Crude)	—	108-120	42-49	—	E	—	—	excess Cl_2 = 10-21 grams/liter. Dissolved Fe = 0.15-1.65 grams/liter. HCl = 0.7-6.6 grams/liter
Acetylene Tetrachloride	90 90	205 223	96 106	S B	E E	— —	— —	at top and bottom of distillation column, in vapor and liquid
Acid Pulping (Ammonia Base)	—	165-175	74-80	—	E	—	E	
Aconitic Acid	—	185-194	85-90	—	E	—	—	plus NaOH, H_2SO_4, and sodium metabisulfide. Alloy C gained weight slightly.
Acrylic Acid	—	212	100	S	B	—	—	H_2SO_4, acrylic acid reactor condensor
Air, Exhaust	—	110	43	G	E	G	G	aeration, saturated with water and containing chlorinated solvents and other organic compounds
Air	—	180	82	—	E	—	G	$Ca(OCl)_2$, Cl_2 and H_2O. Duration of test — 204 days
Air and Steam	—	180	82	E	—	—	E	
Alcohol, Allyl	100 100	75 B.P.	24 B.P.	— —	S S	— —	— —	
Alcohol, Ethyl or Methyl	All	to B.P.	to B.P.	E	E	—	—	
Alkylamines	—	200	93	—	S	—	G	alkyl amines in aqueous solution containing small amounts of CO_2; pH 10-12
Alkylate, Butane and Lighter	—	128	53	E	E	—	—	during petroleum refining in depropanizer tower, vapor and liquid. Alloy C = 0.1 mpy
Alkylbenzene Sulfonate	71	140	60	G	—	—	U	24 hrs., lab test (vigorous stirring)
Alkyl Benzene-Sulfonic Acid	—	100-130	38-54	E	E	—	—	in settling tank and sulfonation tank during detergent manufacture. Alloy C = 0.6 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Alkylphenol — boron trifluoride complex	—	197-205	92-96	E	E	—	—	in alkaylation, mixing and distillation processes liquid and vapor phase. Alloy C = 0.4 mpy
Allyl Chloride	100	75	24	E	—	—	—	
Alumina Hydrate	—	140	60	B	S	—	—	plus phosphated alumina hydrate (60° Bé H_2SO_4), 65 percent alumina hydrate, 75 percent H_3PO_4
Aluminum Acetate	All	to B.P.	to B.P.	S	S	—	—	
Aluminum Brazing Flux	—	800-1300	427-705	E	S	—	—	LiF, NaCl, NaF, specimens were alternately exposed to air and molten flux over 10-day period
Aluminum Chloride	10-80	to B.P.	to B.P.	E	—	—	—	as in ethyl benzene production, isomerization, Friedel Crafts synthesis
Aluminum Chloride Sludge	90 90	125 250	52 121	E E	— —	— —	— —	plus HCl at 250 psi
Aluminum Chloride	—	360	182	—	S	—	—	$AlCl_3$ 85%, NaCl 12%, Al_2O_3 3%, $FeCl_3$ 700 ppm initially. $AlCl_3$ 35-60%, NaCl 8-9%, Al_2O_3 30-55%, $FeCl_3$ 0.5-1.5% final
Aluminum Chloride	Satr. Soln.	B.P.	B.P.	B	U	—	—	no aeration
Aluminum Fluoride	10	75	24	—	S	—	—	
Aluminum Fluoro Sulfate	15	60-80	16-27	S	E	—	—	$Al_2F_4SO_4$ to pH = 2.3. Alloy C = 0.4 mpy
Aluminum Fluoro Sulfate	15-35	180-235	82-113	U	B	—	—	Alloy C = 24 mpy
Aluminum Potassium Sulfate (Alum)	10	to 175	to 79	—	S	—	—	
Aluminum Sodium Sulfate	10	to B.P.	to B.P.	—	S	—	—	
Aluminum Sulfate	10 10 15 20* 20 30 40 50 55	to 130 175-B.P. 120 to 130 175-B.P. B.P. B.P. 130-B.P. 100	to 54 80-B.P. 49 to 54 80-B.P. B.P. B.P. 54-B.P. 38	— — — S — — — — —	E S E E S S S E E	— — — — — — — — —	— — — — — — — — —	*paper makers alum
Aluminum Sulfate	29-58	195-250	91-121	E	—	—	—	in coil descaling. Plus 0.01 percent ferric and 0.03 percent ferrous ions as Fe_2O_3, trace Cr_2O_3. Occasional exposure to NaOH cleaning solution
Amines	30	250	121	E	E	E	E	30% lactam, 20% organic acid, pH 10-11, polymerization kettle, 62 days
Amines	—	257	125	—	E	—	E	hot wash liquid. Reaction product of diphenylamine and acetone in HBR catalyst after addition to 50% NaOH to yield pH of 12-14. Moderate aeration
Amines (Secondary of Tallow)	80-85	160	71	—	E	E	E	dissolved in isopropyl alcohol. Methyl chloride added to MNTN press and 73% NaOH to keep neutral. Manufacture of fabric softener. Air free. Agitation violent, 251 days
Amine Hydrochlorides	30	290-360	143-182	B	U	G	S	ammonia 20%, water 50%. Liquid phase. 25.2 days, no agitation or aeration
Amine Hydrochlorides	30	290-360	143-182	—	U	—	E	ammonia 20%, water 50%. Liquid phase.
Amine Hydrochlorides	30	360	182	B	U	G	G	ammonia 20%, water 50%
Amine Hydrochlorides	40	302-482	150-250	—	U	U	U	ammonia 20%, water 40%, 4 days, agitation > 4ft/sec, aeration — none
Amine Hydrochlorides	40	302-482	150-250	—	U	—	G	ammonia 20%, water 40%. Liquid phase.
Amine Hydrochlorides	—	482	250	—	U	U	U	
3-Aminopyridine	3	144	62	—	E	—	E	3.25% NaOCl, 2% NaOH, 10% NACL, 69% H_2O, Balance inerts. pH 14; production of 3-Aminopyridine; Agitation — none; Air free; 74 days
Ammonia	12	80-90	26-32	G	S	—	—	plus 7 percent carbon dioxide and water in ammonia recovery stripper in urea plant.
Ammonia	27	122-194	50-90	—	E	E	E	6% CO_2, 66% water vapor (all by vol.), 131 days, test in heat exchanger, vapor zone. Aeration — slight, Agitation — slight
Ammonia	27	185	85	—	E	E	E	carbon dioxide 6%, water vapor 66%, air 0.5-1%, all by volume

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G		
Ammonia	—	390-490	199-254	—	G	—	—	plus ammonium chloride, cuprous chloride, cupric chloride. Air-free. Alloy C = 2.21 mpy
Ammonia, Liquid	10	75	24	S	E	—	—	
	10	100-B.P.	38-B.P.	S	S	—	—	
	20	75	24	S	E	—	—	
	20	100-B.P.	38-B.P.	S	S	—	—	
	30	75	24	S	E	—	—	
	30	100-B.P.	38-B.P.	S	S	—	—	
	50	to B.P.	to B.P.	S	S	—	—	
	70	to B.P.	to B.P.	S	S	—	—	
	100	to 600	to 316	S	S	—	—	
Ammonia, Liquid	—	194	90	G	E	—	—	in outlet of methallymine reactor containing amines NH_4Cl, organic chlorides plus polymer. Alloy C = 0.1 mpy
Ammonium Bifluoride	10	77	25	—	E	—	—	Alloy C = 1.1 mpy
Ammonium Bifluoride	50 to anhydrous	77-392	25-200	—	G	—	—	Alloy C = 8.4 mpy
Ammonium Bifluoride	—	300	149	E	E	—	G	fused, 40 days
Ammonium Bisulfite	—	157-162	69-72	—	E	—	—	pulping liquor. Alloy C = 0.3 mpy
Ammonium Bromide	10	75	24	—	S	—	—	
Ammonium Carbonate	10	to B.P.	to B.P.	S	S	—	—	
	20	to B.P.	to B.P.	S	S	—	—	
	30	to 175	to 80	E	E	—	—	
	30	to B.P.	to B.P.	S	S	—	—	
	40	to 175	to 80	S	S	—	—	
	40	B.P.	B.P.	E	E	—	—	
	50	B.P.	B.P.	S	S	—	—	
Ammonium Chloride	6.22	266	130	—	B	—	U	0.07% nickel chloride, 2.95% ammonia, 5.55% ammonium carbonate, pH = 10.8, recovery of ammonia, 24 hrs.
Ammonium Chloride	11-14	194	90	E	—	—	—	plus H_2S, mercapans and non-abrasive solids in agitator.
Ammonium Chloride	14.7	86-176	30-80	—	E	E	E	8% NaCl;, 4.2% CO_2, 131 days, agitation and aeration — slight
Ammonium Chloride	26-31	180	82	—	E	G	G	fluxing stainless steel strip prior to soldering. Duration of test — 98 days, aeration — moderate, agitation — 2-3 ft./sec.
Ammonium Chloride	28-40	77-216	75-102	—	E	—	—	in evaporating tank. Alloy C = 0.02 mpy
Ammonium Chloride	35	221-230	105-110	—	E	—	—	plus less than 0.5 percent NH_3. Alloy C = 0.014 mpy
Ammonium Chloride	35-50	to 225	to 107	—	E	—	—	plus 35 percent $ZnCl_2$ for 2 percent of period, tank contained boiling solution of 50 percent NH_4Cl, 4 percent $ZnCl_2$, 0.15 percent $PbCl_2$. Alloy C = 0.1 mpy in both liquid and vapor phases.
Ammonium Chloride	to 40	to B.P.	to B.P.	S	S	—	—	
	All	to B.P.	to B.P.	—	S	—	—	
Ammonium Chloride	147 g/l	167	75	—	E	E	E	sodium chloride 78 g/l, carbon dioxide 42 g/l (combined as NH_4HCO_3, $(NH_4)_2CO_3$, $NaHCO_3$), ammonia 22 g/l (combined as NH_4HCO_3, $(NH_4)_2CO_3$ NH_4OH. Sulfide trace, organics possible trace
Ammonium Chloride	—	60-70	16-21	—	E	—	—	sole leather dye vat. NH_4Cl and enzymes dispersed in water
Ammonium Chloride	—	140	60	S	E	—	—	sodium sulfite mother liquors. Alloy C = 0.003 mpy in 336-hr. test
Ammonium Chloride	—	140-147	60-64	E	E	—	—	plus sodium sulfite mother liquor. Alloy C = 0.02 mpy
Ammonium Chloride	—	175-218	79-103	E	E	—	—	plus HCl and hydrocarbons in refinery coker bubble tower. Alloy C = 0.1 mpy
Ammonium Chloride	—	194	90	—	E	—	—	400 grams/liter NH_4Cl plus 3-5 grams/liter NH_3
Ammonium Chloride	—	625-652	329-345	—	G	—	—	Alloy C = 2.12 mpy
Ammonium Chloride	—	840	449	—	E	—	—	350 grams/liter NH_4Cl plus 1-2 grams/liter free NH_3. Alloy C = 0.06 mpy
Ammonium Di-hydrogen Phosphate	Satr. Soln.	82	28	E	E	—	—	Alloy C = 0.004 mpy
Ammonium Fluoride	15	60-200	16-93	S	E	—	—	plus excess NH_4OH
Ammonium Fluoride	20	175	80	—	E	—	—	plus 8 percent titanium fluoride in the separation of titanium from its ore
Ammonium Fluoride	45	230-266	110-130	—	—	—	—	plus suspended ferrous titanate (ilmenite)

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concen-tration, percent	Temperature		HASTELLOY® alloy			Type 316 Stain-less Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G		
Ammonium Fluosilicate	18.5	90-110	32-43	—	E*	—	—	plus 1 percent free H_2SiF_6. *Slight weight gain
Ammonium Hydroxide	—	248	120	—	G	—	—	210 hours, 8% NH_3, 2% H_2S, 2% CO_2 and 0.3% HCN
Ammonium Hydroxide	Conc.	572	300	U*	S	—	—	contained 2 grams cupric chloride and sodium sulfate/gal, 159 hrs., lab test, no agitation. *Cracked
Ammonium Hydroxide	—	150	66	—	E	—	E	contains $(NH_4)_2CO_3$, $(NH_4)_2S$, NH_4Cl, NaCl
Ammonium Hydroxide, Ammonia, Carbamate	—	268-275	131-135	—	—	E	E	aeration
Ammonium Hydroxide Mixtures, Ammonia	27	122-194	50-90	—	E	—	—	carbon dioxide 6%, water vapor 66%, air 0.5-1%, all by volume, slight aeration
Ammonium Nitrate	10	75	24	—	E	—	—	
Ammonium Nitrate	12	32-212	0-100	B	E	—	—	plus ammonium hydroxylamine disulfonate SO_2, ammonium sulfates and nitrates. Alloy C = 0.3 mpy
Ammonium Nitrate Fertilizers	13-38	100	38	E	E·	—	E	potassium chloride 11.6 to 30%, calcium phosphates, mono- and di-, 1% to 14%; water 20%, inerts 12%; pH 4.5 to 7.0, moderate aeration
Ammonium Oxylate	10	75	24	—	E	—	—	
Ammonium Perchlorate	All	to 160	to 71	—	S	—	—	
Ammonium Persulfate	10	75	24	—	E	—	—	
Ammonium Phosphate	5	75	24	—	E	—	—	
Ammonium Sulfate	All 45	to B.P. 190	to B.P. 88	— —	S S*	— —	— —	 *liquid anhydrous NH_3, H_2SO_4, and $(NH_4)_2S$ added in process
Ammonium Sulfate	—	212-213	100	U	E	—	—	in dilute and saturated NH_4SO_4 plus 1.5 percent free H_2SO_4. Alloy C = 0.7 mpy
Ammonium Sulfate	—	156	69	—	E	—	—	plus SO_2 and other sulfur compounds. Alloy C = 0.06 mpy
Ammonium Sulfite	—	103	39	—	E	—	—	plus ammonium bisulfite, 3 percent total SO_2, pH = 6.2. Alloy C = 0.1 mpy
Ammonium Sulfite	45-46	—	—	—	E	—	E	NH_4HSO_3, pH 5.0 to 6.0
Amyl Acetate	—	275	135	—	S	—	—	during production of amyl acetate from amyl alcohol, glacial acetic acid, H_2SO_4
Amyl Alcohol	—	104	40	—	S	—	—	plus 44 percent acetic acid, 34 percent amyl alcohol, 2 percent sulfuric acid, balance water
Amyl Chloride	—	75	24	E	E	—	—	plus traces of NaCl, NaOH, $FeCl_3$, and water. Alloy C less than 0.1 mpy
Amyl Chloride	84	86	30	E	E	—	—	plus 16 percent dry HCl. Alloy C less than 0.3 mpy
Amyl Chloride	100 100	86 B.P.	30 B.P.	E E	E —	— —	— —	plus trace of HCl and water
Amyl Mercaptan	—	230	110	E	—	—	—	plus traces of ethanol, brine, amyl chloride, diamyl sulfide and H_2S. 1656-hr. test.
Amyl Mercaptan	—	to 320	to 160	E	E	—	—	in liquid and vapors of distillation column plus some other amyl compounds, water and a trace of H_2S
Amyl Phenol	—	176	80	—	E	—	E	various organic syntheses: tertiary amyl phenol, amylene, ditertiary amyl phenol, trace BF3-ether; t-nonyl mercaptan, sulfur, hydrogen sulfide, ditertiary nonyl-polysulfide, magnesia, diphenylamine, monene, nonyldiphenylamine, styrene, trace 98% H_2SO_4, clay, vapor phase
Amyl Phenol	—	392	200	E	E	—	E	various organic synthesis: tertiary amyl phenol, amylene, ditertiary amyl phenol, trace BF_3-ether; t-nonyl mercaptan, sulfur, hydrogen sulfide, ditertiary nonyl-polysulfide, magnesia; diphenylamine, nonene, nonyldiphenylamine, styrene, trace 98% H_2SO_4
Aniline	100	75	24	—	S	—	—	
Aniline	—	392-518	200-270	E	E	—	—	plus CS_2, H_2S, mercaptobenzol, thiazole and others. Alloy C = 1.0 mpy
Aniline Sulfite	10 100	60 75	16 24	E* —	— E	— —	— —	*SO_2 blown into 10 percent aniline oil in water.
Anisole (Methyl Phenyl Ether), Boron Trifluoride	—	302	150	—	E	—	E	anhydrous, 32 days
Anodizing Solution, Aluminum	—	180	82	U	E	—	—	18.5 percent H_2SO_4 plus 3 percent H_2CrO_4 in lead-lined tank

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Antibiotic Fermentation Media	—	65-90	18-32	—	E	—	—	in processing tank before filtering after fermentation. Usually neutral but occasionally acidified to pH = 2.5 with HCl or H_2SO_4 or alkalized to pH = 10.5 with NaOH. Alloy C = nil mpy
Antimony Chloride	50	160	71	—	E	—	E	8% HCl, trace HF, balance CCl_4 and refrigerants
Antimony Chloride	50	170	77	—	E	—	E	8% HCl, 8% HF, balance CCl_4 and refrigerants
Antimony Fluorochlorides	—	150	66	—	G	U	U	Vapor over mixed antimony fluorochlorides [SbFxCl(5-x)] refluxing condensate of aliphatic halocarbons, anhydrous hydrogen fluoride and hydrogen chloride.
Antimony Pentachloride	50	160	71	—	E	—	E	fluorochemical manufacture: Separation of $SbCl_5$ by distillation. Carbon tetrachloride and refrigerants 42%, hydrogen chloride 8% Duration of test — 341 days Aeration — slight Agitation — about 5 ft./sec.
Antimony Pentachloride	50	160	71	—	E	—	S	carbon tetrachloride and refrigerants 42%, hydrogen chloride 8%, hydrogen fluoride trace, slight aeration.
Antimony Salts	—	-58-212	-50-100	—	U	—	U	vapor over mixed antimony fluorochlorides [SbFxCl(5-x)], refluxing condensate of aliphatic halocarbons, anhydrous hydrogen fluoride and hydrogen chloride
Antimony Salts	—	212	100	—	U	—	G	mixed antimony fluorochlorides [SbFxCl(5-x)] and [SbFyCl(3-y)], to which is alternately added anhydrous hydrogen fluoride and aliphatic organic chlorides.
Aqua Regia	—	B.P.	B.P.	U	U	—	—	25 percent HNO_3, 75 percent HCl
Aromatic Tar	—	482	250	E	—	E	—	distillation process, 167 hrs., welded samples
Aromatic Tar	—	482	250	—	—	E	—	distillation process, 264 hrs., welded samples
Atrazine	—	140	60	—	E	—	—	moderate aeration
Barium Chloride	20-25	140-212	60-100	—	E	—	—	Alloy C = 0.1 mpy
Barium Chloride	All 20 25	to B.P. B.P. B.P.	to B.P. B.P. B.P.	S S S	— E E	— — —	— — —	
Barium Chloride	Saturated	70	21	E	E	—	—	Alloy C = 0.1 mpy
Barium Hydroxide	All 100	B.P. 1500	B.P. 816	S E	S —	— —	— —	
Beeswax Bleach Solution	—	220	104	—	E	—	—	160 lb. H_3PO_4, 50 lb. K_2MnO_4 and 300 lb. H_2O per 1250 lb. of crude beeswax. Alloy C = 0.19 mpy
Benzene	50	80	27	B	B	—	—	plus 40 percent chlorinated benzene, 5 percent HCl, 5 percent H_2O
Benzene	90	80	27	B	E	—	—	plus 5 percent HCl, 5 percent H_2O and chlorinated benzene. Alloy B = 44 mpy, Alloy C = 0.2 mpy
Benzene	All	to B.P.	to B.P.	S	S	—	—	
Benzene, Chlorinated	100	266	130	E	E	—	—	Alloy C = 0.1 mpy
Benzene, Monochlor	—	60-80	16-27	S	E	—	—	in DDT production plus SO_2, Alloy C = 0.3 mpy
Benzene Sulfonic Acid	86.7	140 284	60 140	G S	S U	— —	— —	plus 3 percent H_2SO_4
Benzene Sulfonic Acid	90	329	165	S	B	—	—	process starts with 66° Bé H_2SO_4 and benzene. Final product is 90 percent benzene sulfonic acid and 4 percent H_2SO_4.
Benzene Sulfonic Acid	91.3	284	140	S	S	—	—	plus 3.8 percent H_2SO_4 Alloy C = 18 mpy
Benzene Sulfonic Acid	92	392	200	E	E	—	—	plus 5 percent sulfuric acid and 3 percent water
Benzene Tetrachlor	—	269-554	132-289	—	E	—	—	in still at three points. Alloy C = 0.2 mpy in liquid, 0.5 mpy in liquid-vapor interface, 0.7 mpy in vapor
Benzene, Wet	—	86-95	30-35	G	—	—	—	
Benzoic Acid	10	75	24	—	E	—	—	
Bismuth-Lead Alloy	Eutectic	to 464	to 240	S	S	—	—	both Alloys B and C considered good for long time use
Black Liquor	43-47	450	232	—	B	—	—	in production of dimethyl sulfide from black liquor
Bleach Liquor	100	to 125	to 52	—	E	—	—	containing available chlorine

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Bleach Solution	—	63	17	—	E	—	—	0.044 percent free Cl_2, 0.07 percent available Cl_2, 0.025 percent ClO_2 48-hr. test, Alloy C = 1.1 mpy
Boric Acid	All	to B.P.	to B.P.	E	E	—	—	
Boron Trichloride	—	77-212	25-100	E	—	—	—	in metal halide filter plus chlorine, ferric chloride, aluminum chloride, silicon tetrachloride.
Boron Trifluoride	1.4	140-284	60-140	S	G	—	—	plus 0.2 percent HF in low pressure still. Alloy C = 2.4 mpy (liquid), 1.9 mpy (vapor)
Boron Trifluoride Etherate	—	75-135	24-57	—	E	—	—	in hydrocarbon oil, both liquid and vapor phases. Alloy C = 0.1 mpy
Boron Trifluoride Etherate Catalyst	—	—	—	—	E	—	—	in phenol and water during alkylation. Alloy C = 0.2 mpy (vapor), <0.1 mpy (liquid)
Boron Trifluoride Etherate	4.4	104-212	40-100	—	E	—	—	Alloy C = 0.16 mpy
Brackish water	—	41	5	—	E	—	E	Newark Bay. Contains 0.70% NaCl, 1000 ppm Ca as $CaCO_3$, 60 ppm HCl. Moderate aeration, pH 6.7
Brass Pickling Solution	100	140	60	—	E	—	—	contains 19 to 28 percent H_2SO_4 and 1 to 4 percent $CuSO_4$. Completely immersed in solution in rubber-lined tanks
Brazing Flux	—	1090-1140	588-615	G	G	—	—	alkali fluorides in commercial dip brazing furnace. Alloy C = 5.6 mpy
Brine	2-9	115-125	46-52	—	E	—	—	plus glue and carbon black, H_2SO_4 added to release fatty acid from soap addition. pH = 2.0-2.9, Alloy C = 0.065 mpy
Brine	—	125-150	52-66	—	E	—	—	310 grams/liter NaCl brine plus trace Cl_2, pH = 10.4. Alloy C = nil mpy
Brine, Saturated	—	140	60	—	E	—	—	
Brine, Saturated	—	240-245	115-118	—	E	—	—	aeration
Brine Solution, Waste Stream	—	107	42	G	E	E	E	containing 23 g/l total disolved solids consisting of 10 g/l chloride and 4.4 g/l sulfate pH-1, 90 days
Brine Slurry	—	195	91	—	E	E	E	containing $MgSO_4$, H_2SO_4, KCl, NaCl, $MgCl_2$, trace of S; pH 7.7, moderate to extensive aeration
Brine Slurry containing $MgSO_4$	—	196	92	—	E	E	E	also Na_2SO_4, KCl, NaCl, $MgCl_2$, trace of S, pH 7.7, moderate to extensive aeration
Bromine, Dry	100 100	to 150 150-700	to 66 66-371	— —	E S	— —	— —	
Bromine Gas	—	59	15	G	E	—	—	in equilibrium with 10% Br water solution. As-welded samples.
Bromine Gas	—	59	15	G	G	—	—	in equilibrium with Br liquid. As-welded samples.
Butane	28.5	158	70	G	B	—	—	also 50.2% H_2SO_4, 21.3% water, synthetic butyl acetate liquors
Butane	—	225-250	107-121	S	G	—	—	plus isobutane, hydrogen chloride. Alloy C = 10 mpy
Butanes (Catalyst Cracked)	—	120-140	49-60	E	—	—	—	plus 0.02 percent mercaptan sulfur
Butyl Acetate	—	220	104	E	E	—	E	sea water, distillation of butyl acetate, 64 hrs. field test
Butyl Acetate Dichlorophenoxy	100 100	75 140-171	24 60-77	G S	B S	— —	— —	Alloy C = 30 mpy
Butyl Acetyl Ricinoleate	—	140	60	—	E	—	—	plus charcoal and traces of acetic acid. Alloy C = nil mpy
Butyric Acid	95	239-284	115-140	—	E	—	—	plus 5 percent acetic acid. Alloy C = 0.3 mpy
Butyric Acid	100	230-265	110-130	S	E	—	—	plus traces of $MnSO_4$, $MgSO_4$ and water
Butyric Acid	All	to B.P.	to B.P.	S	E	—	—	
Calcium Bromide	38	60-140	16-60	E	—	—	—	plus 8.6 percent $CaCl_2$, 11.5 percent LiBr, 42 percent H_2O.
Calcium Carbonate	—	117	47	—	E	E	E	calcium carbonate, calcium sulfate, calcium sulfite, all suspended as 6-11% (by wt.) slurry, pH not specified, aeration
Calcium Carbonate	—	80	27	—	E	E	E	calcium carbonate, calcium sulfate, calcium sulfite and fly ash all suspended as about 20% (by wt.) slurry, pH not specified, aeration
Calcium Chlorate	All	to B.P.	to B.P.	—	S	—	—	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Calcium Chloride	12	75-85	24-29	G	—	—	—	plus 8 percent methyl ethyl ketone, 1 percent HCl, 0.5 percent aconitic acid
Calcium Chloride	20	220	104	—	E	E	E	10% KCl; concentrated brine in potash extraction pilot plant.
Calcium Chloride	29	167-194	75-90	E	E	—	—	plus 8.7 percent $MgCl_2$, 1 percent NaCl half in vapor - half liquid phase, Bittern Process. Alloy C = 0.08 mpy
Calcium Chloride	All 40-60	to B.P. 350	to B.P. 177	S E*	E E*	— —	— —	*slight gain in weight. Specimens in pilot plant evaporator
Calcium Chloride	40	180	82	—	E	—	E	zinc sulfate 40%, pH 2.8, 35% of time; aluminum sulfate 3-30%, pH 3, 15% of time; magnesium sulfate 40%, pH 3, 10% of time; zinc chloride 40%, pH 1.8, 5% of time, moderate aeration
Calcium Chloride	40	70-200	21-93	—	E	—	E	5 solutions, each singly: calcium chloride, pH 2, 35% of time; zinc sulfate 40%, pH 1.8, 35% of time; aluminum sulfate, 3-30%, pH 3, 15% of time; magnesium sulfate 40%, pH 3, 10% of time; zinc chloride 40%, pH 1.8, 5% of time. Moderate aeration.
Calcium Chloride	54	260	127	G	G	—	—	hydrogen chloride recovery, pH about 3 to 4 Duration of test — 305 hrs. = 12.71 days Aeration — moderate Agitation — 2-3 ft./sec.
Calcium Chloride	55	220	104	G	—	—	—	partially purified
Calcium Chloride	58	329	165	—	G	—	—	plus 1.0-1.3 percent NaCl, 0.10 percent $Ca(OH)_2$. Alloy C = 2.1 mpy
Calcium Chloride	62	310	154	G	G	—	—	
Calcium Chloride	73	350	177	G	—	—	—	partially purified
Calcium Chloride	—	175	79	E	—	—	—	140 g/l $CaCl_2$, 80 g/l NaCl, 2 g/l $Ca(OH)_2$
Calcium Chloride	—	248-266	120-138	G	—	—	—	plus Na_2S, Na_2CO_3, elemental sulfur, in sulfur separator.
Calcium Chloride Brine	—	176-194	80-90	—	E	—	—	plus $MgCl_2$ brine, pH = 5.0
Calcium Hydroxide	18-20	70 75	21 24	—	E	—	S*	duration of test — 204 days, *severe pitting
Calcium Hydroxide	to 50	to B.P.	to B.P.	—	E	—	—	
Calcium Hydroxide	—	75	24	—	E	—	G*	duration of test — 42 days, *perforated
Calcium Hypochlorite	0-5	86-140	30-60	—	E	—	—	
Calcium Hypochlorite	0.5	86-140	30-60	—	U	—	—	chlorine absorption
Calcium Hypochlorite	2-3	86	30	—	S	—	—	Alloy C = 13.5 for 2 percent, 16.4 for 3 percent
Calcium Hypochlorite	6	95-212	35-100	—	E	—	—	Alloy C = 0.2 mpy
Calcium Hypochlorite	10 15 20 20	75 125 75 125	24 52 24 52	— — — —	S S E S	— — — —	— — — —	
Calcium Hypochlorite Bleach	—	65-86	18-30	—	E	—	—	spray drying (180 grams/liter $CaOCl_2$). Alloy C = 0.07 mpy
Calcium Hypochlorite Bleach Liquor	—	80	27	—	E	—	—	2-3 grams/liter available Cl_2. Alloy C = 0.1 mpy
Calcium Hypochlorite Liquor	—	72-80	22-27	—	E	—	—	220-230 grams/liter. Alloy C = 0.01 mpy
Calcium Hypochlorite (Lime Sludge)	—	60-100	16-38	—	E	—	—	free Cl_2 = 40 grams/liter, $CaCl_2$, $CaClO_3$, $CaCO_3$ and free lime in small amounts
Calcium-Magnesium Chloride Solutions	Conc.	212-220	100-104	S	G	—	—	plus free 0.63 percent HCl in condensate. Alloy C = 6.7 mpy
Calcium Pyridine Sulfonate	—	100-150	38-66	—	E	—	—	plus 1-5 percent H_2SO_4 and a trace of $HgSO_4$. Alloy C = 0.1 mpy
Calcium Sulfite	—	115	46	—	E	E	E	calcium sulfate, calcium carbonate, fly ash, all suspended as 30-50% (by wt.) slurry, pH not specified
Calcium Sulfite	—	117	47	—	E	E	E	calcium sulfate, calcium carbonate, fly ash, all suspended as 10-15% (by wt.) slurry, pH not specified, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Calcium Sulfate	10	to B.P.	to B.P.	S	S	—	—	
Candelilla Wax	—	96-221	36-105	—	E	—	—	plus $NaClO_3$, H_2SO_4 and HNO_3 (acid content about 25 percent of total). 100-hr. test
Caprolactone and Ammonia	—	—	—	—	S	—	G	664 hrs., production of caprolactum
Carbon Dichloride	65	250	121	—	E	—	—	plus 25 percent CCl, 10 percent heavy organic chlorides saturated with HCl and Cl_2, about 20-30 ppm H_2O. Alloy C = 0.05 mpy
Carbon Dioxide	10	150	66	—	E	—	—	in humidification process plus 0.2 percent SO_2, 2 percent CO and some O_2. Alloy C = 0.02 mpy
Carbon Dioxide	All 100	to 1000 to 1400	to 538 to 760	— E	E —	— —	— —	
Carbon Slurry	—	75	24	E	E	—	—	plus HCl to a pH of 1.5. Alloy C = 0.02 mpy. 11-week test
Carbon Tetrachloride	10 100 100	75 75 to 300	24 24 to 149	S S S	E E —	— — —	— — —	
Carbon Tetrachloride	85-87	85-167	30-75	B	G	—	—	plus 13-15 percent chlorinated high polymer, 0.08 percent chlorine, 0.1-0.2 percent HCl. Normally anhydrous. Alloy C = 2.2 mpy
Carbon Tetrachloride	87.5	185	85	U	G	—	—	plus 12 percent H_2O, 0.4 percent Cl_2, 0.1 percent HCl. Alloy C = 2.3 mpy
Carbon Tetrachloride	—	932-1112	500-600	G	G	—	—	CCl_4 carried in air stream
Carbonic Acid	15 100	75 75	24 24	E E	E E	— —	— —	
Caustic (mild)	0.6	40-212	4-100	—	E	—	—	plus tetra sodium phosphate, dilute NaOCl, some free Cl_2, dilute H_2SO4 (1.5 percent acid)
Caustic	6	80-90	27-32	B	—	—	—	absorption of Cl_2 and acidic material from reactor off-gases. Solution contains 1 percent NaOCl maximum
Caustic	2-17	60-110	16-43	E	E	—	—	plus 7 percent NaCl, 8 percent CH_3COOH, 12 percent organic salt and water in neutralization process. Alloy C = 0.1 mpy
Chestnut Wood Extract	—	150-200	66-93	—	E	—	—	plus organic and sulfurous acids and tannin
Chloracetic Acid	90	73	23	E	E	—	—	
Chloracetic Acid	100	158	70	E	E	—	—	
Chloracetic Acid	to 70 80 100	to B.P. 75 to 356	to B.P. 24 to 180	— E* E*	S E —	— — —	— — —	*monochloracetic acid
Chloracetic Acid, Mono	—	68	20	E	E	—	—	plus 15 percent dichloracetic acid and 15 percent acetyl chloride. Alloy C <0.1 mpy
Chloracetic Acid, Mono	—	160-180	71-82	G	S	—	—	Alloy C = 14 mpy
Chloracetic Acid, Mono	60 60 60 60	77 (1) 77 (2) 77 (3) 140 (1)	25 (1) 25 (2) 25 (3) 60 (1)	— E — S	E S — S	— — — —	— — — —	plus 38 percent acetic acid, 1.5 acetyl chloride, 0.5 percent H_2S in mother liquor (1) no agitation (2) slow agitation (3) fast agitation
Chloracetic Acid, Mono (Tech. Grade)	—	86	30	S	E	—	—	process is to dissolve 945 grams/liter solid MCA in water. Solution agitated with air. Alloy C = 0.2 mpy
Chloracetic Acid, Mono (Tech. Grade)	100	60-70	16-21	G	E	—	—	Alloy C = nil mpy
Chloralphenoxy-Acetic Acid, 2-4 Di	—	250	121	—	E	—	—	production of this acid from monochlorobenzene, dichlorophenol, monochloracetic acid, NaOH and H_2SO_4.
Chlorethylene, Tri	100	to B.P.	to B.P.	E	—	—	—	vapor and liquid — sometimes steam and ammonia present
Chloric Acid	3	75	24	U	E	—	—	4 percent H_2SO_4, 3 percent H_2O_2 carotting solution. Alloy C = 0.1 mpy. 47-day test.
Chlorinated Water	100 100	75 190	24 88	— —	E S	— —	— —	saturated
Chlorine	97	50-180	10-82	—	E	—	—	plus 3 percent inert gas (CO_2 H_2, etc.) water saturated. Alloy C = 0.07 mpy (50 deg. F), 0.9 mpy (180 deg. F)

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS–CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	deg. C	HASTELLOY® alloy B/B-2	C/C-276	G	Type 316 Stainless Steel	Conditions
Chlorine	—	0	-18	—	E	—	E	duration of test — 139 days, dry chlorine gas
Chlorine	—	Ambient	Ambient	—	G	—	—	chlorine "sniff" scrubber, 400 hrs.
Chlorine	—	68	20	—	E	—	—	plus HCl and organic acid
Chlorine	—	76-86	24-30	B*	S*	—	B*	feed Cl_2 to dichloropropene at 5 psig, 672 hrs. *vapor phase in liquid. Alloy B = 30 mpy, Alloy C-276 = 13 mpy, Type 316 Stainless Steel = 32 mpy
Chlorine	—	77-90	25-32	—	E	—	E	dry chlorine gas
Chlorine	—	86	30	G	G	—	—	chlorination system in alkylbenzene unit samples in chloronator circulating loop, 3936 hrs.
Chlorine	—	120-135	49-57	—	E	—	—	above sodium cell in fumes containing sodium oxychloride, sodium chloride, sodium oxide smoke and moist air. Alloy C = 0.1 mpy, 0.001 in max. pitting
Chlorine	—	140	60	—	E	—	—	w/entrained 89.1% sulfuric acid and organic impurities
Chlorine	—	302	150	—	E	—	—	1000 ppm Cl_2 in vapor phase during dechlorination. Alloy C = 0.3 mpy, 1776-hr. test
Chlorine (Wet)	100	75	24	—	G	—	—	
Chlorine (Wet)	—	60-200	16-93	—	G	—	—	
Chlorine (Wet)	—	86	30	—	E	—	—	Alloy C = 1.1 mpy, 67.8 hr. test
Chlorine (Wet)	—	104	40	—	G	—	—	with some sea-water spray
Chlorine (Wet)	—	122	50	—	E	—	—	plus hydrochloric and hydrochlorous acid, chlorination of polyethylene, 72 hrs.
Chlorine (Wet)	—	170	77	—	E	—	—	organic solids, condensed water, slight attack under spacer. Duration of test — 67 days
Chlorine (Wet)	—	185	85	—	S	—	—	in vapor space of sulfur separator. Plus H_2O, S, and organic thio and chloride
Chlorine (Wet)	—	190	88	—	G	—	—	Alloy C = 4.5 mpy, 72 hrs.
Chlorine (Wet)	—	190	88	—	G	—	—	condensed water and organic solids, duration of test — 203 days, perforated
Chlorine (Wet)	—	190	88	—	U	—	—	duration of test — 28 days, perforated, salt brine spray
Chlorine (Wet)	—	190	88	—	G	—	—	duration of test — 74 days, severe pitting, salt brine spray
Chlorine (Wet)	—	190	88	—	G	—	—	duration of test — 18 days, moderate attack under spacer
Chlorine (Wet)	—	190	88	—	G	—	—	duration of test — 202 days, perforated
Chlorine (Wet)	—	190	88	—	S	—	—	condensed water and organic solids/spacer, duration of test — 18 days, moderate attack under spacer
Chlorine (Wet)	—	205	96	—	U	—	—	duration of test — 40 days, moderate pitting, salt brine spray
Chlorine (Wet)	—	205	96	—	B	—	—	duration of test — 203 days, salt brine spray
Chlorine (Wet)	—	225	107	—	E	—	—	in steam, HCl_1 cell liquor, tetrachloroethane bleach
Chlorine Saturated River Water	—	200	93	—	G	—	—	in vertical section overflow pipe. Alloy C = 2 mpy
Chlorine Saturated Water	—	205	96	—	E	—	—	
Chlorine Dioxide	0.01	50	10	—	E	—	—	residual amounts in bleached pulp, pH = 8-9. Alloy C = 0.1 mpy
Chlorine Dioxide	5	210	99	—	S	—	—	in steam
Chlorine Dioxide	8-10*	150	66	—	B	—	—	condensed chlorine dioxide solution, flow rate of 250 c.f.m., 350-hr test *by volume.
Chlorine Dioxide	15	110	43	—	E	—	—	$HOCl_1$ Cl_2 and water
Chlorine Dioxide	—	35-40	2-4	—	G	—	—	in water saturated with ClO_2 (7 grams/liter). Alloy C = 3.7 mpy
Chlorine Dioxide	—	36	2	—	S	—	—	4-5 g/l, pH 2-3.5, 351-hr test
Chlorine Dioxide	—	38	3	—	E	—	—	at top of absorber. Alloy C = 0.1 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Chlorine Dioxide	—	50	10	—	E	—	—	0-1.5 grams/liter ClO_2 plus trace SO_2, 0-9 grams/liter $NaClO_3$, 18-38 percent H_2SO_4 in spent liquor tank. Alloy C = 0.5 mpy
Chlorine Dioxide	—	135	57	—	S	—	—	78 percent H_2SO_4, 32 percent sodium chlorate and methanol aeration, flow rate of 60 g.p.m., 351-hr. test.
Chlorine Dioxide	—	150-170	60-77	—	E	—	—	ClO_2 water and gas, plus 0.2 grams/liter HCl in water. pH = 3.5. Alloy C = 0.1 mpy
Chlorine Dioxide	—	155	68	—	E	—	—	spent gas in vent line of bleach tower, 338-hr. test
Chlorine Dioxide	—	155	68	—	S	—	—	plus 45 percent H_2SO_4, 0.020 grams/liter sodium chlorate in pulp bleaching.
Chlorine Dioxide	—	155	68	—	E	—	—	pH = 6.5 spool exposed in headbox in No. 6 pulp washer. Kraft pulp stock plus residual ClO_2
Chlorine Dioxide	—	175-185	79-85	—	E	—	—	at top of bleach retention tower. Alloy C = 0.7 mpy
Chlorine (Mixtures)	—	59-86	15-30	—	E	—	U	cyanogen chloride, chlorine, water (all gas)
Chlorine (Mixtures)	—	68-85	20-29	—	E	—	B	cyanogen chloride (CNCl), chlorine, water vapor (about 1000 ppm)
Chlorine (Mixtures)	—	169-212	76-100	—	E	—	E	cyanogen chloride (CNCl) chlorine, carbon tetrachloride, water (trace)
Chlorine w/Nitrogen	—	180-205	82-96	E	E	—	—	
Chlorine Oxides	38	120	49	—	E	—	G	sodium chlorate 1.55%, sulfur dioxide 8% in air, sodium chloride 0.3%, extensive aeration
Chlorine Oxides	—	40	4	—	G	—	E	chlorine dioxide solution in water, part of time sulfur dioxide 6% in air, moderate aeration
Chlorinated Hydrocarbons, Amines, Ammonium Chloride	—	100-250	38-121	G	G	—	U	production of NIAX catalyst A-99. React chlorex with methylamine to make ammonium chloride then react w/diethanolamine; 275 hrs.
Chloroacrylic Acid	—	131	55	U	G	—	—	HCl, CuCl, $CuCl_2$, NaCl, production of defoliant; 204 hrs.
Chloroacrylic Acid	—	140	60	G	E	—	—	HCl, CuCl, CIS-3 Chloroacrylic acid extraction concentrated solution after stripping (tails) was used, 48 hrs. lab test
Chlorobenzene	60	40-100	4-38	E	E	E	E	40% chloral, pH 2.0, 96 days
Chlorobenzene	60	40-100	4-38	—	E	—	E	chloral 40% (trichloro acetaldehyde), water not over 0.5%, hydrogen chloride trace. (pH of water extract 2.0)
Chlorobenzene	—	250	121	—	E	—	—	commerical trichlorobenzene vapor, ammonia and chlorides, extensive aeration
Chlorobenzene, Mono	—	77-338	25-170	S	E	—	—	1114-lb. 3-chlorodiphenylamine, 311-lb. sulfur, 11-lb. iodine, 475-gal. monochlorobenzene. Alloy C = 1.5 mpy
Chloro Ethyl Ether, Ethylene Chlorohydrin	—	302	150	E	E	—	G	still system for cracking DI (2-chloroethyl) acetal to vinyl 2-chloroethyl ethers and ethylene chlorohydrin. Samples in kettle liquid, 300 hrs.
Chlorofluoromethanes	64	100-180	38-82	—	E	—	E	trichloromonofluoromethane and dichlorodifluoromethane, hydrogen chloride 20%; hydrogen fluoride 10%; carbon tetrachloride 1%; antimony pentachloride, oxygen, nitrogen, total 5% (all approx.) water not over 200 ppm.
Chlorofluoromethanes	60	100-180	38-82	—	E	—	E	dichloromonofluoromethane and monochlorodifluoromethane, hydrogen chloride 20%; hydrogen fluoride 10%; chloroform 5%, antimony pentachloride, oxygen, nitrogen, total 5% (approx.) water not over 200 ppm.
Chloroform	100	to B.P.	to B.P.	S	S	—	—	
Chloromethylphenoxyacetic Acid	99	300	149	—	E	—	—	4-chloromethylphenoxyacetic acid, small amts. hydrogen chloride, sodium chloride, water.
Chloromethylphenoxyacetic Acid	99	315	157	G	E	G	B	4-chloromethylphenoxyacetic acid, small amts. hydrogen chloride, sodium chloride, water.
Chloronaphthalenes	100 100	300-360 300	149-182 149	E* —	— E**	— —	— —	*vapor and liquid in neutralization of free HCl with lime **vapor and liquid phases
Chlorophenol	—	122-140	50-60	S	E	—	—	in liquid and vapor phase during chlorination of phenol. Contamination from HCl, H_2S, $FeCl_3$
Chlorophenol, Dichlorophenol	—	250	121	—	E	—	—	hydrogen chloride trace, water vapor trace, moderate aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS–CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Chloropicrin	—	203	95	—	E	—	—	plus water, calcium hypochlorite, lime, 8 percent calcium chloride and calcium carbonate, pH = 10-11
Chlorosulfonic Acid	10 45	75 75	24 24	— E*	S —	— —	— —	in smoke screen manufacturing. *plus 50 percent SO_3
Chlorosulfonic Acid	45	49-84	9-29	E	—	—	—	plus 50 percent SO_3. Alloy B = 0.02 mpy in liquid and vapor
Chlorosulfonic Acid	80	68-113	20-45	E	—	—	—	plus 20 percent oleic acid. 0.1 mpy in vapor, 0.3 in liquid
Chlorosulfonic Acid	100	185	85	G	E	—	G	163 hrs. lab test
Chlorosulfonic Acid	—	to B.P.	to B.P.	E	—	—	—	alkyl-aryl organics, HCl, and SO_2 in sulfonation vessel
Chlorosulfonic Acid — Ethyl Ether System	—	32	0	—	E	—	S	sulfonation reactor, 20 hrs.
Chloro-Trifluoro Ethylene	—	70-120	21-49	E	E	—	—	partially liquefied plus 1 percent or less HCl and water in trace amounts.
Chromic Acid	2	Boiling	Boiling	—	G	—	—	120 hr. lab test
Chromic Acid	10	Boiling	Boiling	—	U	U	—	120 hr. lab test
Chromic Sulfate (Basic)	to 30 50	to B.P. 125	to B.P. 52	S S	— —	— —	— —	
Chromium Sulfate (Basic)	50	130	54	G	E	—	—	Alloy C = 0.07 mpy, mild agitation
Chromium Sulfate (Basic)	55	150-250	66-121	—	B	—	—	480-hr. test
Chromium Potassium Sulfate	10	to B.P.	to B.P.	S	—	—	—	
Citric Acid	10	60-180	16-82	S	E	—	—	manufacture by aerobic fermentation — air sparging. Alloy C = 0.1 mpy
Citric Acid	10	80-170	27-77	B	G	—	—	manufacture by acid by fermentation with sucrose, made acid with HCl. Alloy C = 4 mpy
Citric Acid	10	Boiling	Boiling	—	E	—	—	
Citric Acid	to 58	130	54	U	G	—	—	concentration by boiling solution from 15° to 30° Bé. 120-hr. test, Alloy C = 4.5 mpy
Citric Acid	All	to B.P.	to B.P.	E	E	—	—	
Citric Acid	—	105	41	—	E	E	E	mixed fermentation tank effluent, some citric acid salt, 5 to 65% solids, 0.08 to 1.2% chloride, pH 5
Clarifier Liquid	—	180	82	—	E	E	E	clarifier liquid in municipal refuse incinerator. Water treated with calverts coagulant II and ammonia to nominal pH of 6, moderate aeration
Coagulation Solution, Synthetic Rubber	—	90	32	B	—	—	—	plus 0.01 percent H_2SO_4, 3.3 percent NaCl, pH = 3.3, in discharge weir of dewatering skimmer
Cooking Liquor	13.2	115	46	—	U	S	U	aeration
Cooking Liquor	13.2	115	46	U*	U*	—	G	aeration, *specimen corroded away or was lost
Cooking Liquor	13.2	300	149	B	B	—	B	aeration
Cooking Liquor	13.2	300	149	—	U*	G	G	aeration, *specimen corroded away or was lost
Copper Chlorides	—	455	234	—	E	—	U	cuprous chloride, cuprous cyanide, p-chloro phenol N methyl pyrrolidone, p-cyanophenol
Copper Cyanide	—	170	77	S	E	—	—	copper plating solution copper cyanide = 10 oz./gal. caustic soda = 4 oz./gal. sodium cyanide = 2 oz./gal.
Copper Smelting Gas	—	105	41	—	E	E	E	copper smelting gas containing 0.75-1% SO_2 and some sulfuric acid mist (25-100 ppm), extensive aeration
Copper Smetler Gas	—	135	57	—	E	E	E	copper smelter gas after cooling in a H_2O spray tower. Gas contains H_2O at 2.5 pH plus sulfuric acid mist (25-100 ppm), extensive aeration
Copper Smelter Gas	—	100	38	—	E	E	S	copper smelter gas and recycled cooling spray water (pH as low as 1.7 avg. 2.5) 1-1.5% SO_2 in gas plus particulate and SO_3, extensive aeration
Copper Sulfate	45	190	88	U	E	E	E	12% Cu avg., 0.5% H_2SO_4, 90 days, copper refining, moderate aeration
Copper Sulfate	88	160	71	U	E	—	E	12% sulfuric acid, air free, copper refining, 113 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Copper Sulfate	All	to B.P.	to B.P.	—	E	—	—	
Copper Sulfate	—	150	66	—	E	—	E	electrolyte, 194 g/l H_2SO_4, 49 g/l $CuSO_4$, 1 g/l CaO
Copper Sulfate	—	160	71	—	U	—	—	40-70 grams/liter $CuSO_4$, 3-6 grams/liter Ag_2SO_4
Corn Starch	1.5-1.7	300	149	—	E	—	E	corn starch acidified with HCl to pH of 1.5-1.7, steam injection at 150 psi
Creosote Oil	—	329	165	S	E	—	—	plus 7 percent acetic acid, 2-3 percent propionic acid and higher acids.
Cresylic Acid	All	to B.P.	to B.P.	S	S	—	—	
Cresylic Acid	—	86-356	30-180	—	S	—	U	cresylic acid, phosphorous oxychloride, tricresyl phosphates, hydrogen chloride, aluminum chloride 1%, pyridines less than 0.1%. Anhydrous.
Cresylic Acid	—	100	38	—	E	—	—	plus NaOH and water. Alloy C = 0.5 mpy
Cresylic Acid	—	113-266	45-130	—	E	—	E	cresylic acid, phenol, formaldehyde, sulfuric acid, ethylenediamine, phosphoric acid, sodium hydroxide, carbon dioxide, ammonia, barium hydroxide. Corrosive media varied from mixed phenol and sulfuric acid at 266°F to 20% sodium hydroxide at 212°F. (Batch-basis manufacture of phenolic resins and varnishes), moderate aeration
Cresylic Acid	—	266	130	—	E	—	E	cresylic acid, phenol, formaldehyde, sulfuric acid, ethylenediamine, phosphoric acid, sodium hydroxide, barium hydroxide, carbon dioxide, ammonia, aeration
Cresylic Acid	—	284	140	E	E	—	U	phenol, phosphorus oxychloride, tricresyl phosphate, hydrogen chloride, aluminum chloride 0.5-1%, pyridines <1%. Anhydrous
Cresylic Acid	—	350	177	—	E	—	—	plus H_2S, H_2O and some organics in boiling solution. Alloy C <0.1 mpy
Cresylic Acid (Crude)	—	350	177	—	E	—	—	Alloy C = 0.04 mpy, some H_2S
Crude Oil	—	145	63	—	E	—	E	with oil field brine containing 15 ppm S
Crude Oil	—	750-780	399-416	E	—	—	—	mixed Louisiana crude; sulfur = 0.26 percent, salt content = 3-5 lb./1000 lb.
Crude Toluene	—	339	171	G	E	—	S	dimethylaniline hydrochloride refining crude toluene; 235 hrs.
Cumeme	—	140-160	60-71	U	—	—	—	plus phenol, acetone
Cumeme	75	207-221	97-105	E	—	—	—	plus 25 percent cumene hydroperoxide. In liquid phase. Manufacture of phenol from cumene.
Cumeme Hyperoxide	75	176-221	80-105	E	—	—	—	plus 25 percent cumene
Cupric Chloride	5	104	40	—	E	—	—	max. pitting = 0.001 in.
Cupric Chloride	to 50	to 75	to 24	—	S	—	—	
Cupric Chloride	—	60-80	16-27	—	E	—	—	plus $CuSO_4$ and NaCl in gasoline sweetening
Cupric Cyanide	10	to B.P.	to B.P.	—	S	—	—	
Cupric Nitrate	5	75	24	—	S	—	—	
	10	75	24	—	S	—	—	
	50	75	24	—	S	—	—	
	75	75	24	—	S	—	—	
	100	75	24	—	S	—	—	
Cuprous Chloride	—	455	235	U	E	—	U	cuprous cyanide, 48 hrs., agitaion — boiling action only
Cyanuric Chloride	5-20	115	46	E	E	—	G	in carbon tetrachloride or toluene, chlorine 0.5%, cyanogen chloride (CNCL) 0.3%, hydrogen chloride and phosgene (carbonyl chloride, $COCl_2$) traces, moderate aeration
Cyanuric Chloride	5-20	60-160	16-71	—	E	—	G	in carbon tetrachlorine or toluene, chlorine 0.5%, cyanogen chloride (CNCl) 0.3%, hydrogen chloride and phosgene (carbonyl chloride, $COCl_2$) traces, moderate aeration
Cyanuric Chloride	—	50	10	G	E	—	E	toluene, dichlorocyanuroisopropamide ($C_3N_3Cl_2NHCH(CH_3)_2$), sodium hydroxide, sodium chloride 10%; pH 11-13, moderate aeration
Cyanogen Chloride	—	77	25	—	E	—	B	chlorine water vapor (about 1000 ppm)
Cyanogen Chloride	—	176	80	E	E	—	E	chlorine, carbon tetrachloride, water (trace)
Cyanuric Chloride	—	221	105	E	E	—	E	toluene, carbon tetrachloride, traces of chlorine, cyanogen chloride, water
Cyanogan Chloride (Gas)	—	59-86	15-30	G	E	—	U	chlorine, water

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Detrose (Greens) Liquor	—	315-325	158-163	—	G	—	—	0.04 N HCl. Alloy C = 4.35 mpy
Di-basic Organic Acid and Thiourea	—	158	70	E	E	—	E	
Di-basic Organic Acid and Thiourea	—	158	70	E	E	—	E	aeration, H_2S in vapor phase
Dichlorethane	100	to 125	to 52	S	S	—	—	
Dichlorobenzene	—	355	180	E	E*	—	—	4-5% hydrogen chloride, duration of test — 53 days, *slight attack under spacer
Dichloromonofluoromethane and monochlorodifluoro-methane	60	165	74	G	E	—	E	hydrogen chloride 20%; hydrogen fluoride 10%; chloroform 5%; antimony pentachloride, oxygen, nitrogen, total 5% (all approx.); water not over 200 ppm
Dichlorophenol	100	250	121	E	E	E	E	trace of hydrogen chloride and water vapor Duration of test — 36 days Aeration — moderate Agitation — none Process involved — dichlorophenol
Diethyl Malonate	—	77-212	25-100	G	E	—	—	2 cycles, liquid 72 hrs., vapor 130 hrs., malononitrile process (pilot plant test)
Diethyl Sulfate	—	180-194	82-90	G	E	—	U	Alloy B pitted in liquid. H_2SO_4 (small amt. probably). 153 hrs.
Dimethylaniline Hydrochloride	26	212	100	E	G	—	U	117 hrs. field test, aqueous DMA-HCl
Unsymmetrical Dimethylhydrazine	—	86	30	E	E	—	E	testing rocket fuels, 28 days
Unsymmetrical Dimethylhydrazine	—	146	63	E	E	—	—	testing rocket fuels, 7 days
Diphenylamine	—	212	100	E	E	—	E	hot wash liquid, reaction product of diphenylamine and acetone in HBr catalyst after addition of 50% NaOH to yield pH of 12-14, moderate aeration
Dodecylbenzene Sulfonic Acid	—	145-165	63-74	B	—	—	—	plus SO_2, SO_3, spent H_2SO_4 at bottom of sulfonator. Alloy B = 27 mpy (liquid), 32 mpy (vapor)
Duke's Mixtures	—	70	21	—	E	—	S	industrial waste: water, low but widely varying concentrations of hydrochloric, hydrobromic, sulfuric, sulfurous acids, alcohols, chlorinated organic solvents. pH about 1, moderate aeration
Electrolyte	—	150	66	S*	E	E	E	194 g/l H_2SO_4, 49 g/l $CuSO_4$, 1 g/l CaO. *specimen corroded away or was lost, air free
Epichlorhydrin	—	176-212	80-100	—	E	—	—	plus caustic soda, bisphenol, trichloroethylene, and sodium chloride brine. pH = 10-12 in resin manufacture. Alloy C <0.1 mpy
Esterification	—	—	—	—	E	—	E	
Ethanol	50-75	176	80	—	—	E	E	2-5% Diethyl Ether, 05-0.2% H_2SO_4, Balance primarily water. Phthalate ester manufacturing. Agitation, by 1100 lb./hr. flow, total days 146.
Ethanol	75	—	—	—	—	E	E	containing 0.81% ethyl acid pthalate and 0.405% sulfuric acid under reflux. Pthalate ester mfg.; total days 45.7
Ethanol	—	176-212	80-100	—	G	—	—	plus ethyl acetate, calcium acetate, H_2SO_4 in distillation of ethyl acetate. Alloy C = 7 mpy
Ethanol	—	258	125	U	E	—	—	ethanol acid system, 240 hrs.
Ether	100	75	24	—	E	—	—	
2-Ethoxyethyl Acetate	98	334	168	E	E	—	E	water 1%, acetic anhydride 0.2%, acetic acid 0.1%, non-volatile, 0.2%, moderate aeration
Ethyl Acetate	35	250	121	—	E	—	—	plus 32 percent benzene, 2 percent formic acid, 15 percent acetic acid, 9.5 low boilers. Alloy C = 0.78 mpy
Ethyl Acetate	100	75 to B.P.	24 to B.P.	—	S	—	—	
Ethyl Alcohol	56	122-171	50-77	G	E	—	—	plus 1-11 percent butyraldehyde, 5 percent ethyl acetate, 0.4 percent H_2SO_4, Alloy C = 0.8 mpy
Ethyl Benzene	—	240	116	—	E	—	—	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Ethyl Chloride	25 50 70 100	75 75 75 75	24 24 24 24	S S S S	S S S S	— — — —	— — — —	
Ethyl Cyanoacetate	—	77-212	25-100	G	E	—	—	lab test, agitation
Ethylene, Cracked Gases	—	160-170	71-77	E	E	—	—	contains some organic acids, CO_2, HCl, H_2O. pH = 5.0 approx., Alloy C = 0.127 mpy
Ethylene Diamine Hydrochloride	100	to B.P.	to B.P.	—	B	—	—	
Ethylene Diamine Hydrochloride	8-8.5	250-365	121-185	S	G	—	—	in 50 percent ammonia solution. Alloy C = 5.7 mpy
Ethylene Diamine Tetra-acetic Acid	50-60	183	84	—	E	—	—	plus 30-40 percent anhydride 0-20 percent solids. Alloy C = nil mpy, 16,800-hr. test.
Ethylene Dichloride	—	100-220	38-104	E	U	—	—	plus water, pella oil, and occasional traces of HCl. Alloy C = 72 mpy
Ethylene Glycols	20	Ambient to 320	Ambient to 160	—	E	—	—	sodium hydroxide diethylene glycol 80% forming sodium diethylene glycolate. Addition of dimethylamine, organic chloride, forming amide: strongly alkaline
Ethylene, Trichlor Crude	—	156	69	E	E	—	—	plus gaseous ammonia in distillation process. Alloy C = 0.03 mpy
Exhaust Air	—	170	77	—	E	—	E	saturated with water vapor containing chlorine (low concentration and in suspended droplets), sodium hydroxide, chromate and chromic wastes (low concentration) and chloride, extensive aeration
Exhaust Gases from evaporator	—	50-355	10-180	—	G	—	—	entrained phosphoric acid, sulfuric acid vapor, sulfur trioxide, nitrous acid, silicon tetrafluoride, water vapor: sprayed with water containing phosphoric acid 0.1%, sulfuric acid 0.06%, combined fluoride 0.1%, extensive aeration
Exhoxylates	—	94	35	G	E	—	B	36 hrs., samples in circulator line. Sulfonation of ethoxylates with chlorosulfonic acid. HCl evolved.
Fabric Softeners & Manufacture	80-85	160	71	—	E	—	—	secondary amines of tallow dissolved in isopropyl alcohol, methyl chloride added to MNTN press and 73% NaOH to keep neutral
Fabric Softener Rx Effluent	—	130	54	—	E	E	E	quaternary salt of tallow in isopropyl alcohol with 1-2% HCl to make slightly acid, 1% H_2O and Cl. Manufacture of fabric softener, agitation — lightening mixer, total days 235.0
Fatty Acids	90	220-240	104-116	—	E	—	—	plus 5 percent H_2SO_4, 3 percent sebacic acid, small amounts of Na_2SO_4, K_2SO_4 and H_2O
Fatty Acids	100 100	to 275 to 600	to 135 to 316	E E	E* E*	— —	— —	*liquid and vapor phases
Fatty Acids	—	210	99	—	E	—	—	in distillation from tail oil
Fatty Acids	—	455-473	235-245	—	E	—	—	during fractionation. Alloy C = 0.5 mpy
Fatty Acids	—	Room to 220	Room to 104	—	E	—	E	vapor over fatty acid (sebacic), sulfuric acid, pH 2-6, extensive aeration
Fatty Acids	—	250-450	121-232	G	E	—	—	plus iodine and rosin vapors. Alloy C = 0.5 mpy
Fatty Acids, Tall Oil	—	560-590	293-310	—	E	—	—	in Kraft pulp manufacture. Alloy C = 1.0 mpy in vapor phase, 0.1 mpy in liquid
Ferric Chloride	—	200	93	—	U	—	—	plating solution, 450 grams/liter $FeCl_3$, enough HCl to keep pH = 0.4
Ferric Chloride	—	216	102	—	E	—	—	plus ammonia and fatty acids. Alloy C <0.1 mpy
Ferric Chloride	5 10 15 45 50	75 150 75 75 to B.P.	24 66 24 24 to B.P.	U U U U U	E B E S —	— — — — —	— — — — —	
Ferric Nitrate	10	75	24	—	E	—	—	
Ferric Sulfate	2-4	160	71	B	E	—	E	ferrous sulfate 0-2%, sulfuric acid 0.5%, pH 1.2, hydrogen peroxide trace, aeration
Ferric Sulfate	—	235	113	—	—	E	E	slurry reaction mixture, lab test 68.7 days, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Ferric Sulfate	4	160-163	71-73	—	E	—	—	plus $Fe_2(SO_4)_3$, H_2SO_4 to pH = 2.5. Alloy C = 0.3 mpy
Ferric Sulfate	to 30	to 150	to 66	—	E	—	—	
Ferrous Ammonium Sulfate	—	212	100	—	—	E	—	1390 g/l
Ferrous Ammonium Sulfate	—	212	100	—	—	E	—	695 g/l
Ferrous Chloride	10	86	30	U	E	—	—	aeration, saturated.
Ferrous Chloride	Satr. Soln.	275	135	G	G	—	—	in evaporator with 0.09 percent HCl. Alloy C = 2.5 mpy
Ferrous Sulfate	Weak	450	232	U	B	—	—	plus traces of ferric sulfate and sulfuric acid. pH = 2.5-4.0 in crystallization process. Alloy C = 22 mpy
Ferrous Sulfate	5	65	18	U	E	—	—	Fe_2O_3 slurry. Alloy C = 0.03 mpy
Ferrous Sulfate	All	to B.P.	to B.P.	S	S	—	—	
Ferrous Titanite	55 55	to B.P. 375	to B.P. 191	— —	E E	— —	— —	during digestion and evaporation — 45 percent ammonium fluoride
Fertilizer, "Slurry mix"	6-12-18	30	-1	—	E	—	E	calcium acid phosphates, mono- and di-, approx. 21%, potassium chloride 19%, ammonium nitrate 17%, water 30%, inert materials approx. 12%, largely insoluble. pH 6.5 to 7.5, moderate aeration
Fertilizer, "Slurry mix"	6-12-18	40	4	B	E	—	E	calcium acid phosphates, mono- and di-, approx. 21%, potassium chloride 19%, ammonium nitrate 17%, water 30%, inert materials approx. 12%, largely insoluble. pH 6.5 to 7.5, extensive aeration
Fertilizer, "Slurry mix"	14-7-7	25	-4	E	E	—	E	ammonium nitrate, 40%, calcium acid phosphate, mono- and di- approx. 12%, potassium chloride 11%, water 30%, inert materials approx. 12%, largely insoluble. pH 3.5 to 4.5
Fertilizer, "Slurry mix"	—	200	93	—	G	—	B	nitric acid, phosphoric acid, sulfuric acid, phosphate rock reactants. Product: potassium chloride 9 to 18%; calcium acid phosphates, mono- and di- 6 to 14%; ammonium nitrate 6% to 14%. Water approx. 30%. Inerts approx. 12%, mostly solubles, moderate aeration
Fibers (Hardwood or Pine)	1	83	28	—	E	E	E	pH 5-6. Low concentrations of chlorides and sodium, trace chlorine dioxide. Kraft pulp bleaching; agitation 2 FPS; moderate aeration, total days — 379
Flue Gas	—	100	38	—	E	—	E	recirculating refuse incinerator scrubber water pH 6.1 ave., 1.8 min., 11.2 max. inhibited with 121 ppm LN 120 and pH adjustment with NaOH, moderate aeration
Flue Gas	—	120	49	—	E	—	E	containing sulfur dioxide, 100-500 ppm, saturated, 62.5 days
Flue Gas	—	130	54	—	E	—	E	containing sulfur dioxide, 100-500 ppm, 62.5 days
Flue Gas	—	140	60	G	S	—	S	particulates and gaseous emission from a glass frit smelter. Gases contain nitrogen oxide, fluorides, moderate aeration
Flue Gas	—	150	66	—	B	B	U	wet flue gas (spool 5950) after H_2O spray, scrubber slurry ($CaSO_3$) mainly, also $Ca(OH)_2$ or $CaCO_3$ plus $CaSO_4$ pH 3-12 during upsets
Flue Gas	—	150	66	B	E	E	S	incinerator scrubber, municipal wastes, excess air added during incineration, 85 days
Flue Gas	—	150	66	U	E	E	E	incinerator scrubber, municipal solid waste, excess oxygen added during incineration, 85 days
Flue Gas	—	150	66	B	E	—	E	
Flue Gas	—	160	71	G	E	—	S	scrubbed fumes from garbage incineration. Hot flue gas and suspended solids directly from furnace during bypass operation, extensive aeration
Flue Gas	—	160	71	E	—	E	E	neutralized mixed effluent from quench chamber and scrubber — neutralized with NaOH pH about 6.0, 105 days, moderate aeration
Flue Gas	—	160	71	U	E	E	E	mixed effluent from quench chamber and scrubber — unneutralized pH 3-5, excess air added during incineration, 85 days, moderate agitation
Flue Gas	—	164	73	—	E	E	E	aeration
Flue Gas	—	169	76	—	E	E	E	aeration present from higher excess air
Flue Gas	—	170	77	—	E	E	E	from incineration of medicinal solid wastes and waste pathological animal remains. pH partially controlled near 7 but ranges to 1 or 2, 74 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	deg. C	HASTELLOY® alloy B/B-2	C/C-276	G	Type 316 Stainless Steel	Conditions
Flue Gas	—	170	77	S	E	E	E	incinerator scrubber, municipal solid waste, excess air added during incineration, 85 days
Flue Gas	—	180	82	B	E	E	E	incinerator scrubber, municipal solid waste, excess air added during incineration, 85 days
Flue Gas	—	175-195	79-91	U	G	G	B	aeration: ~ 15% O_2
Flue Gas	—	200	93	—	E	—	E	water-scrubbed from combustion of municipal refuse; nearly saturated with water vapor, considerable aeration
Flue Gas	—	200-220	93-104	U	E	E	E	aeration: ~ 15% O_2
Flue Gas	—	200-250	93-121	—	E	E	E	aeration
Flue Gas	—	212	100	B	E	E	E	effluent from quench chamber incineration of garbage, excess in air added during incineration, 85 days
Flue Gas	—	300	149	B	E	E	S	incinerator scrubber, municipal solid waste, excess air added during incineration, 85 days
Flue Gas	—	305	152	B	E	—	S	water and water vapor, pH 2.0 to 4.0, aeration
Flue Gas	—	350	177	—	E	—	E	containing sulfur oxides, nitrogen oxides, CO, CO_2, HCl, O_2, N_2 and fly ash, pH 4.5, excess air to support
Flue Gas	—	370	188	—	E	E	E	750 ppm, CO_2 0.7%, H_2O 1-3%, bal. air
Flue Gas	—	400	204	—	G	—	S	carbon dioxide 15%, oxygen 4.7%, nitrogen 80.4%, (all dry basis) water vapor about 25%, suspended solids.
Flue Gas	—	100-800	38-427	E	—	—	—	plus 1-5 percent HCl by volume and CO_2
Flue Gas	—	1100	593	—	E	—	E	hot exhaust gases and steam from water sprays off refuse incinerator, extensive aeration
Flue Gas	—	—	—	—	E	—	E	stack gas from firetube boiler burning #4D oil (4% sulfur content) in cyclic operation
Flue Gas	—	—	—	—	E	G	S	from municipal refuse, aeration
Flue Gas	—	—	—	—	E	—	E	from municipal refuse incinerator
Flue Gas	—	—	—	—	E	E	E	with entrained H_2O and slurry (calcium sulfate, calcium sulfite), aeration
Fluegas, Power Plant	—	130-135	54-57	—	—	E	E	aeration
Fluegas, Power Plant	—	140	60	—	E	G	B	with entrained scrubbing liquor, aeration
Fluoboric Acid	32	149-176	65-80	E	—	—	—	plus 1.5 percent boric acid
Fluoboric Acid	—	90-100	32-38	—	E	—	—	40 grams/liter H_3BF_4 at pH 1.7 to 1.9 in gas washer. Possible traces of HF. Alloy C = 0.2 mpy
Fluoboric Acid	—	100-180	38-82	—	E	—	—	10 grams/liter H_3BF_4 at pH 3.2-3.4 in spent liquor tank. Alloy C <0.1 mpy
Fluoboric Acid	—	160-209	71-98	—	E	—	—	plus aluminum trihydrate slurry at pH 1.9 to 2.1. Alloy C = 0.4 mpy
Fluorine	100 100 100	75 150 950	24 66 510	G — —	— E E*	— — —	— — —	*furnace gas after lime water spray. Penetration rate varied from 0.7 to 2.6 mpy at lower temperatures. Alloy C gained weight slightly
Fluorides, Fused	—	1112	600	E	—	—	—	NaF-ZrF_4, fluorine purge 63 hrs., helium purge 153 hrs., fluorine flow rate 10 gal./hr.
Fluosilicic Acid	11-13	140-165	60-74	B	G	E	B	wet process H_3PO_4, liquid phase, 49 days, extensive aeration
Fluosilicic Acid	16	80-140	27-60	S	G	—	—	plus 0.3 percent H_2PO_4, 0.5 percent SiO_2, 83 percent water. Alloy C = 2 mpy
Fluosilicic Acid	20	130-140	54-60	—	G	—	—	in fume scrubber. Alloy C = 5 mpy
Fluosilicic Acid	25 50 70 100	75 75 75 75	24 24 24 24	S S S S	S S S S	— — — —	— — — —	
Formaldehyde	2	245	119	—	G	—	—	plus 0.2 percent formic acid, methanol, ketones and other aldehydes. 138-day test with agitation and no aeration.

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Formaldehyde	10 10	220 243	104 117	— —	E • E	— —	— —	plus traces of formic acid, calcium formate, and glycols, 87-day test in bottom of fractionating tower. 87-day test at center of tower.
Formaldehyde	12-15	275	135	—	G	—	—	plus 2 percent formic acid, 2 percent various alcohols, aldehydes and resins. Alloy C = 7 mpy
Formaldehyde	20 50 70 100	to B.P. to B.P. to B.P. to B.P.	to B.P. to B.P. to B.P. to B.P.	S S S S	S S S S	— — — —	— — — —	
Formaldehyde	20	275	135	—	E	—	—	plus 10-15 percent volatiles (ethanol, acrolein, acetone) and 0.1 percent formic acid, 71-day test with agitation and no aeration.
Formaldehyde	40	122	50	—	E	—	—	plus 10 percent methanol and 0.01 percent formic acid, 28-day test with moderate agitation and aeration. Alloy C = 0.04 mpy
Formic Acid	2	300	149	—	E	—	—	plus 0.5-1.5 percent formaldehyde, resins, higher glycols. Alloy C = 0.4 mpy
Formic Acid	10	214	101	G	—	—	G	immersed, 96 hrs.
Formic Acid	10	—	—	—	G	—	—	
Formic Acid	10 20 40 60 85	150 150 150 150 150	66 66 66 66 66	G G G G E	E E E E E	— — — — —	— — — — —	
Formic Acid	25	B.P.	B.P.	G	G	—	—	Alloy C = 8.1 mpy
Formic Acid	50	217	103	S	—	—	B	immersed, 96 hrs.
Formic Acid	84	230	110	—	E	—	—	
Formic Acid	88-90	217	103	E	—	—	S	immersed, 96 hrs.
Furfural	25 100	B.P. 75	B.P. 24	S* S	— —	— —	— —	*plus one percent acetic acid and one percent formic acid and a trace of acetaldehyde and CO_2
Furfural Residue	—	100	38	B	—	—	—	plus 40 percent H_2O, 3-4 percent H_2SO_4, traces acetic and formic acids.
Gallic Acid	10 100	B.P. B.P.	B.P. B.P.	— S	S S	— —	— —	
Gas	—	100	38	—	E	—	E	0.1 to 8.3% SO_2; 0.006% SO_3; 80% saturated, possible entrained sodium bisulfite solution; pH 4, extensive aeration
Gas, Exhaust	—	100	38	—	E	—	E	exhaust air, saturated with water and containing chlorinated solvents and other organic compounds, considerable aeration
Gas, Exhaust	—	142	62	—	E	—	E	gas up to 1.5% SO_2; 0.006% SO_3; 2 mg/5CF H_2SO_4 mist, 0 to 80% saturated; spray water -0.2 to 0.3% SO_2, 1.5 pH, extensive aeration
Gas, Exhaust	—	235	113	—	E	—	E	vapor — wet SO_2, approx. 90% H_2O; 10% SO_2 by weight; pH of condensed vapor = 1.5
Gaseous Stream	—	170-187	77-86	—	—	E	E	principally N_2, aeration, 23 ppm H_3PO_4
Gaseous Stream	—	284	140	—	—	—	S	containing 75-80% N_2, 4.5-5.0% O_2, 10-12% P_2O_5, 3-15% H_2O and a small amount of H_3PO_4 mist, extensive aeration
Gaseous Stream	—	302	150	—	—	E	E	containing 75-80% N_2, 4.5-5.0% O_2, 10-12% P_2O_5, 3-15% H_2O and a small amount of H_3PO_4 mist, aeration
Gasoline	100	325	163	E	E	—	—	straight run, crude, etc. in liquid and vapor phases, 630 A.P.I., 105 psig
Gasoline	—	140-225	60-107	E	—	—	—	low end-point containing HCl
Gasoline	—	200-375	93-191	E	—	—	—	high end-point containing HCl
Gelatin Solution	20-30	90-125	32-52	S	—	—	—	plus some NaCl, $CaSO_4$, $CaCl_2$, HCl at pH = 3.
Glutamic Acid	—	75	24	E	—	—	—	saturated, plus NaCl at a pH of 3.2
Glutamic Acid, Crude	—	75	24	—	G	—	—	some H_2O_2. Alloy C = 2.9 mpy
Glutamic Acid, Crude	—	176-194	80-90	—	E	—	—	plus H_2O_2 pH = 1.8. Alloy C = 1.3 mpy
Glutaric Acid	—	210	99	—	G	—	U*	143 hrs., lab test, production of glutaric anhydride. *5 mpy in vapor, 61 mpy in liquid

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	deg. C	HASTELLOY® alloy B/B-2	C/C-276	G	Type 316 Stainless Steel	Conditions
Glycerine	100	75	24	E	E	—	—	
Glyoxal	30-35	266	130	G	G	—	S	1% formic acid; 2% glycolic acid; 3% formaldehyde; 10% ethylene glycol, 505 hrs., lab test, glyoxal stripping system
Hexamine	25-30	140	60	—	E	—	—	plus 0.5 percent methanol, 0.5 to 2.0 percent formaldehyde, 0-0.3 percent NH_3 pH = 11. Alloy C = 0.02 mpy
Hexamine	20 30 40 80	140 140 130 140	60 60 54 60	— — — —	E E E E	— — — —	— — — —	
Hexamine	80	140	60	—	E	—	—	plus 0.1 percent formaldehyde, 0.1 percent NH_3. Alloy C = 0.3 mpy
Hexane Vapor	—	257	125	—	E	—	—	low boiling vapor from tall oil plus 0.3 percent SO_2, 5 percent H_2O. Alloy C <0.1 mpy
Hexone	—	Room	Room	E	E	—	—	2 mols/liter HCNS
Hexone	—	Room	Room	S	S	—	—	with 2 mols/liter HCNS, production of HF (Zr free), 2-5 days
Hydrobromic Acid	48	B.P.	B.P.	S	—	—	—	
Hydrocarbons, Short-chain	—	90	32	E	—	—	E	ethylene methane, acetylene, ethane, propylene, propane, some butane and higher hydrocarbons; hydrogen, carbon monoxide, carbon dioxide, hydrogen sulfide; oxygen, nitrogen, water, heating oil, moderate aeration
Hydrochloric Acid	Dilute	50-90	10-32	—	E	—	—	plus ammonium sulfate in enzyme bath. Alloy C <0.1 mpy
Hydrochloric Acid	<1	70-150	21-66	G	—	—	—	plus organic acid, phosphates, sulfur compounds in pepsin extraction.
Hydrochloric Acid	<1	320	160	S	E	—	—	plus $FeCl_3$ and other salts pH = 3.5-5, Alloy C = nil mpy
Hydrochloric Acid	1	80	27	—	B	—	—	Cl_2, CO & CO_2, 22 days
Hydrochloric Acid	1	Boiling	Boiling	E	G	U	U*	*dissolved. Lab test
Hydrochloric Acid	2M	—	—	E	E	—	—	containing approximately 1 mol NH_4CNS per liter
Hydrochloric Acid	2M	Room	Room	E	E	—	—	production of HF (Zr free)
Hydrochloric Acid	2	140-176	60-80	G	G	—	U	in ethanol, ethyl silicated reactor, 120 hrs.
Hydrochloric Acid	5	150	66	S	S	U	U*	*dissolved. Lab test
Hydrochloric Acid	5	150	66	—	S	U	—	120 hrs., lab test
Hydrochloric Acid	5	200	93	B	U	—	—	aeration
Hydrochloric Acid	5	200	93	—	U	—	—	ferric chloride, (conc. not stated), considerable aeration
Hydrochloric Acid	5	Boiling	Boiling	S	U	—	—	240 hrs., lab test
Hydrochloric Acid	5-30	77	25	B	E	E	S	sulfuric acid 10 to 40%, nitric acid 10 to 25%, sodium hydroxide 1 to 40%, sodium carbonate, dichlorobenzene 2 to 5%, pomalus acid and fumaric acid <5%, mono- and dinitrobenzenes and aniline traces, moderate aeration
Hydrochloric Acid	10	72	23	U	G	—	U	with 5% sodium nitrate, production of nitrophenol; 47 hrs., lab test
Hydrochloric Acid	10	150	66	—	B	U	—	120 hrs., lab test
Hydrochloric Acid	10	158	70	—	B	—	—	5% sodium nitrite, 4% HNO_3, 48 hrs., lab test, production of nitrophenol
Hydrochloric Acid	10 10	176 176	80 80	— —	B B	— —	— —	7 days, liquid 7 days, vapor
Hydrochloric Acid	10	176	80	S	U	—	—	240 hrs., lab test
Hydrochloric Acid	10	207	97	B	—	—	—	plus 5 percent isopropyl alcohol with isopropyl chloride bubbled through. Alloy B = 10 mpy (vapor) and 32 mpy (liquid)
Hydrochloric Acid	10	Boiling	Boiling	—	U	—	—	with 1% $FeCl_3$, 6% H_2O
Hydrochloric Acid	15	95	35	B	U	—	—	chlorine traces, unidentified traces, moderate aeration
Hydrochloric Acid	17	100	38	—	G	—	—	Cl_2O and Cl_2, test 203 days
Hydrochloric Acid	20	220-230	105-110	G	U	—	—	38% HCl added to ferro chrome powder, final solution acidity approx. that of 20% HCl; 77 hrs., lab test

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point
M — Molar

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	deg. C	HASTELLOY® alloy B/B-2	C/C-276	G	Type 316 Stainless Steel	Conditions
Hydrochloric Acid	27	60-216	16-102	—	S	—	—	plus chromium chloride dye, corn syrup, water, sodium dichromate
Hydrochloric Acid	27	125	52	U	E	—	—	plus 6-10 ppm free CXL_2, 6 percent inert organic liquid, 3.5 ppm Fe, balance water. Alloy C = 1.7 mpy
Hydrochloric Acid	35	160-170	71-77	S	B	—	—	230 hrs.
Hydrochloric Acid	36	Ambient	Ambient	U	—	—	—	test 163 days, specimen consummed. Chlorine present.
Hydrochloric Acid	40	76	25	E	—	—	—	processing of glycerol mono- and dichlorohydrin, 150 hrs., lab test
Hydrochloric Acid	—	Room	Room	—	G	—	—	from vent system of HCl absorber. Alloy C = 5 mpy
Hydrochloric Acid	—	Ambient	Ambient	G	B	—	—	108 hrs., field test, exposed in vapor section of autoclave
Hydrochloric Acid	—	60-212	16-100	E	E	—	—	HCl to pH of 1.5 in conversion of corn starch to corn syrup plus some HCl and SO_2. Alloy C = 0.1 mpy
Hydrochloric Acid	—	104	40	—	E	—	S	assorted concentrations; separate waste solutions: hydrochloric acid 5 to 30%, sulfuric acid 10 to 40%, nitric acid 10 to 25%, sodium hydroxide 1 to 40%, sodium carbonate, dichlorobenzene 2 to 5%, pomaius acid and fumaric acid less than 5%, mono- and dinitrobenzenes and aniline, trace, moderate aeration
Hydrochloric Acid	—	140	60	E	E	—	E	Cu Salts; chloroacrylic acid; 48 hrs., chloroacrylic acid extracted w/toluene
Hydrochloric Acid	—	140	60	—	E	—	—	saturated HCl brine, 183 days
Hydrochloric Acid	—	200-800	93-427	—	G	—	B	wire insulation decomposition, incl. PVC. 220 hrs., agitation considerable
Hydrochloric Acid	—	200	93	U	E	—	B	and hypochlorides in water, varying amounts of ethylene dichloride, Cl_2, NaCl, NaOH, and NaOCl, pH 3-12
Hydrochloric Acid	—	212	100	U	E	—	S	sodium hypochlorite in water, ethylene dichloride, Cl_2, NaCl, NaOH, 24 days, air free
Hydrochloric Acid	—	212	100	—	E	—	S	unspecified concentrations, sodium hypochlorite in water, varying amounts of ethylene dichloride, Cl_2, NaCl and NaOH. (pH 3-12)
Hydrochloric Acid	—	226	108	E	E	—	—	fumes above hydrolizing kettle in mono sodium glutamate production. Alloy C = 0.1 mpy
Hydrochloric Acid	—	662	350	—	S	—	B	oxidizing agents, 6 days, vinyl chloride production
Hydrochloric Acid	—	800-1000	427-538	—	E	—	E	sulfuric acid 0.008%, incinerator scrubber water, aeration
Hydrofluoric Acid	5	Room	Room	G	E	—	—	
	25	Room	Room	G	G	—	—	
	40	75	24	S	—	—	—	
	40	120	49	E	—	—	—	
	45	Room	Room	G	G	—	—	
	55	75	24	E	—	—	—	
	90	90	32	S	—	—	—	
	90	110	43	S	—	—	—	
	All	to B.P.	to B.P.	—	S	—	—	
Hydrofluoric Acid	8	Room	Room	G	—	—	—	plus some fluosilicic acid in tube washing and etching machine.
Hydrofluoric Acid	10	140	60	U	B	—	—	plus H_2SiF_6 and H_2PO_4 impurities. Alloy C = 33.7 mpy
Hydrofluoric Acid	14	115	46	—	U	—	—	plus 13% chromic acid, 96 hrs.
Hydrofluoric Acid	22	100	38	G	S	—	—	plus 35 percent H_2SiF_6 and 0.06 H_2SO_4 in HF acid production
Hydrofluoric Acid	50	140	60	—	B	—	—	35 days, nitrogen purge in vapor phase
Hydrofluoric Acid	65	140	60	—	G	—	—	35 days, vapor phase purged with nitrogen
Hydrofluoric Acid	70	60-140	16-60	—	S	—	—	dissolution of columbite ore. Alloy C = 11 mpy
Hydrofluoric Acid	99.5	140	60	—	E	—	G	SO_2 0.275%, H_2SiF_6 0.005%, H_2SO_4 0.010%, H_2O 0.11%, plus approx. 5% air, moderate aeration
Hydrofluoric Acid	99.5	150	66	—	E	—	G	SO_2 0.275%, H_2SiF_6 0.005%, H_2SO_4 0.010%, H_2O 0.11%, plus approx. 5% air, aeration
Hydrofluoric Acid	0-100	300	149	B	B	—	G	anhydrous hydrofluoric acid 0 to 100%; sulfuric acid concentration 100 to 0%
Hydrofluoric Acid	—	Room	Room	S	G	—	—	plus H_2SO_4 and gypsum dust

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	deg. C	HASTELLOY® alloy B/B-2	C/C-276	G	Type 316 Stainless Steel	Conditions
Hydrofluoric Acid	—	140-165	60-74	—	G	—	U	11-13% fluosilicic acid plus undescribed impurities from wet process phosphoric acid. Liquid phase, extensive aeration
Hydrofluoric Acid (Anhydrous)	0-100	-10 to 300	-23 to 149	B	B	—	S	H_2SO_4, 100-0%
Hydrofluoric Acid — Barium Fluoride	— —	68 248	20 120	— —	B B	— —	— —	HF-BF_3 (as catalyst) plus liquid aromatic hydrocarbons
Hydrofluoric Acid (Boron Trifluoride Catalyst)	—	-6 68 176 248	-21 20 80 120	— — — —	G B B B	— — — —	— — — —	plus liquid aromatic hydrocarbons (ortho-, para-, and metaxylene plus ethyl benzene)
Hydrofluoric Acid, Chemical pure	60	Boiling	Boiling	—	S	—	—	4 days, vapor phase purged with 1% oxygen, rest nitrogen.
Hydrofluoric Acid Conditions	10 20 48	Ambient Ambient Ambient	Ambient Ambient Ambient	— — —	G G G	— — —	— — —	30 days
Hydrofluoric Acid Mixtures	—	176	80	—	E	—	G	(except HNO_3-HF) polymerization of a proprietary organic in an aromatic solvent with a BF_3 catalyst. HF & possibly fluoborates present. Open to moisture and air. HF attacked glass in vapor area and glass has spalled from surface during 350 hrs. of actual exposure, extensive aeration
Hydrofluoric Acid Mixtures	40	65	18	—	G	—	S	40% H_2SO_4, 20% H_2O. moderate aeration
Hydrofluoric Acid Mixtures	—	-10 to 300	-23 to 149	—	B	—	G	(except HNO_3-HF) anhydrous hydrofluoric acid 0 to 100%; sulfuric acid, concentration 100 to 0%
Hydrofluosilicic Acid	9	120	49	B	G	—	B	spool failed
Hydrofluosilicic Acid	10-11	160	71	—	—	E	—	impurities from wet process phosphoric acid.
Hydrofluosilicic Acid	12-13	160	71	—	—	G	—	impurities from wet process phosphoric acid.
Hydrofluosilicic Acid	30	100	38	S	—	—	—	plus 22 percent hydrofluoric acid and 0.06 percent H_2SO_4 in hydrofluoric acid production
Hydrofluosilicic Acid	35	80	27	—	G	—	—	plus 4.7 percent NaCl solution becomes saturated with Na_2SiF_6. Alloy C = 3.2 mpy
Hydrofluosilicic Acid	—	165	74	B	G	G	B	12-13%, with impurities from wet process phosphoric acid, some suspended
Hydrofluosilicic Acid	—	—	—	U	G	E	U	10-11%, with impurities from wet process phosphoric acid, some suspended, aeration
Hydrofluosilicic Acid Fumes	—	55	13	—	G	—	G	salt water (from estuary), silicon tetrafluoride, phosphoric acid, air; pH 1 to 2
Hydrogen	100	to 700	to 371	—	E	—	—	
Hydrogen Chloride	—	200-800	93-426	—	G	—	—	HCl resulting from the decomposition of all types of wire insulation, including polyvinylchloride-cooling water spray.
Hydrogen Chloride	95	0 to 50	-18 to 10	G	G	—	—	plus 3 percent acetyl chloride and 2 percent acetic acid vapors. Alloy C = 7.6 mpy
Hydrogen Chloride	100	to 800	to 427	S	—	—	—	
Hydrogen Chloride	—	289	143	S*	E	—	—	plus anhydrous organo-chlorosilanes and amines. *Alloy B = 1.6 mpy in liquid and 15 mpy in vapor.
Hydrogen Chloride, Dry	—	572	300	E	E	—	—	plus caustic soda in plastic synthesis. Alloy C = 0.01 mpy
Hydrogen Chloride	—	75	24	—	E	—	—	moisture in gases evolved, concentration low but not specified. Industrial atmosphere, considerable aeration
Hydrogen Chloride	—	110	43	E	—	—	G	vapor (almost all HCl) feed to fractionator is normally 0.4% HCl. 70% phosgene ($COCl_2$) and 23.6% monochlorobenzene.
Hydrogen Chloride and other gases and vapors, unidentified	—	600	316	—	G	—	—	
Hydrogen Chloride and other gases and vapors, unidentified	—	800	427	—	G	—	B	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Hydrogen Chloride and other gases and vapors, unidentified	—	800	427	—	S	—	U	
Hydrogen Chloride and other gases and vapors, unidentified	—	1300	704	—	U	—	—	
Hydrogen Cyanide, Hydrocyanic Acid	— —	122 224	50 107	— —	E G	— —	S G	HCN stripping still feed line and tails line, 372 days feed, 672 hrs. tails
Hydrogen Fluoride	100	to 1000	to 537	—	S	—	—	
Hydrogen Fluoride, Dry	—	930	499	G	—	—	—	in Zircex Process for dissolving fuel elements.
Hydrogen Fluoride, Slurry	1	140	60	G	—	—	—	plus some sulfur compounds, 0.2 percent solids.
Hydrogen Fluoride, Wet	—	932-1112	500-600	E	E	—	—	7 lb. HF gas per hour at 4 psi in laboratory furnace. Alloy C = 0.3 mpy
Hydrogen Iodide	31	150	66	—	U	—	—	hydroiodic acid plus elemental iodine 36%, water 33%
Hydrogen Peroxide	100	75	24	—	E	—	—	suitable for repeated short-time exposures. Alloy tends to decompose solution
Hydrogen Sulfide	—	75	24	—	E	—	—	with CS_2 in rayon spinning bath atmosphere
Hydrogen Sulfide	—	40-215	4-102	E	E	—	—	plus SO_2 and CO_2 above liquid end of leaching tank. Alloy C = 0.1 mpy
Hydrogen Sulfide	—	150-160	66-71	—	E	—	—	plus phenols, alifatic acids, sulfates, and sulfites. pH maintained at 4.5 with soda ash. Alloy C = 0.1 mpy
Hydrogen Sulfide	—	275	135	S	—	—	—	plus some CO_2 and sulfur — gas phase of sulfur processing
Hydrogen Sulfide Gas and De-aerated Fresh Water	—	77	25	—	E	—	E	
Hydrogen Sulfide	—	100-170	38-77	E	E	—	—	saturated with water. Alloy C = 0.1 mpy
Hydroiodic Acid	All	to B.P.	to B.P.	S	—	—	—	
Hydroiodic Acid	31 31 31	150 150 150	66 66 66	— — —	U E* E*	— — —	— — —	plus 36 percent iodine and water plus $ZnCl_2$ and water plus $CdCl_2$ and water *Alloy C = 2 mpy
Hypochlorite Bleach	—	110-130	44-54	—	E	—	—	0.1 grams/liter CaOCl, 1.5 grams/liter $CaCl_2$, pH = 7, extensive aeration. Alloy C = 0.1 mpy
Insulin Extract	—	to 100	to 38	E	E	—	—	plus some protein, fats, HCl, ammonia salts, H_2SO_4 and NaCl. Alloy C = 0.04 mpy
Iodine	All	to B.P.	to B.P.	—	S	—	—	
Iodine	—	572	300	E	G	—	—	pressure of iodine 400 mm Hg
Iodine	—	842	450	S	—	—	U	pressure of iodine 400 mm Hg
Iodine vapor	—	572 842	300 450	E S	E —	— —	— —	24 hrs. 24 hrs.
Iron Ore Sinter, Plant Flue Gas and Scrubbing Liquors	—	105-180	41-82	—	E	E	E	aeration
Isopropyl Alcohol	11	72	22	—	E	—	—	plus 9.3 percent iodine, 2 percent non-ionic detergent. Alloy C · 0.1 mpy
Isopropyl Chloride	50	95	35	B	—	—	—	air bubbled through solution. Alloy B = 9.0 mpy in vapor and 32.0 mpy in liquid
Isopropyl Chloride	80	95	35	G	—	—	—	plus 20 percent isopropyl alcohol. HCl bubbled through liquid.
Kraft Fibers, (Hardwood or Pine) at 1% Consistency	—	83	28	—	E	E	E	pH 5-6, low concentration of chlorides and sodium, trace chlorine dioxide, moderate aeration
Lactic Acid	1	60-75	16-24	S	E	—	—	plus 0.01 percent methylene blue and possible Cu ++ ions. Alloy C · 0.1 mpy
Lactic Acid	10	Boiling	Boiling	—	G	—	—	
Lactic Acid	17	Boiling	Boiling	G	G	—	—	10% ammonium chloride; 0.4% NaCl; 115 hrs., lab test, proposed lactic acid service
Lactic Acid	All 25-60	to B.P. 130	to B.P 54	S —	— E	— —	— —	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Lactic Acid	50	Boiling	Boiling	G	G	—	G	proposed lactic acid service, 115 hrs., lab test
Lactic Acid	85	Boiling	Boiling	—	E	—	—	
Lactic Acid	90	Boiling	Boiling	G	G	—	S	proposed lactic acid service, 115 hrs., lab test
Lanolin Bleach	—	210	99	E	E	—	—	plus dilute H_2SO_4, HCl, alcholic caustic solutions, H_2O_2 and strong NaOCl bleaches. Alloy C = 0.141 mpy
Lead-Bismuth Alloy	Eutectic	to 464	240	S	S	—	—	
Lead, Lead Chloride	—	982-1000	526-537	B B B	U U U	U U U	U U U	argon atmosphere. Top — lead, middle — lead chloride, bottom — lead chloride upper phase
Levulinic Acid	95	80-110	27-43	E	—	—	—	
Lime Slurry and Caustic Soda	—	184	85	—	E	—	E	added to organic polymer containing excess sulfuric acid
Limestone Slurry	8	120	49	—	E	E	E	$CaCO_3$ $CaSO_3$, $CaSO_4$ and fly ash, pH 5.0-6.0, moderate aeration
Limestone Slurry	—	89	32	—	E	E	E	15% $CaCO_3$ in water, pH 6.3-7.9
Limestone Slurry	—	107	42	—	E	E	E	15% solids, $CaCO_3$ plus $CaSO_3$ and a small amount of $CaSO_4$, pH 3.7-6.7, avg. 5.6, moderate aeration
Limestone Slurry	—	127	53	—	—	E	E	flue gas containing 2 lbs./min. of SO_2, pH 3.5-6.3 avg. 5.7, 91 days, scrubbing liquor for SO_2 removal from power plant
Limestone Slurry	—	254	123	—	—	E	E	scrubbing liquor for SO_2 removal from power plant flue gas, 91 days, moderate aeration
Liquid leaving bottom of Fractionator	—	265	129	E	—	—	E	virtually free of HCl, mostly phosgene and monochlorobenzene
Lithium Chloride	30	260	127	—	—	E	—	bal. H_2O, 2000 hrs., LiCl production, one sample out of four showed shallow pitting, 1.5 mils deep.
Lithium Chloride	90	300	149	—	—	E	—	bal. H_2O, 2000 hrs., LiCl production
Manganese Sulfate	—	60-145	16-63	—	E	—	—	manganese ore leaching (anoxide and sulfide) plus sulfuric and sulfurous acids. Alloy C = 0.1 mpy
Magnesium Carbonate	10	to B.P.	to B.P.	S	S	—	—	
Magnesium Chloride	10 25 40 50	75 to B.P. 175-B.P. to B.P.	24 to B.P. 79-B.P. to B.P.	E E E E	E E E E	— — — —	— — — —	
Magnesium Chloride	30-40	273	134	—	E	—	E	with small amounts of $MgSO_4$, NaCl, KCl, LiCl, traces of Br, 3-4% solids of $MgSO_4$, 1.25 H_2O, extensive aeration
Magnesium Chloride	51	330	166	G	E	—	—	1% NaCl, 1% KCl, 2% LiCl, vapor phase, 120 hrs., aeration and agitation moderate
Magnesium Chloride	51* Cl_2	330-335	166-168	—	E	—	—	*100 hrs. with $MgCl_2$ brine only, 1% NaCl, 1% KCl, 2% LiCl as concentrated from natural Bonneville brines of 33% solubles. Liquid phase exposure, moderate to considerable aeration
Magnesium Chloride	53	345	174	E	E	—	—	vapor phase above with 8,000-10,000 ppm HCl in condensate
Magnesium Chloride	55	345	174	G	E	—	—	with 1% NaCl, 1% KCl, and 2% LiCl, as concentrated from natural Bonneville brines of 33% solubles.
Magnesium Chloride	85 100	266 334	130 168	S E	E E	— —	— —	in open-pan evaporator. Concentration expressed as $MgCl_2 \cdot 6H_2O$. Alloy C = 0.1 mpy (85 percent) 0.3 mpy (100 percent)
Magnesium Chloride	—	310	154	—	G	—	—	in vapor phase — vapors over 50% $MgCl_2$ with 500 to 4,000 ppm HCl in condensate and 1,000 ppm $MgCl_2$. In liquid phase — 50% $MgCl_2$ solution, plus 1% NaCl, 1% KCl, 2% LiCl. Concentration of natural Bonneville brine from 33% solubles to 50%.
Magnesium Chloride	—	335-355	168-179	—	E	—	—	53% magnesium chloride with 1% NaCl, 1% KCl, and 2% LiCl, as concentrated from natural Bonneville brines of 33% solubles, moderate to considerable aeration
Magnesium Hydroxide	—	150	66	—	—	E	E	absorption liquid for SO_2. Generates bisulfite cooking acid w/pH of 5.4, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Magnesium Oxide Slurry	—	120	49	—	E	E	E	flue gas scrubbing liquor for SO_2 removal, 238 days, moderate aeration
Magnesium Sulfate	25 50	to B.P. 125-B.P.	to B.P. 52-B.P.	E E	S S	— —	— —	
Magnesium Sulfate	—	198	92	—	E	—	E	brine slurry containing $MgSO_4$, Na_2SO_4, KCl, NaCl, $MgCl_2$, trace of S^-, pH 7.7, moderate to extensive aeration
Maleic Acid	10 10 100	to 175 B.P. to B.P.	to 79 B.P. to B.P.	E S S	— — —	— — —	— — —	
Maleic Acid Liquor	10-18	32-40	0-4	U	E	—	—	plus small amounts of alpha naphtha quionone, phthalic acid. Alloy C = 0.2 mpy
Maleic Anhydride	—	400-545	204-285	E	E	—	—	plus phthalic anhydride, 1090-hr. test in vapor velocity of 7 ft./sec. at top tray of fractionating column
Mercuric Chloride	10	to 175	to 80	—	S	—	—	
Mercuric Chloride Vapors	—	620-750	326-398	B	E	—	—	air-free nitrogen atmosphere. Mercuric chloride is present as 10 percent weight percent of varying amounts of activated carbon. Alloy C = 1.1 mpy
Mercury	All 100	to 800 to 700	to 426 to 371	S —	— E	— —	— —	
Methanol	All	to B.P.	to B.P.	E	E	—	—	
Methanol	—	Boiling	Boiling	—	E	—	—	N_2 atmosphere, methanol recovery column stock solutions sent to lab for test
Methyl Acetate	20	to 144	to 62	S	E	—	—	plus 20 percent ethyl acetate, 18 percent methyl ethyl ketone, 15 percent acetone, 6 percent acetaldehyde, 14 percent low boilers, trace acetic acid. Alloy C =0.01 mpy
Methyl Acetate	60	to B.P.	to B.P.	—	E	—	—	with 10 percent acetaldehyde, 5 percent H_2O, 2 percent acetic acid, traces of acetone and alcohols
Methyl Alcohol	60	165	74	E		—	—	plus 15 percent methyl acetate, 23 percent acetone, 0.03 percent acetic acid. Slight pitting.
Methyl Alcohol	95	203	95	—	U	—	—	plus 4 percent HCl, CH_3Cl bubbled through. Vapor phase = 16 mpy, liquid phase = 55 mpy
Methyl Chloride	100	95-113	35-45	—	E	—	E	
Methyl Chloride	—	95-113	35-45	—	E	—	E	containing 100 ppm hydrogen chloride and 30 ppm water
Methyl Chloride	—	100	38	G	—	—	—	bubbling through water, 2.0 mpy in vapor phase, 3.0 in liquid phase
Methyl Ethyl Ketone	1	210	99	—	E	—	—	Alloy C <0.1 mpy
Methyl Ethyl Ketone	77	90-100	32-38	S	—	—	—	plus 15 percent aconitic and 8 percent H_2O, trace of TiCl
Methyl Isopropanol Ketone	44	230	110	E	—	—	—	plus 1 percent phosphoric acid, 3 percent diamer, 1 percent vinyl isopropl ketone, 1 percent alcohols
Methylene Chloride	22.5	100-250	38-121	G	E	—	—	plus 2.5 percent methanol. Alloy C = 0.2 mpy
Methylene Chloride	40	to B.P.	to B.P.	—	S	—	—	
Methylene Chloride	50	140-200	60-93	E	E	—	—	plus 50 percent methanol.
Methylene Chloride	70	120-140	49-60	E	E	—	—	plus 30 percent methanol. Alloy C = nil mpy
Methylene Chloride	75	275	135	G	E	G	B	HCl 20%, H_2O 5%, 27 days in vapor above solution, moderate aeration
Methylene Chloride	90	100-212	38-100	E	E	—	—	plus 10 percent methanol. Alloy C = nil mpy
Methylene Chloride	—	180-250	82-121	—	E	E	E	contaminated w/H_2O, aeration
Methyldichlorophosphine (Anhydrous)	—	195-225	91-107	E	E	—	E	CH_3PCl_2: lower concentrations methoxydichlorophosphine, phosphorus trichloride, phosphorus oxychloride, triethylphosphate. 76 days, aeration — none, agitation — rapid
Methylenedioxybenzene Reaction Mixture	—	221-248	105-120	—	E	E	E	aeration
Moist Air	—	Ambient	Ambient	—	E	—	—	containing Cl_2, 166 days
Moist Air	—	Ambient	Ambient	—	E	—	—	trace Cl_2, 195 days
Molybdic Acid	10	75	24	—	S	—	—	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concen-tration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Molybdic Acid	—	300	149	—	B	S	S	formed by reaction of MoS_2, oxygen and 5% HNO_3. H_2SO_4 conc. goes to 20%. Jacketed vessel allows heating-cooling. Extensive aeration
Mono Phosphates	10	to B.P.	to B.P.	S	—	—	—	sodium, potassium, or ammonium
Monoethanolamine Hydrochloride	30	150	65	E	E	—	—	in methanol, 72 hrs., lab test
Monoethanolamine Hydrochloride	—	204	95	E	E	—	—	N_2 atmosphere, 72 hrs., lab test
Monomer & Dimer Fatty Acids from Tall Oil Purification	—	537-550	281-288	—	E	E	E	aeration
Morpholine Reaction Mixture	— —	156 392	125 200	G B	B U	— —	— —	88 hrs., lab test
Morpholine Sulfate	—	374	190	B	B	—	—	141 hrs., lab test, valves for morpholine sulfate service
Municipal Garbage Incinerator Flue Gas	—	170	77	—	E	E	E	from secondary chamber after passing through scrubber marble bed plus entrained liquor at pH 3-4, extensive aeration
Municipal Garbage Incinerator Scrubbing Liquor	—	160	71	—	E	E	E	water draining from marble scrubbing bed plus direct spray of neutral H_2O. pH = 2.0-3.5. Municipal garbage incinerator flue gas scrubbing; moderate agitation; extensive aeration. 51 days
Naphtha	100	75	24	S	—	—	—	
Naphtha, Solvent	96	160-180	71-82	E	—	—	—	in vapor space of still column. Some nitrogen oxides possibly evolved
Naphthalene	—	180	82	—	G	—	S	organic condensation product
Naphthalene Chloride	— —	110 392	43 200	E E	— —	— —	— —	production of naphthalene and HCl vapor, in vapor phase
Naphthalene Sulfonic Acid	—	180	82	—	G	—	E	formaldehyde, condensation product of: $Ca(OH)_2$, NaOH, $CaSO_4$, Na_2SO_4, natural aeration through agitation
Naphthalene Sulfonic Acid	— —	B.P. 300	B.P. 149	E —	E E	— —	— —	also formaldehyde in condensation reaction.
Naphthenic Acid	—	650-750	343-398	E	E	—	—	in distillate from heavy asphalt containing crude oil in flash section of vacuum tower. Alloy C = 0.1 mpy
Nickel Chloride	10 10 20 30 80	to B.P. 140 to B.P. to B.P. 200	to B.P. 60 to B.P. to B.P. 93	E — E E —	— E — — E	— — — — —	— — — — —	
Nickel Chloride	25	554	290	U	B	—	U	nickel chloride feed tubes to converters in an Aminco bomb, pH 3.4, unstressed specimens
Nickel Chloride	—	428	220	—	S	—	—	nickel carbonyl, nickel hexammine chloride, ammonium carbonate, ammonia, H_2, CO, CO_2, CO-CO_2 pressure 2500 psig — specimens metallic-arc welded and stressed; 243 hrs.
Nickel Nitrate	10	75	24	—	S	—	—	
Nickel Plating Bath	—	140	60	E	—	—	—	chloride type
Nickel Sulfate	0-60	to B.P.	to B.P.	—	S	—	—	
Nitric Acid	1.92M	75	24	U	E	—	U	1.08M hydrofluoric acid, 0.08M hydroxylamine nitrate, 0.11M sulfamic acid, 0.02 ascorbic acid; welded
Nitric Acid	10	120	49	U	G	—	—	plus 2 percent HF for descaling stainless steel products. Alloy C = 5 mpy
Nitric Acid	10	Boiling	Boiling	—	G	E	—	120 hrs., lab test
Nitric Acid	20	Boiling	Boiling	—	B	G	—	120 hrs., lab test
Nitric Acid	35	185	85	—	—	E	—	2000 ppm chloride ions, 96 hrs.
Nitric Acid	40	Boiling	Boiling	—	U	G	—	120 hrs., lab test
Nitric Acid	49	177-183	81-84	—	—	G	—	37% phosphate rock, 4% H_2SO_4
Nitric Acid	50	Boiling	Boiling	—	—	G	—	1000 ppm chloride ions, 96 hrs.
Nitric Acid	53	177-183	81-84	—	—	E	—	37% phosphate rock, 4% potassium sulfate

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point
M — Molar

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G		
Nitric Acid	63	120	49	—	E	—	G	15% by wt. (20% by vol.) 40° Bé or 2% sodium dichromate (dihydrate)
Nitric Acid	65	150	66	—	S	E	—	120 hrs., lab test
Nitric Acid	65	Boiling	Boiling	—	U	B	—	120 hrs., lab test
Nitric Acid	72	177-183	81-84	—	—	E	—	6% H_2SO_4
Nitric Acid Mix	25	177-183	81-84	—	—	E	—	25% phosphate rock, 24% H_3PO_4, 4% H_2SO_4
Nitric-Sulfuric Acid Mixtures	—	365	185	—	B	—	B	20% by vol. of 50% H_2SO_4 - 50% HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and later dried at 170 deg. C in 10% ClO_2.
Nitric-Sulfuric Acid Mixtures	—	365	185	—	B	—	U	20% by vol. of 50% H_2SO_4 - 50% HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and exposed in 16.5% NaOCl at 170 deg. C
Nitric-Sulfuric Acid Mixtures	—	392	200	—	B	—	B	20% by vol. of 50% H_2SO_4 - 50% HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and exposed in 20% by vol. of 50% HNO_3-50% $HClO_4$ added to H_2O and heated to 200 deg. C for 12 hrs.
Nitriding Gases	All	1000	538	E	E	—	—	
Nitrobenzene	85	212	100	U	G	—	—	plus chlora-beta methyl quinone, copper chloride, 5 percent HCl in stripping nitrobenzene from organic solution. Alloy C = 2.6 mpy
Nitrosyl Chloride	—	Room	Room	—	G	—	—	during production from reaction of HCl, nitrous oxide, and isopropyl alcohol, Alloy C = 2.5 mpy
Nitrous Oxide	10	780	416	E	E	E	E	corrosion rack test (in plant), balance O_2, H_2O, N_2
Nonylphenol	60-75	340	171	G	G	—	U	dinonylphenol 0.6%, water 0.1% max., nonyl and dinonylphenol sulfide 67-73% and process oil 25%, hydrogen chloride a few percent. (Compositions of liquid phases)
Oil-Water Emulsion	—	75	24	—	—	E	E	containing dilute sulfuric acid (pH 1.8) and possibly some carbon dioxide, 90 days, moderate aeration
Oleic Acid	100	to B.P.	to B.P.	S	—	—	—	
Oleum	20	125	52	E	—	—	—	1.32 parts to one part dodecyl benzene and SO_2
Oleum	20	125-150	52-66	E	—	—	—	vapors plus pyridine vapors in sulfonation of pyridine.
Oleum	20	125-150	52-66	B	—	—	—	plus pyridine and 2.5 percent water in sulfonation of pyridine.
Oleum	25	50-90	10-32	E	E	—	—	in detergent manufacture. Alloy C = 0.1 mpy
Oleum	40	to 140	to 60	—	E	—	—	plus 4 percent HNO_3
Oleum	75-120	86-248	30-120	—	—	G	—	25 to 98% HNO_3, trace HF
Orange Juice	—	100-125	38-52	—	E	—	—	with pectin liquor
Organic Chlorides	All	to B.P.	to B.P.	S	—	—	—	
Orthoformyl Benzene-sulfonic Acid	6.75	85	29	E	E	—	E	
Oxalic Acid	10	Boiling	Boiling	—	G	—	—	
Oxalic Acid	20	110	43	—	E	—	—	to which is added 93% H_2SO_4 (approx. 10% when diluted), pH less than 1, plus calcium oxalate and calcium sulfate, moderate aeration
Oxalic Acid	45	140	60	—	E	—	E	slurry, 35% sulfuric acid, calcium oxalate, calcium sulfate, pH 1, moderate aeration
Oxalic Acid	Satr. Soln.	B.P.	B.P.	G	S	—	—	
Oxalic Acid	All	to B.P.	to B.P.	S	S	—	—	
Oxalic Acid	—	140	60	S	E	E	E	slurry, 35% sulfuric acid, calcium oxalate, calcium sulfate, pH 1, moderate aeration
Oxidizing Gases	100	to 1800	to 982	—	E	—	—	
Paper, Acid Pulping	—	285	141	—	G	—	E	cooking liquors: acid sulfite, sodium base; alkaline, Kraft
Paper, Alkaline Pulping Cooking Liquor	1.5M	323	162	—	G	—	B	oxygenated sodium hydroxide pulp digester liquor, extensive aeration
Paper Bleaching	1	114	46	—	E	—	E	0.01% chlorine, trace chlorine dioxide, pH 5.5 to 6.0, moderate aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point
M — Molar

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Paper Bleaching	1	132	56	—	E	—	E	atmosphere over a 1% slurry of paper pulp; 0.05 chlorine, trace chlorine dioxide, pH 7.0, moderate aeration
Paper Bleaching	1	145	63	—	E	—	E	paper pulp 1% slurry; 0.01% chlorine, trace chlorine dioxide, pH 5.2, moderate aeration
Paper Bleaching	1	150	66	—	E	—	E	atmosphere over a 1% slurry of paper pulp; 0.01% chlorine, trace chlorine dioxide, pH 5.2
Paper Pulp, Bleached	1.5	135-165	57-74	—	E	—	E	calcium chloride 0.3%, residual chlorine dioxide .002%, pH 5.5 to 6.0, extensive aeration
Paper Pulp, Bleached	—	135-165	57-74	S	E	—	E	1.5% CaCl, pH 5.5 to 6.0, 95 days, aeration and agitation extensive
Paper Pulp Slurry	1	114	46	—	E	—	E	Chlorine — .01%, pH 5.5 to 6.0 Duration of test — 58 days Aeration — moderate Agitation — moderate Type of test — field Process involved — paper pulp bleaching
Paper Stock	—	75	24	—	E	—	—	0.15 g/l HCl, 0.02 g/l free chlorine
Paper Stock	—	155	68	—	E	—	—	Kraft pulp stock, pH 9.5-10, moderate aeration, flow rate of 4500 g.p.m., 337-hr. test
Peanut Oil	—	to 125	to 52	E	—	—	—	sulfonation of peanut and corn oil
Pentane	—	70	21	G	E	—	—	plus traces of HCl, moisture and air. Alloy C = 0.8 mpy
Pepsin	—	to 150	to 66	S	—	—	—	extraction of pepsin with one percent HCl and organic acids, pH 4.8-7.0
Perchloric Acid	72	75-212	24-100	—	G	—	U	
Perchloroethylene — Carbon Tetrachloride	—	250	121	—	E	—	—	HCl and Cl_2, duration of test — 47 days
Perchloryl Fluoride	—	86	30	—	E	—	E	519 hrs., lab test, tank placed in air cabinet
Phenol	95	302-320	150-160	E	—	—	—	plus 5 percent acetophenone, mildly boiling solution
Phenol	— —	125 125	52 52	S E	E E	— —	— —	chlorination process, exposed 19 days in liquid phase exposed 19 days in vapor phase.
Phenol Di-Carbonate	90	380	193	E	—	—	—	plus 11 percent phenol and 1 percent $AlCl_3$
Phenol Formaldehyde	—	212	100	E	E	E	U	sulfuric acid, phosphoric acid, lime, caustic, moderate aeration
Phenol Formaldehyde	—	265	129	G	E	E	E	Duration of test — 107 days Aeration — present Agitation — present Type of test — field Process involved — phenolic resin Remarks — vapors present intermittently during operating cycle.
Phenol, Paratertiary Butyl	—	500	260	—	E	—	—	plus formaldehyde, turpentine, boron trifluoride, and oxalic acid in kettle. Alloy C = 0.2 mpy
Phenol Sulfonic Acid	30 30	75 250	24 121	E E	— —	— —	— —	during production from phenol and concentrated sulfuric acid.
Phenolpthalein	100	175	79	E	—	—	—	fusion of phenolpthalein
Phenyl Piperazine	—	176-436	80-225	G	S	—	—	245 hrs., production of phenyl piperazine from aniline, hydrogen chloride, and diethylanolamine.
Phosgene	5	307	153	E	E	—	E	chlorobenzene 70%; polyisocyanate 25%; phenyl isocyanate (trace).
Phosgene	50	45	7	—	E	—	E	monochlorobenzene 40%, HCl 10%, traces of isocyanate, liquid phase, air free
Phosgene	—	250	121	E	E	—	E	HCl and chlorinated solvents
Phosgene Gas	—	752	400	S	S	—	—	
Phosgene Vapor	—	122	50	E	E	—	G	984 hrs., lab test
Phosphoric Acid	0.5	60	16	S	—	—	—	H_3PO_4 catalyst plus organics
Phosphoric Acid	3-14	150	66	—	E	—	—	small amounts of fluorine compounds

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS–CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Phosphoric Acid	7	50	10	—	E	—	E	n-Propylalcohol 18%, sodium chloride 5%, aluminum chloride 0.4%, ether chlorides totaling 0.8%; cupric, ferric, zinc, manganous, cobalt. Water 70%, pH about 1.5, furnace process
Phosphoric Acid	10	214	101	B	—	—	E	immersed 96 hrs.
Phosphoric Acid	15	165-185	74-85	—	G	—	—	plus 20 percent H_2SiF_6, 1 percent H_2SO_4. Alloy C = 2 mpy
Phosphoric Acid	16 30.7	65-80 72	18-27 22	— —	E E	— —	— —	plus iodine, non-ionic detergent (nonyl phenyl ether of polyethylene glycol), and water. Alloy C <0.1 mpy
Phosphoric Acid	27	122-161	50-72	—	—	E	E	H_2SO_4 and gypsum impurities, aeration
Phosphoric Acid	30	165	74	—	G	—	U	4% sulfuric acid; 4% silica. Traces of iron, aluminum and fluorine, moderate aeration
Phosphoric Acid	31.4	113-140	45-60	B	E	—	—	in manufacture of ammonium phosphate. Plus 1.64 percent H_2SO_4, 1.46 percent H_2SiF_6
Phosphoric Acid	35	350	177	—	B	—	—	plus newsprint in 3-4 hrs. heating cycle
Phosphoric Acid	36	100-111	38-44	—	—	E	—	2.9 percent H_2SO_4, 350 ppm chloride, some hydrofluosilicic acid
Phosphoric Acid	36	172	78	—	—	E	—	2.9 percent H_2SO_4, 350 ppm chloride, some HF, 30 percent gypsum
Phosphoric Acid	40	158	70	—	G	—	G	(29% P_2O_5), sulfuric acid 2-3%, slurry contains 2-3% calcium sulfate dihydrate (gypsum), 0.5% fluorine compounds as hydrofluosilicic acid, metallic compounds
Phosphoric Acid	40-80	225	107	U	E	—	—	plus 10-20 percent HNO_3, 10-20 percent ZnO, 10-20 percent Na_2ClO_3, 5 percent Na_2SO_4. Alloy C = 0.4 mpy
Phosphoric Acid	45	77-266	25-130	—	—	B	—	sulfuric acid 45 percent, water 10 percent
Phosphoric Acid	45	145-155	63-68	E	G	—	—	half in vapors, half immersed. Alloy C = 7.9 mpy
Phosphoric Acid	45	266	130	—	E	E	—	sulfuric acid 45%, water 10%
Phosphoric Acid	50-55	200-300	93-149	U	B	—	—	in wet vapors containing HF. Alloy C = 24 mpy
Phosphoric Acid	50	230	110	G	—	—	G	immersed 96 hrs.
Phosphoric Acid	52.5	113	45	—	G	E	G	H_3PO_4 (P_2O_5 equivalent 35%), sulfuric acid 2.9%, chloride 400 ppm, hydrofluosilicic acid trace, ferric phosphate trace, moderate aeration
Phosphoric Acid	53	250	121	U	G	—	—	plus 1-2 percent H_2SO_4, 1.2 to 1.5 percent HF. Alloy C = 5 mpy
Phosphoric Acid	54	260	127	U	U	—	—	in fume hood of defluorinator plus 1 percent H_2SO_4,SiF_4, and HF
Phosphoric Acid	54†	310-335	154-168	—	—	U	—	1.4 percent, 4.3 percent H_2SO_4, 48 hours exposure, hot wall
Phosphoric Acid	55	175-185	79-85	—	G	E	U	some fluorides, calcium sulfate, hydrofluosilicic acid
Phosphoric Acid	55	221-261	105-127	—	U	—	U	(40% P_2O_5), sulfuric acid 3.0% (2.5% SO_3), calcium sulfate (hemihydrate) slurry; fluorine compounds. Liquid phase, gases containing H_2O and SiF_4 are evolved. Foam distribution process
Phosphoric Acid	55	221-261	105-127	—	—	B	—	sulfuric acid 3.0 percent (2.5 percent SO_3), calcium sulfate (hemihydrate slurry), fluorine compounds
Phosphoric Acid	55	228	109	—	B	—	—	reagent grade plus 0.8% hydrofluoric acid
Phosphoric Acid	55	228	109	—	—	G	—	0.8 percent HF
Phosphoric Acid	55	237	114	U	U	B	U	(40% P_2O_5), sulfuric acid 3.0% (2.5% SO_3), calcium sulfate (hemihydrate) slurry; fluorine compounds. Liquid phase, gases containing H_2O and SiF_4 are evolved.
Phosphoric Acid	56.2	72	22	—	E	—	—	plus iodine, non-ionic detergent (nonyl phenyl ether of polyethylene glycol), and water. Alloy C <0.1 mpy
Phosphoric Acid	61	176	80	—	G	—	U	(44% P_2O_5), filtered, containing small concentrations of sulfuric acid and hydrofluosilicic acid
Phosphoric Acid	69	81	27	—	E	—	S	(50% P_2O_5), sulfuric acid 3-4%, calcium sulfate 3-4%, traces hydrofluosilicic acid, aluminum compounds, pH about 1.8
Phosphoric Acid	69	212	100	—	B	—	U	(50% P_2O_5), filtered, containing small concentrations of sulfuric acid and hydrofluosilicic acid

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

† — percent P_2O_5

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Phosphoric Acid	70-100	200-212	93-100	—	E	—	—	acid mist (0.04-.35 grains 100% H_3PO_4 per "standard cubic foot" or 0.10-.86 grams 100% H_3PO_4 per cubic meter (STP)). Chloride (20-30 ppm) in city water used in scrubber liquor, extensive aeration
Phosphoric Acid	75	68-212	20-100	—	—	E	G	pH below 1.140 ppm As_2O_3 as impurity. Furnace process to produce phosphoric acid. Moderate aeration; total days — 375. agitation — 590 fpm velocity
Phosphoric Acid	75	100	38	—	—	E	G	pH below 1.140 ppm As_2O_3 impurity, moderate aeration
Phosphoric Acid	75	185	85	—	E	—	—	30 days approx., 726-793 hrs., agitation — acid velocity 895 ft./min.
Phosphoric Acid	75	194	90	—	E	—	—	30 days approx., 726-793 hrs., agitation — acid velocity 895 ft./min.
Phosphoric Acid	75	203	95	—	G	—	—	30 days approx., 726-793 hrs., agitation — acid velocity 895 ft./min.
Phosphoric Acid	75	212	100	—	—	B	—	30 days approx., 726-793 hrs., agitation — acid velocity 895 ft./min.
Phosphoric Acid	75	212	100	—	—	G	—	164 hours
Phosphoric Acid	75	221	105	—	G	—	—	48 hours
Phosphoric Acid	75	240-260	116-127	U	S	—	—	HF, 30 percent Ca ($CaSO_4$ plus H_2O plus SiO_2), half in vapors, half immersed
Phosphoric Acid	82-87	190-215	88-102	E	—	—	—	lower oxides of phosphorous present as impurities
Phosphoric Acid	85-95	165-185	74-85	—	E	—	—	small amounts of fluorine compounds
Phosphoric Acid	85-95	212-239	100-115	—	B	—	—	small quantities of fluorine compounds in mist. Alloy C = 21 mpy
Phosphoric Acid	86	208	98	E	—	—	S	immersed 96 hrs.
Phosphoric Acid	87-90	176-230	80-110	G	E	—	E	furnace process, 102 days, trace NaCl and HCl, aeration moderate, agitation none
Phosphoric Acid	87-90	194	90	G	E	—	E	furnace process (63 to 65% P_2O_5), trace HCl and NaCl moderate aeration
Phosphoric Acid	93	260	127	U	—	—	—	
Phosporic Acid	93.5	375-410	190-210	—	U	—	U	vapor above phosphoric acid 93.5% (67% P_2O_5), wet process, containing about 4.3% sulfuric acid and 4.4% iron and aluminum oxides. Fluoride is present below 1.5%, moderate aeration
Phosphoric Acid	98	390-460	199-238	—	—	G	—	(71 percent P_2O_5) sulfuric acid 4-6 percent, iron and aluminum 2.8-3.0 as trioxides, fluorine compounds 0.5-1.0 percent
Phosphoric Acid	101	300	149	—	—	G	—	solids 1.17 percent, 0.4 percent fluorine
Phosphoric Acid	103	300	149	B	—	—	—	H_3PO_4 as catalyst in polymerization reaction, 1000 hrs., mol esters/mol acid = 0.1
Phosphoric Acid	117	140	60	E	—	—	—	85 percent P_2O_5
Phosphoric Acid	118	485	251	S	B	—	—	
Phosphoric Acid	—	60-650	16-343	—	E	—	—	gases containing HF, SiF_4, SO_2, with entrained H_3PO_4, 99% (72% P_2O_5), H_2SO_4 3.7%, (3.0% SO_3), extensive aeration
Phosphoric Acid	—	230	110	—	—	E	E	75-105% by wt., aeration, 126 days
Phosphoric Acid, Commercial	75	172	78	—	E	—	—	Alloy C = 1 mpy
		194	90	—	E	—	—	Alloy C = 1.4 mpy
		208	98	—	E	—	—	Alloy C = 1 mpy
		221	105	—	G	—	—	Alloy C = 4.6 mpy
Phosphoric Acid, Dehydrated	—	320	160	S	G	—	—	plus acrylic acid and betaproprlolactone. Alloy C = 5 mpy at top of acrylate unit.
Phosphoric Acid Fumes	75	122	50	G	—	—	—	some P_2O_5 and H_2S
Phosphoric Acid Mist	100	200-212	93-100	G	E	E	—	.04-.35 grains/ft_3, 78 days, aeration extensive, agitation 5-12 fps, pit depth, alloy B = 4 mils, alloy C = 0, alloy G = 0
Phosphoric Acid Mist	—	206	97	G	E	E	—	0.04-.35 grains 100% H_3PO_4 per "standard cubic foot" or 0.10-.86 grams 100% H_3PO_4 per cubic meter (STP)) Chloride (20-30 ppm) in city water used in scrubber liquor, extensive aeration
Phosphoric Acid Mixtures	39	170-183	77-84	—	G	—	U	(28% P_2O_5), sulfuric acid 2%, hydrofluosilicic and hydrofluoric acids in trace amounts; total fluoride equivalent about 1.2 suspended gypsum 30% of suspension weight. Liquid phase, moderate aeration
Phosphoric Acid Pickling Solution	22	180-200	82-93	U	G	—	—	for removing scale from parts to be bonderized. Alloy C = 2.5 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	deg. C	HASTELLOY® alloy B/B-2	C/C-276	G	Type 316 Stainless Steel	Conditions
Phosphoric Acid, Production gases and vapors	—	130	54	G	S	—	B	silicon tetrafluoride approx. 0.31-0.44 lb./1000 cu. ft.; carbon dioxide approx. 0.47-0.68 lb./1000 cu. ft.; P_2O_5 equivalent 0.00033-0.00048 lb./100 cu. ft. Possibly very small amount H_3PO_4 as spray, moderate aeration
Phosphoric Acid Slurry	20	170-200	77-93	U	G	—	—	in digester during production of wet process H_3PO_4. Plus $CaSO_4$, 40 percent H_2O, 2 percent H_2SO_4, 1 percent fluorine. Alloy C = 7.9 mpy
Phosphoric Acid and Sulfuric Acid (0.4%)	0.1	122-248	50-120	E	E	E	E	Duration of test — 64 days (56 in H_3PO_4, 8 in H_2SO_4) Aeration — air free Agitation — extensive Type of test — field Process involved — syntheses of tertiary and secondary amylphenols Remarks — unwashed
Phosphoric Acid and Sulfuric Acid (0.3%)	0.1	122-347	50-175	E	E	E	E	Duration of test — 43 days (25 in H_3PO_4, 18 in H_2SO_4) Aeration — air free Agitation — extensive Type of test — field Process involved — syntheses of tertiary and secondary amylphenols Remarks — unwashed
Phosphoric Acid, Wet Process	14.5	158	70	—	E	—	—	plus 0.381 percent. HNO_3 in acid. Alloy C = 0.1 mpy
Phosphoric Acid, Wet Process	28	180-230	82-110	U	G	—	U	42 days, 20-22% H_2SO_4, 1-1.5% fluosilicic acid, aeration moderate
Phosphoric Acid, Wet Process	28	180-230	82-110	—	G	—	U	P_2O_5 20%, sulfuric acid 20-22%, fluroride about 1-1.5%, probably as fluosilicic acid, moderate aeration
Phosphoric Acid, Wet Process	30†	185	85	—	—	G	—	2 percent F, 4.5 percent H_2SO_4 (110 hours exposure), liquid
Phosphoric Acid, Wet Process	30†	250	121	—	—	G	—	2 percent F, 4.5 percent H_2SO_4 (110 hours exposure), hot wall
Phosphoric Acid, Wet Process	30†	185	85	—	—	G	—	2.4 percent F, 3 percent H_2SO_4, 1.2 percent ferrous oxides 1.1 percent solids (96 hours exposure), liquid
Phosphoric Acid, Wet Process	30†	250	121	—	—	G	—	2.4 percent F, 3 percent H_2SO_4, 1.2 percent ferrous oxides 1.1 percent solids (96 hours exposure), hot wall
Phosphoric Acid, Wet Process	36	104	40	—	G	E	B	P_2O_5 equivalent 26%, sulfuric acid 2.9%, chloride 350 ppm, hydrofluosilicic acid trace, aluminum phosphate trace, ferric phosphate trace, moderate aeration
Phosphoric Acid, Wet Process	36	172	78	—	G	E	U	P_2O_5 equivalent 26%, sulfuric acid 2.9%, chloride 350 ppm, hydrofluoric acid, trace water. Suspended matter: calcium sulfate dihydrate 30% of suspension weight, calcium phosphate 0.1%, moderate aeration
Phosphoric Acid, Wet Process	39	170-183	77-84	—	—	E	—	2 percent H_2SO_4, total fluorides 1.2 percent, gypsum 30 percent
Phosphoric Acid, Wet Process	39	170-183	77-84	U	G	E	U	96 days, liquid phase, 2% H_2SO_4, HF and H_2SiF_6 trace, aeration moderate, agitation strong
Phosphoric Acid, Wet Process	39	183	84	U	G	E	U	28% P_2O_5, sulfuric acid 2%, hydrofluosilicic and hydrofluoric about 1.2%. Suspended gypsum 30% of suspension weight, aeration
Phosphoric Acid, Wet Process	53.8	121-149	49-65	—	E	—	—	in evaporation of H_3PO_4 plus 1.62-1.70 F_2, 1.5-2.5 H_2SO_4, 2 percent $CaSO_4$ in thickener. Alloy C = 1.7 mpy
Phosphoric Acid, Wet Process	55	180	82	—	G	G	U	H_3PO_4 (40% P_2O_5), containing combined fluorine, calcium sulfate, hydrofluosilicic acid
Phosphoric Acid, Wet Process	55	232	111	U	U	—	U	40% P_2O_5 equivalent, containing 3% sulfuric acid and suspended calcium sulfate; slurry. Gases containing water and fluorine compounds are evolved at the exposure area
Phosphoric Acid, Wet Process	56†	190-230	88-110	—	—	E	—	2 percent H_2SO_4, 1 percent F, 1.5 percent ferrous and aluminum oxides, 4 percent solids (48 hours exposure), liquid
Phosphoric Acid, Wet Process	56†	225-245	107-118	—	—	G	—	2 percent H_2SO_4, 1 percent F, 1.5 percent ferrous and aluminum oxides, 4 percent solids (48 hours exposure), hot wall
Phosphoric Acid, Wet Process	56†	300	149	—	—	B	—	2 percent H_2SO_4, 1 percent F, 1.5 percent ferrous and aluminum oxides, 4 percent solids (48 hours exposure), hot wall
Phosphoric Acid, Wet Process	56† 66† 66†	330 325 340	166 163 171	— — —	— — —	U B U	— — —	small amounts of Co, MgO, Fe, Al_2O_3, SiO_2, Na_2O, Cl. No fluorides or H_2SO_4 present (48 hours exposure), hot wall
Phosphoric Acid, Wet Process	69	490 to 550	254 to 287	B	B	—	—	highly concentrated, aerated acid, 69% P_2O_5, static and agitated

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

† — percent P_2O_5

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Phosphoric Acid, Wet Process	70-100	60-600	16-315	—	B	—	—	H_3PO_4 (72% P_2O_5), sulfuric acid 3.7% (3.0% SO_3); fluoride 0.5%, moderate aeration
Phosphoric Acid, Wet Process	70	200	93	E	E	—	E	highly concentrated, unaerated acid, 70.3% P_2O_5, static and agitated
Phosphoric Acid, Wet Process	70	300	149	E	E	—	S	highly concentrated, unaerated acid, 70.3% P_2O_5, static and agitated
Phosphoric Acid, Wet Process	93.5	398-410	203-210	—	—	B	—	(67.8 percent P_2O_5), containing about 4.3 percent sulfuric acid and 4.4 percent iron and aluminum
Phosphoric Acid, Wet Process	96.6	410	210	—	E	—	G	70% as P_2O_5, 35% ortho, 35% non-ortho; sulfuric acid about 4%, hydrofluoric acid about 0.3%, calcium about 0.2%
Phosphoric Acid, Wet Process	98	390-460	199-238	—	S	—	—	(71% P_2O_5), sulfuric acid 4-6%, iron and aluminum 2.8-3.0% as trioxides, fluorine compounds 0.5-1.0% (calculated as fluoride), extensive aeration
Phosphoric Acid, Wet Process	98	400	204	B	B	B	—	ammonium bisulfate 3.8%, hydrofluoric acid 0.4%, 23 days
Phosphoric Acid, Wet Process	98	460	237	U	S	G	—	71% P_2O_5, sulfuric acid 4-6%, iron and aluminum 2.8-3.0% as trioxides, fluorine compounds 0.5-1.0% (calculated as fluoride), aeration
Phosphoric Acid, Wet Process	—	300	149	G	G	G	B	nominal analysis: H_3PO_4 equivalent 101.0%; total P_2O_5 73.19% ortho P_2O_5 27.58%; total solids 1.17%; CaO 0.59%; SO_4 1.97%, F 0.40%, Fe_2O_3 2.05%; Al_2O_3 1.56%, MgO 0.75%, aeration
Phosphoric Acid, Wet Process	—	300-350	149-177	—	G	—	S	superphosphoric acid, 94.8% (as ortho acid) Total P_2O_5 68.54%; ortho P_2O_5 51.08%; Fe_2O_3 = 2.30%, SO_4 = 2.19%, Al_2O_3 = 1.92%, Fe = 0.33%. Concentration gradually reduced to 80% H_3PO_4 (54% P_2O_5), each day 1/40 of acid was replaced with 54% P_2O_5 acid (80% H_3PO_4 equivalent)
Phosphoric Acid, Wet Process	—	410	210	U	U	B	U	vapor above phosphoric acid 93.5% (67% P_2O_5), containing about 4.3% sulfuric acid and 4.4% iron and aluminum oxides. Fluoride is present below 1.5%, aeration
Phosphorous Chlorides	—	-45 to -30	-43 to -34	—	E	—	E	phosphorus trichloride, methyl dichlorphosphine, CH_3PCl_2, lower concentrations phosphorous oxychloride, $POCl_3$, methoxydichloro phosphine, CH_3OPCl_2; triethyl phosphate, $(C_2H_5O)_3PO$; chlorine. Anhydrous.
Phosphorous, Elemental	—	149-158	65-70	—	E	—	—	storage. Alloy C = 0.2 mpy
Phosphorous Pentoxide	13	285-300	141-149	G	U	—	—	contains approx. 250 ppm F.
Phosphorous Pentoxide	—	1472	800	U	—	—	—	
Phosphorous and Phosphoric Acid	—	—	—	—	G	—	—	phosphorus pentoxide, iodine, chlorine and water
Phthalic Anhydride	—	60	16	E	E	—	S	unspecified alcohol, phthalate ester, sulfuric acid · 1%
Phthalic Anhydride	—	60-275	16-135	—	E	—	S	phthalic anhydride, unspecified alcohol, phthalate ester, sulfuric acid less than 1%
Phthalic Anhydride	—	70-302	21-150	—	E	—	—	plus methyl CELLOSOLVE, dimethoxyethyl phthalte. Alloy C = 0.3 mpy
Phthalic Anhydride Liquid	—	335-500	168-260	E	E	—	—	plus small amounts of maleic benzoic acid and naphthaquinone
Phthalic Anhydride Vapors (Crude)	—	400-550	204-288	E	E	—	—	plus maleic acid and water. Vapors 7 ft./sec. Alloy C = 0.05 mpy
Phthalic Anhydride, (Vapor off Reaction of)	—	60	16	E	E	—	E	unspecified alcohol with sulfuric acid · 1%, forming phthalate seter
Phthalate, Dipropyl	78	245	118	—	S	—	—	plus 17.4 percent propyl alcohol, 3 percent benzene, 1 percent phthalic anhydride, 1 percent H_2SO_4, 0.1 percent water
Pickling Solution, Prague	—	B.P	B.P	—	E	—	—	88 percent NaCl, 6 percent $NaNO_2$, 5 percent $NaNO_3$, and small amounts of dextrose glycerine. Alloy C · 0.1 mpy
Plating Solutions, Lead, Tin, Antimony	—	68-72	20-22	E	—	—	—	in plating tank
Polyamine	—	360	182	E	E	—	E	air free
Potassium Bicarbonate	10	to B.P.	to B.P.	S	—	—	—	
	20	to B.P	to B.P	S	—	—	—	
	30	to B.P	to B.P	S	—	—	—	
	40	B.P	B.P	S	—	—	—	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Potassium Bisulfite	—	130	54	—	E	—	E	about 50% water; pH 6.5 to 4.5, moderate aeration
Potassium Bisulfite	—	145	63	S	E	—	E	about 50% water; pH 6.5 to 4.5, aeration
Potassium Bromide	75	180	82	—	E	—	—	plus potassium bromate, KOH, Br_2, trace of iron. Alloy C = 1.1 mpy
Potassium Carbonate	All 100	to B.P. 1500	to B.P. 816	S S	S —	— —	— —	
Potassium Chloride	10 20 28 28 28	to B.P. 125 to B.P. 150 175 B.P.	to B.P. 52 to B.P. 66 79 B.P.	S S E* E B	S — E — —	— — — — —	— — — — —	*during manufature of electrolytic potassium hydroxide
Potassium Chloride	10	220	104	—	E	—	E	concentrated brine in KCl, 20% $CaCl_2$ (extraction pilot plant; some iron chloride present as contaminant)
Potassium Chloride	10	230	110	—	E	E	E	plus 20% calcium chloride (some iron chloride present as contaminant), slight aeration
Potassium Chloride	99	325	163	E	E	E	E*	sodium chloride 1%, acetic acid Duration of test — 93 days Aeration — extensive Agitation — extensive Type of test — field Process involved — anti-caking treatment of fine granular KCl *stress-corrosion cracked
Potassium Chloride	99	325	163	—	E	—	E	sodium chloride 1%, solid, acetic acid vapor, water vapor, amine acetate-water emulsion was added to salt mixture, extensive aeration
Potassium Chloride	—	85-105	29-41	—	E	—	E	saturated KCl-NaCl brine with small amounts of $MgCl_2$ and H_2O. Possible traces of copper.
Potassium Chloride	—	95	35	—	E	E	E	saturated KCl-NaCl brine
Potassium Chloride	—	195-198	91-92	—	E	—	S	saturated KCl-NaCl brine with small amounts of $MgCl_2$ and H_2O. Possible traces of copper.
Potassium Chloride	—	196	91	—	E	G	S	saturated KCl-NaCl brine with small amounts of $MgCl_2$ and H_2O. Possible traces of copper.
Potassium Chloride Brine	—	140	60	—	E	—	—	KCl = 325 grams/liter, KOH = 2 grams/liter, K_2CO_3 = 0.2 grams/liter. Alloy C = 0.002 mpy
Potassium Chloride — Sodium Chloride Brine	Saturated	85-105	29-41	—	E	E	E	small quantity of $MgCl_2$ and H_2S. 113 days, agitation .1 to .3 fps
Potassium Chloride — Sodium Chloride Brine	Saturated	196	91	—	E	G	S	small amounts $MgCl_2$ and H_2S. 42 days, agitation .1 to .3 fps
Potassium Chloride — Sodium Chloride Brine	Saturated	200	93	—	—	E	E	impurities $MgSO_4$, $CaSO_4$, $MgCl_2$, 36 days
Potassium Chromate	10	75	24	E	E	—	—	
Potassium Cyanide	10	75	24	S	—	—	—	
Potassium Dichromate	10 15 25	100 100 100	38 38 38	— — —	S S S	— — —	— — —	
Potassium Ferrocyanide	5	75	24	S	—	—	—	
Potassium Ferricyanide	10 30	75 75	24 24	S S	— —	— —	— —	
Potassium Hypochlorite	50	200	93	E	E	—	—	plus 50 percent NaOH. Alloy C = 0.03 mpy
Potassium Hypochlorite	All	to B.P.	to B.P.	—	S	—	—	
Potassium Hydroxide	10 20 30 40 50 60 90	to B.P. to B.P. to B.P. to B.P. to B.P. B.P. to 125	to B.P. to B.P. to B.P. to B.P. to B.P. B.P. to 52	S S S S S S S	S S S S S — —	— — — — — — —	— — — — — — —	
Potassium Hydroxide	20	203	95	—	E	—	—	in isopropanol and isopropanol solution of hexachlorpentadiene. Alloy C = 0.09 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Potassium Hydroxide	40	Room	Room	—	E	—	—	
Potassium Iodide	—	203	95	—	E	—	—	in preparation of KI by neutralizing iron iodide (40° Bé, pH = 2) with K_2CO_3. Max. pit = 0.001. Alloy C <0.1 mpy
Potassium Nitrate	All	to B.P.	to B.P.	—	S	—	—	
Potassium Perchlorate	25 50 75	75 75 75	24 24 24	— — —	S S S	— — —	— — —	
Potassium Permanganate	25 50 75	75 75 75	24 24 24	— — —	E E S	— — —	— — —	
Potassium Persulfate	4	75	24	—	E	—	—	catalyst for synthetic rubber production. Alloy C = 0.1 mpy
Potassium Sulfate	10 20	75 to 125	24 to 52	— S	S —	— —	— —	
Potassium Sulfite	—	140	60	—	E	—	G	potassium bisulfite, about 50% water; pH 6.0-5.0, sulfur dioxide in flue gas, extensive aeration
Potassium Sulfite	—	145	63	—	E	—	E	potassium bisulfite, about 50% water; pH 5.9-7.2, moderate aeration
Potassium Sulfite	—	145	63	—	E	—	E	potassium bisulfite, about 50% water; pH 6.0-7.2
Potassium Sulfite	—	180	82	G	E	—	E	potassium bisulfite, about 50% water; pH 5.9-7.2
Potassium Sulfite	—	180	82	U	E	—	G	potassium bisulfite, about 50% water; pH 6.0-7.0, sulfur dioxide in flue gas, aeration
Potassium Sulfite	—	180	82	S	E	—	E	potassium bisulfite, about 50% water; pH 6.0-7.2
Potassium Sulfite	—	230	110	—	E	—	E	potassium bisulfite, about 50% water; pH 6.5-5.0, sulfur dioxide in flue gas
Potassium Sulfite	—	270	132	—	G	—	E	potassium bisulfite, about 50% water; pH 6.8-5.5
Potassium Sulfite	—	280	138	S	E	—	E	potassium bisulfite, about 50% water; pH 6.5 to 5.0, sulfur dioxide in flue gas
Potassium Sulfite	—	300	149	B	G	—	E	potassium bisulfite, about 50% water; pH 6.8 to 5.5
Propanol	47	356	180	—	E	—	G	3% formic acid, balance water, 24 hrs. lab test
Propanol	—	110	43	E	E	—	—	plus free SO_2 and H_2SO_4, pH = 2.5-5. Alloy C = 0.1 mpy
Propionic Acid	60-65	311	155	—	E	—	—	plus 10-12 percent butyric acid, 4-7 percent acetic acid. Alloy C <0.1 mpy
Propionic Acid	64	500	260	B	S	—	U	35% propionic anhydride; 1% nickel acetate, 7 hrs., lab test, continuous feed 2000 cc per hour
Propionic Acid	80	212-338	100-170	—	E	—	—	plus 2.5 percent butyric acid, 2 percent nitric acid, 0.1 percent acetic acid. Alloy C = 0.7 mpy
Propionic Acid	90	248-320	120-160	—	E	—	—	plus 4 percent butyric acid, 1 percent nitric acid, acetic acid. Alloy C = 0.5 mpy
Propionic Acid	94	85-356	30-180	—	E	—	—	plus 2 percent butyric acid, 3 percent boiling esters, 1 percent acetic acid during nitric acid treatment. Alloy C = 0.1 mpy
Propionic Acid	97	288	142	—	E	—	—	plus 3 percent acetic acid. Alloy C = 0.07 mpy
Proprietary Compounds	—	284	140	—	E	—	G	proprietary acid chlorides, toluol and VMP naphtha. Also methanol N, 1-3% HCl during a cleaning cycle, occasionally DMF also to clean.
Proprietary Compounds	—	329	165	—	E	—	G	proprietary acid chlorides, toluol and VMP naphtha. Also methanol N, 1-3% HCl during a cleaning cycle, occasionally DMF also to clean.
Protein Hydrolysate	—	100-115	38-46	—	E	—	—	plus HCl to pH of 1.5 and some SO_2 mixing digestion tank. Alloy C = 0.6 mpy
2 Pthoxyethyl Acetate	96	331	166	E	E	—	E	acetic anhydride 0.4%, acetic acid 0.2%, water unknown, extensive aeration
Pyridine	6	100-120	38-49	E	E	—	—	plus 5 percent NaCl, 2 percent CH_2Cl_2, 1 percent NaOH, and water. Alloy C · 0.1 mpy
Pyridine	50	80-100	27-38	E	E	—	—	plus traces of HCl, CH_2Cl_2 and acetone in separation of pyridine from water. Alloy C · 0.1 mpy. At 200 deg. F, alloy C · 0.1 mpy
Pyridine	9M	572	300	U	U	—	—	plus 1M ferric chloride; also a mixture of pyridine, pyridine hydrochloric and ferric chloride, 6 to 48 hrs., lab test

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point
M — Molar

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Pyrogallic Acid	All	to B.P.	to B.P.	S	S	—	—	
Rayon	—	122-167	50-75	—	E	—	S	rayon "spin" bath — 5-10% sulfuric acid; 1-8% zinc sulfate; 10-15% sodium sulfate. Free carbon bisulfide present and saturated with hydrogen sulfide. Amines and ethylene oxide condensation products present to 1%.
Rayon	—	208	98	—	E	—	B	rayon "cascade" bath — 1.5-5% sulfuric acid; 1-3% zinc sulfate; 10-15% sodium sulfate; free carbon bisulfide present and saturated with hydrogen sulfide.
Rayon Bleach	—	210	99	—	G	—	—	plus 0.1 percent sodium chlorite, 0.03 percent sodium carbonate, 0.1 percent synthetic detergent, 0.035 percent H_2O_2, 0.07 percent acetic acid. Alloy C = 3 mpy
Rayon Spin Bath	—	125	52	E	E	—	—	10 percent H_2SO_4 — spinning bleach, hardening etc. Vapor and liquid phases.
Rayon Spin Bath	—	100-210	38-99	S	G	—	—	extensive aeration. Alloy C = 4 mpy
Rayon Spin Bath	—	122	50	—	E	—	—	11 percent H_2SO_4, 24 percent SO_4, saturated with H_2S
Rayon Spin Bath, Dilute	—	Room	Room	—	G	—	—	in splash zone H_2SO_4 10 percent to less than 0.001 percent. From 0.500 ppm of CS_2 and H_2S. Alloy C = 3 mpy
Rayon Spin Bath, Spent	—	203	95	S	E	—	—	H_2SO_4 = 0.25 percent, Na_2SO_4 = 0.25 percent in casting machine. Alloy C = 0.1 mpy
Resin (Alkyd, Polyester, Amine Types)	—	25	-4	E	E	—	E	sodium hydroxide cleaning solutions (6% boiling). Various raw materials include phthalic and maleic anhydrides, isopthalic acid, glycerol, pentacrythritol; linseed, soy, castor and tall oils, vinyltoluene, propylene and ethylene and other glycols.
Rosin and Rosin Oil	—	572	300	—	E	—	—	in boiling solution at still bottom and in vapors. Alloy C = 0.1 mpy
Rubber	—	72	22	—	E	—	—	elastomer dissolved in aliphatic solvent to which bromine was added. pH 7.4, tested in absence of any light source, moderate aeration.
Rubidium	100	1400 1500 1600	760 815 871	S B S	— — —	— — —	— — —	lab test, 500 hrs., 1400°F-IG cracking, 1500°F-IG cracking, 1600°F-no cracking
Salicylic Acid	—	77-258	25-126	U	E	—	—	production of acid. pH varies from 12 to 2. Alloy C = 1.73 mpy
Salt Water, Clean	—	38	3	G	E	—	E	
Scrubbed Boiler Fluegas	—	120	49	—	—	E	E	15% CO_2, 3% O_2, 400 ppm SO_2, NOX and fly ash being scrubbed in slurry of 7% $CaSO_3$, 2% $CaSO_4$, .5% CaCO, pH 5. Scrubbing of SO_2 and fly ash from power plant flue gas Aeration — moderate Agitation — 200,000 ACFM gas Total days — 158
Scrubbed Boiler Fluegas	—	120	49	—	E	E	E	limestone slurry, 1750 ppm SO_2, 2-3% fly ash, 3% $CaCO_3$, 2-3% $CaSO_3$ plus $CASO_4$, pH 6-6.6, 2000-3000 ppm Cl, moderate aeration
Scrubbed Boiler Fluegas	—	120	49	—	—	E	E	15% CO_2, 3% O_2, less than 100 ppm SO_2. Liquid spray with some dissolved solids present, pH 6-7. Scrubbing of SO_2 and fly ash from power plant flue gas. Aeration — moderate Agitation — by gas flow Total days — 158
Scrubbed Boiler Fluegas	—	190	88	—	E	E	E	0-400 ppm SO_2, 10% water vapor, fly ash after limestone slurry scrubbing, moderate aeration
Scrubber Effluent Gas	—	110-115	43-46	—	E	E	E	aeration
Scrubber Environment	—	300	149	—	E	E	E	for municipal refuse incinerator. Hot, acid chloride environment, pH range about 1-6, extensive aeration
Scrubber Environment	—	400	204	—	E	—	E	for municipal refuse incinerator. Hot, acid chloride environment, pH range about 1-6, extensive aeration
Scrubbing Liquor Boiler Fluegas	—	120	49	—	—	E	E	4.4% $CaSO_3$, 2.5% $CaCO_3$, 0.5% fly ash, 0.1% $CaSO_4$, pH 6-7. Scrubbing of SO_2 and fly ash from power plant flue gas Aeration — moderate Agitation — by gas flow Total days — 158
Scrubbing Liquor	—	150	66	—	E	E	E	portable steam generator flue gases containing SO_2, NOX, N, CO_2 and O_2. Liquor alkaline oil field H_2O with 5000 ppm Cl, 21 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Scrubbing Liquor	—	160	71	—	E	E	E	portable steam generator flue gases containing SO_2, NOX, N, CO_2 and O_2. Liquor alkaline oil field H_2O with 5000 ppm Cl, 20 days, moderate aeration
Scrubbing Liquors Incinerators	—	105	41	—	E	—	E	flue gas scrubbing liquor containing fly ash and dissolved chlorides, sulfur oxides, nitrogen oxides, carbon dioxide and carbon monoxide, pH 4.5, extensive aeration
Scrubbing Liquors Incinerators	—	160	71	—	E	—	E	flue gas containing chlorides, sulfur oxides, nitrogen oxides, carbon dioxide, carbon monoxide, extensive aeration
Scrubbing Liquors Incinerators	—	160	71	—	E	—	E	flue gas, municipal, saturated with water vapor.
Scrubbing Liquors Incinerators	—	164	73	—	E	—	E	flue gas from furnace incinerator after scrubbing, water saturated, high excess air (100-200%), extensive aeration
Scrubbing Liquors Incinerators	—	185	85	—	E	—	E	clarifier liquid in municipal refuse incinerator. Water treated with Calverts coagulant 11 and ammonia to nominal pH of 6, moderate aeration
Scrubbing Liquors Incinerators	—	200	93	—	E	—	E	municipal refuse incinerator flue gas effluent after H_2O scrubbing environment. Should be mainly steam with entrained impurities; extensive aeration
Scrubbing Liquors Incinerators	—	200	93	—	E	—	E	scrubber water effluent from prequench chamber of municipal refuse incinerator scrubber. pH about 1
Scrubbing Liquors Incinerators	—	300	149	—	E	—	G	scrubber water, pH 2.53; chloride 175 ppm, sulfate 75 ppm, moderate aeration
Scrubbing Liquors Incinerators	—	400	204	—	E	—	G	municipal refuse incinerator water quenched flue gas hot, acid chloride environment, pH range about 1-6, extensive aeration
Scrubbing Liquors Incinerators	—	800	426	—	E	—	E	hydrochloric acid 0.018%, sulfuric acid 0.008%. Incinerator scrubber water pH 2.53, moderate aeration
Scrubbing Liquors Incinerators	—	—	—	—	G	—	S	flue gas from municipal refuse incinerator
Scrubbing Liquors Pollution Control	—	100	38	—	E	—	E	gas — 0.1 to 0.3% SO_2; 0.006% SO_3; 80% saturated, entrained sodium bisulfite solution; pH = 5 to 6. Extensive aeration
Scrubbing Liquors Pollution Control	—	134	57	—	E	—	E	scrubber stack gas saturated with scrubber liquor containing 0.0084 grains P_2O_5/SCF and 0.14 mg F/SCF.
Scrubbing Liquors Pollution Control	—	155	68	—	G	—	U	scrubber water in defluorination system. HF solution 0.6% as F, 2000 ppm P_2O_5, 700 ppm SO_4, pH 3.0.
Scrubbing Liquor, Power Plant Fluegas Double-Alkali SO_2	—	115-125	46-52	—	E	E	E	aeration
Scrubbing Liquor, Power Plant Fluegas	—	120	49	—	E	E	E	7% $CaSO_3$, 2% $CaSO_4$, 1% chloride, pH 5.8-6.1. Joy Hi liquid energy limestone scrubbing process for SO_2 and fly ash removal Aeration — extensive Agitation — gas and liquid flow Total days — 173
Scrubbing Liquor, Power Plant Fluegas	—	120	49	—	—	E	E	SO_2 300-800 ppm, 14% CO_2, 3% O_2, pH of liquor 5-5.5. Scrubbing of SO_2 and fly ash from power plant flue gas. Aeration — extensive Agitation — 5-10 ft./sec. Total days — 135.6
Scrubbing Liquor, Power Plant Fluegas	—	120	49	—	E	E	E	inlet flue gas, aeration
Scrubbing Liquor, Power Plant Fluegas	—	120	49	—	E	E	E	
Scrubbing Liquor, Power Plant Fluegas	—	122	50	—	E	—	E	7% $CaSO_3$, 2% $CaSO_4$, 1% chloride, pH 5.8-6.1. Gas in 2000-2400 ppm SO_2. Joy Hi liquid energy limestone scrubbing process for SO_2 and fly ash removal Aeration — extensive Agitation — gas and liquid flow Total days — 100
Scrubbing Liquor, Power Plant Fluegas	—	122	50	—	E	—	E	7% $CaSO_3$, 2% $CaSO_4$, 1% $CaCO_3$, 1% Chloride, pH 5.8-6.1. Gas in 2000-2400 ppm SO_2 extensive aeration
Scrubbing Liquor, Power Plant Fluegas	—	130-135	54-57	—	—	E	E	aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Scrubbing Liquor, Power Plant Fluegas	—	145	63	—	E	G	S	aeration
Scrubbing Liquor, Power Plant Fluegas	—	150-350	66-177	—	G	G	G	aeration
Scrubbing Liquor, Power Plant Fluegas	—	176	80	—	E	E	E	H_2S sparged into citric acid $NaCO_3$ plus absorbed SO_2 solution to put sulfur. pH 4-5. Citrate process for sulfur dioxide removal (and sulfur recovery) Aeration — none Agitation — violent Total days — 91
Scrubbing Liquor, Power Plant Fluegas	—	176	80	—	E	E	E	SO_2 being absorbed in solution of citric acid, 80 g/l Na_2CO_3; pH 4.0-5.0. Citrated process for sulfur dioxide removal (and sulfur recovery) Aeration — moderate Agitation — by liquid flow Total days — 91
Scrubbing Liquor, Power Plant Fluegas	—	176	80	—	E	E	E	recycled and makeup 190 g/l citric acid, 80 g/l Na_2CO_3, pH 4-5. Citrate process for sulfur dioxide removal (and sulfur recovery) Aeration — none Agitation — agitated Total days — 91
Scrubbing Liquor, Power Plant Fluegas	—	240	116	—	—	E	E	SO_2 1600-2000 ppm, 14% CO_2, 3% O_2, exposed to liquor spray at pH 10 containing solids. Scrubbing SO_2 and fly ash from power plant flue gas. Aeration — extensive Agitation — 5-10 ft./sec. Total days — 135.6
Scrubbing Liquors Smoke and Fluegas	—	70	21	—	E	—	B	hydrochloric acid, sulfuric acid, sulfurous acid, hydrobromic acid, organic solvents, some chlorinated, pH approx. 1, moderate aeration
Scrubbing Liquors Smoke and Fluegas	—	117	47	—	E	—	E	calcium sulfite, calcium sulfate, calcium carbonate, fly ash, all suspended as 10-15% (by wt.) slurry, pH not specified
Scrubbing Liquors Smoke and Fluegas	—	130	54	—	E	—	E	flue gas containing sulfur dioxide. Entrained potassium sulfite-bisulfate solution, pH about 4.0, extensive aeration
Scrubbing Liquors Smoke and Fluegas	—	135	57	—	E	—	E	flue gas scrubbing liquor containing fly ash and dissolved chlorides, sulfur oxides, nitrogen oxides, carbon dioxide and carbon monoxide, pH 4.5, extensive aeration
Scrubbing Liquors Smoke and Fluegas	—	140	60	—	E	—	—	flue gas containing wetted fly ash. Scrubber liquor containing sulfuric acid 0.19%, hydrochloric acid 0.057%, pH 2 to 5, extensive aeration
Scrubbing Liquors Smoke and Fluegas	—	160	71	—	E	—	E	water scrubber; pH 2.53; chloride 175 ppm, sulfate 75 ppm, moderate aeration
Scrubbing Liquors Smoke and Fluegas	—	164	73	—	E	—	E	flue gas from incinerator, scrubbed
Scrubbing Liquors Smoke and Fluegas	—	170	77	—	E	—	E	water from incinerator scrubber. Chlorides 900-1000 ppm, iron 24 ppm, pH 1.95-2.03, extensive aeration
Scrubbing Liquors Smoke and Fluegas	—	175	79	—	G	—	B	flue gas containing H_2O, SO_2, SO_3, HCl, H_2S and NaOH
Scrubbing Liquors Smoke and Fluegas	—	175	79	—	E	—	G	flue gas containing H_2O, SO_2, SO_3, HCl, H_2S and NaOH
Scrubbing Liquors Smoke and Fluegas	—	200	93	—	E	—	E	flue gas containing H_2O, SO_2, SO_3, HCl, H_2S and NaOH
Scrubbing Liquors Smoke and Fluegas	—	200	93	—	E	—	E	flue gas, water-scrubbed, from combustion of municipal refuse; nearly saturated with water vapor, considerable aeration
Scrubbing Liquors Smoke and Fluegas	—	280	138	—	E	—	S	flue gas containing sulfur dioxide and sulfur trioxide. Considerable liquid water and water vapor, pH 2.0 to 4.0, entrained, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	80	27	—	E	—	E	calcium carbonate, calcium sulfate, calcium sulfite, and fly ash all suspended as about 20% (by wt.) slurry. pH not specified, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	89	32	—	E	—	—	limestone slurry 15% $CaCO_3$ in water. pH 6.3-7.9
Scrubbing Liquors Sulfur Dioxide	—	93	34	—	E	—	—	5% H_2SO_4 scrubbing solution for smelter gas containing 2-10% O_2, less than 500 ppm sulfur dioxide and 160 ppm chlorides, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	100	38	—	E	—	—	copper smelter gas and recycled cooling spray water (pH as low as 1.7 average 2.5) 1-1.5% SO_2 in gas plus particulate and SO_3, extensive aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Scrubbing Liquors Sulfur Dioxide	—	105	41	—	E	—	—	copper smelting gas containing .75-1% SO_2 and some sulfuric acid mist (25-100 ppm), extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	105	41	—	E	—	—	smelter gas in TCA scrubber and limestone slurry (15%, pH 5.2-7) which is converted to $CaSO_3$ and some $CaSO_4$ by SO_2 in the gas, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	107	42	—	E	—	—	limestone slurry 15% solids, $CaCO_3$ plus $CaSO_3$ and a small amount of $CaSO_4$, pH 3.7-6.7, ave. 5.6, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	115	46	—	E	—	E	calcium sulfite, calcium sulfate, calcium carbonate, fly ash, all suspended as 30-50% (by wt.) slurry. pH not specified
Scrubbing Liquors Sulfur Dioxide	—	117	47	—	E	—	E	calcium carbonate, calcium sulfate, calcium sulfite, all suspended as 6-11% (by wt.) slurry, pH not specified, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	117	47	—	E	—	E	flue gas containing entrained H_2O and slurry (calcium sulfate, calcium sulfite, calcium carbonate), moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	—	magnesium oxide slurry scrubbing liquor for SO_2 removal from power plant flue gas, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	E	boiler flue gas, 0-400 ppm SO_2, 10% water vapor, fly ash after limestone slurry scrubbing, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	E	8% limestone slurry, $CaCO_3$, $CaSO_3$, $CaSO_4$ and fly ash, pH 5.0-6.0, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	E	boiler flue gas and limestone slurry, 1750 ppm SO_2, 2-3% fly ash .3% $CaCO_3$, 2-3% $CaSO_3$ plus $CaSO_4$, pH 6-6.6, 2000-3000 ppm Cl, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	E	sodium sulfate scrubber liquor. Gas from oil fired sodium sulfate flash drying system. Liquor contains dilute Na_2SO_4, H_2SO_3, pH 2-3, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	122	50	—	E	—	E	power plant flue gas scrubbing liquor 7% $CaSO_3$, 2% $CaSO_4$, 1% $CaCO_3$, 1% chloride, pH 5.8-6.1 Gas in 2000-2400 ppm SO_2 extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	122	50	—	E	—	E	power plant flue gas scrubbing liquor 7% $CaSO_3$, 2% $CaSO_4$, 1% $CaCO_3$, 1% chloride, pH 5.8-6.1 Gas in 2000-2400 ppm SO_2 extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	122	50	—	E	—	E	scrubbed power plant flue gas containing 300-500 ppm SO_2 and 15% H_2O, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	125	52	—	E	—	E	SO_2 gas scrubbing, 800 ppm SO_2, 15% H_2O, 12% CO_2, 68% N_2, 5% O_2, chlorides, 2000 ppm fluoride, some SO_3, pH 3, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	125	52	—	E	—	E	power plant flue gas after limestone slurry scrubbing containing 0.1 lb./min. of residual SO_2. Effluent of absorber section of scrubber, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	131	55	—	S	—	B	SO_2 scrubber gas, 5% SO_2, 3% SO_3, 7% O_2, balance N_2 saturated with H_2O. Possible splashing with solution containing 1-3 g/l Cu, pH 6
Scrubbing Liquors Sulfur Dioxide	—	135	57	—	E	—	—	copper smelting gas after cooling in a H_2O spray tower. Gas contains H_2O at 2.5 pH plus sulfuric acid mist (25-100 ppm), extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	140	60	—	G	—	—	scrubbed roaster gas; SO_2 100-2000 ppm, H_2SO_4 100-1500 ppm, balance wet air; heavy loading H_2O droplets, containing Ca salts and ore dust
Scrubbing Liquors Sulfur Dioxide	—	143	62	—	E	—	E	wet venturi scrubbing stream removing fly ash from boiler burning corn cobs. Gas 83% N_2, 360 ppm SO_2, 80 ppm H_2SO_4. Ash 6% Cl, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	150	66	—	E	—	E	scrubbing liquor for portable steam generator flue gases containing SO_2, NOX, N, CO_2, and O_2. Liquor alkaline oil field H_2O with 5000 ppm Cl, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	150	66	—	B	—	—	wet flue gas after H_2O spray, scrubber slurry ($CaSO_3$ mainly, also $Ca(OH)_2$ or $CaCO_3$ plus $CaSO_4$, pH 3-12) during upsets.
Scrubbing Liquors Sulfur Dioxide	—	160	71	—	E	—	E	scrubbing liquor for portable steam generator flue gases containing SO_2, NOX, N, CO_2, and O_2. Liquor alkaline oil field H_2O with 5000 ppm Cl, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	167	75	—	E	—	—	dimethylaniline containing SO_2 steam and sulfur dioxide
Scrubbing Liquors Sulfur Dioxide	—	176	80	—	G	—	B	SO_2 scrubber gas, 5% SO_2, 6.5% O_2 and 88.5% N_2 (dry basis) saturated with water vapor, extensive aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Scrubbing Liquors Sulfur Dioxide	—	176	80	—	E	—	E	power plant flue gas scrubbing liquor. Recycled and makeup 190 g/l citric acid, 80 g/l Na_2CO_3, pH 4-5
Scrubbing Liquors Sulfur Dioxide	—	176	80	—	E	—	E	power plant flue gas scrubbing liquor. H_2S sparged into citric acid, sodium carbonate plus absorbed SO_2 solution to ppt sulfur. pH 4.5
Scrubbing Liquors Sulfur Dioxide	—	190	88	—	E	—	E	boiler flue gas, 0-400 ppm SO_2, 10% water vapor, fly ash after limestone slurry scrubbing, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	200	93	—	E	—	E	power plant flue gas scrubbing. Decanted scrubbing liquor after removal of sulfur and during removal of Na_2SO_4 by-product by XTALZN.
Scrubbing Liquors Sulfur Dioxide	—	235	113	—	E	—	E	power plant flue gas scrubbing. Molten sulfur phase
Scrubbing Liquors Sulfur Dioxide	—	235	113	—	E	—	E	power plant flue gas scrubbing. Sulfur slurry phase of sulfur decanter containing 30-50% solids
Scrubbing Liquors Sulfur Dioxide	—	235	113	—	E	—	E	power plant flue gas scrubbing. Citrate solution phase of sulfur decanter. (Dilute and impure sodium citrate)
Scrubbing Liquors Sulfur Dioxide	—	370	188	—	E	—	—	flue gas from a metallurgical roaster, typical .02 grains/cu. ft. dust, SO_2 1500 ppm, SO_3 750 ppm, CO_2 .7% H_2O 1-3%, bal. air
Scrubbed Power Plant Fluegas	—	115-125	46-52	—	E	E	E	containing droplets of dbl. alkali scrubbing liquor, aeration
Scrubbed Power Plant Fluegas	—	120	49	—	E	E	E	aeration
Scrubbed Power Plant Fluegas	—	122	50	—	E	—	G	containing 300-500 ppm SO_2 and 15% H_2O. Joy Hi liquid energy limestone scrubbing process for SO_2 and fly ash removal Aeration — extensive Agitation — gas and liquid flow Total days — 100
Scrubbed Power Plant Fluegas	—	135-145	57-63	—	E	E	E	dbl. alkali process, aeration
Scrubbed Power Plant Fluegas	—	160-165	71-74	—	—	E	E	saturated with H_2O and SO_2, aeration
Scrubbing Power Plant Fluegas	—	176	80	—	E	E	E	vapor phase of 190 g/l citric acid, 80 g/l Na_2CO_3, solution for absorption of SO_2. pH 4-5 Aeration — moderate Agitation — by gas flow Total days — 91
Scrubbing Power Plant Fluegas	—	176	80	—	E	E	E	SO_2 being absorbed into solution of 190 g/l citric acid, 80 g/l Na_2CO_3. pH 4.0-5.0, moderate aeration
Scrubbing Power Plant Fluegas	—	200	93	—	E	E	E	decanted scrubbing liquor after removal of sulfur and during removal of Na_2SO_4 by-product by XTALZN. Citrate process for sulfur dioxide removal (and sulfur recovery), 91 days
Scrubbing Power Plant Fluegas	—	235	113	—	E	E	E	citrate solution phase of sulfur decanter, (dilute and impure sodium citrate). Citrate process for sulfur dioxide removal (and sulfur recovery), 91 days
Scrubbing Power Plant Fluegas	—	235	113	—	E	E	E	molten sulfur phase. Citrate process for sulfur dioxide removal (and sulfur recovery), 91 days
Scrubbing Power Plant Fluegas	—	235	113	—	E	E	E	sulfur slurry phase of sulfur decanter containing 30-50% solids. Citrate process for sulfur dioxide removal (and sulfur recovery), 91 days
Scrubbed Recovery Boiler, Fluegas	—	165	74	—	E	—	E	N_2, O_2, water vapor, CO_2, traces of CO, H_2S, SO_2, methyl mercaptan plus slight liquor carryover. Scrubbing of recovery boiler flue gas firing kraft process black liquor Aeration — extensive Agitation — 10-12 ft./sec. Total days — 67
Scrubber Fluegas, Incineration of Sewage Sludge	—	240	116	U	E	E	E	Aeration — extensive Agitation — by gas flow Total days — 65.9
Scrubber Liquor for Recovery Boiler Fluegas	—	165	74	—	E	—	E	20.5 g/l Na_2CO_3, 21.5 g/l $NaHCO_3$, 3.1 g/l chloride solids, 15% traces $Na_2S_2O_3$. Scrubbing of recovery boiler flue gas firing kraft process black liquor Aeration — extensive Agitation — moderate-violent Total days — 67.0

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS–CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Scrubber Liquor, Sodium Sulfate	—	120	49	—	E	E	E	gas from oil fired sodium sulfate flash drying steam. Liquor contains dilute Na_2SO_4, H_2SO_3, pH 2-3, extensive aeration
Scrubbed Municipal Garbage Incinerator Fluegas	—	170	77	—	E	G	G	90% water saturated, downstream of scrubber and demister. pH 3-4. Municipal garbage incinerator flue gas scrubbing; agitation high, aeration extensive; 51 days
Scrubbed Power Plant Fluegas & Condensate	—	143	63	—	—	E	G	gas 10% CO_2, 13% O_2, Bal N_2 (H_2O Satd). Fly ash carryover, pH below 0. Scrubbing of SO_2 and fly ash from power plant flue gas. Aeration — extensive Agitation — 5-10 ft./sec. Total days — 135.6
Scrubbing Solution & Quenched Boiler Stack Gas	—	110-115	43-46	—	E	E	E	plus fly ash, aeration
Scrubber Water	—	155	68	S	G	E	U	defluorination system. HF solution 0.6% as F, 2000 ppm P_2O_5, 700 ppm SO_4, pH 3.0, 92 days
Scrubber Water Effluent	—	200	93	—	E	E	E	from prequench chamber of municipal refuse incinerator scrubber. pH about 1
Seawater Mixtures	—	240	116	—	E	—	E	hydrogen sulfide gas with mist of de-aerated sea water
Sea Water	—	196	91	—	E	—	—	5 months, flow rate — 5 gpm
Sea Water and Diesel Fuel Exhaust Products	—	Ambient	Ambient	—	E	—	—	containing chlorides, sodium, sulfur, carbon
Sebacic Acid	10 10	90 B.P.	32 B.P.	B B	E E	— —	— —	plus small amounts of H_2SO_4, Na_2SO_4 and K_2SO_4
Sebacic Acid	10	90-220	32-104	S	E	—	—	plus 0.05-2 percent max. H_2SO_4 and traces of Na_2SO_4, K_2SO_4, H_2O balance. Alloy C = 0.4 mpy
Sebacic Acid (Crude)	—	428	220	—	E	—	—	in still. Alloy C = 0.4 mpy
Secondary Discharge Effluent	—	170	77	—	E	E	E	municipal garbage incinerator flue gas from secondary chamber after passing through scrubber, marble bed plus entrained liquor at pH 3-4. Agitation moderate; aeration extensive, 51 days
Secondary Discharge Effluent	—	200	93	—	E	E	E	municipal refuse incinerator flue gas effluent after H_2O scrubbing. Environment should be mainly steam with entrained impurities, extensive aeration
Secondary Discharge Effluent	—	300	149	—	E	E	G	municipal refuse incinerator water quenched flue gas, acid chloride environment, pH range about 1.6, extensive aeration
Separate Water Solutions	—	55-104	13-40	B	E	E	S	5-30% HCl, 10-40% H_2SO_4, 10-25% HNO_3, 1-40% NaOH, 127 days, aeration and agitation moderate
Sewage Gas	—	85-95	29-35	E	—	—	—	moisture laden gas from anaerobic digestion of packing house waste. 63 percent CO_2, 36 percent CH_4 and 1 percent H_2S, pH = 7.4 approx.
Sewage, Raw and Processed	—	240	116	—	E	—	—	avg. composition of brine: NH_3 5 ppm, Cl 100 ppm. B.O.D. 200 mg/l, moderate aeration, pH 6.0
Sewage (Scrubbed) Sludge Incinerator Fluegas	—	100-160	38-71	E	E	E	E	aeration
Sewage Sludge Incinerator Fluegas	—	66-72	19-22	G E	E E	E E	E E	sewage sludge incinerator flue gas being scrubbed by once thru water plant effluent water, aeration
Sewage Sludge Incinerator Fluegas	—	100-210	38-99	E E	E E	E E	E E	sewage sludge incinerator flue gas being scrubbed by once thru water plant effluent water, aeration
Sewage Sludge Incinerator Fluegas and Scrubbing Liquor	—	150	66	—	E	—	E	extensive aeration
Sewage Sludge Incinerator Fluegas	—	190-220	88-104	E E	E E	E E	E E	sewage sludge incinerator flue gas being scrubbed by once thru water plant effluent water, aeration
Silica, Acidified	—	700-900	371-482	E	E	—	—	in deacidification of silica by rotary kiln. Alloy C = 0.04 mpy
Silicon Tetrachloride	100	140	60	E	E	—	—	with dry HCl and Cl_2 bubbled through. In production of high purity silica of pigment. Alloy C = 0.1 mpy
Silicon Tetrafluoride	—	113	45	—	G	—	G	acid spray of droplets containing phosphoric acid, hydrofluosilicic acid, phosphate rock dust, water.

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Silicon Tetrafluoride	—	131	55	—	E	—	G	acid spray containing hydrofluoric acid, phosphoric acid, hydrofluosilicic acid
Silicon Tetrafluoride	—	167	75	—	S	—	B	acid spray containing phosphoric acid (69% H_3PO_4, 50% P_2O_5), hydrofluosilicic acid, phosphate rock dust, water
Silicon Tetraiodide	—	285-300	140-149	G	—	—	—	plus 2 percent free iodine under reflux half immersed
Silver Bromide	10	75	24	S	—	—	—	
Silver Chloride	10	75	24	—	S	—	—	
Silver Fines (Wet, Grey)	—	212	100	B	U	—	—	very dilute $FeCl_3$ bleaching powder and muratic acid solution, aeration none, agitation by boiling. Alloy C — 12 days
Silver Nitrate	10 20 40	75 75 75	24 24 24	S S S	— — —	— — —	— — —	
Silver Refining	—	220	104	—	E	—	E	acid leach slimes of silver refinery containing Cu, Au, Ag, Se, Te, Pt and Pd, moderate aeration
Silver Refining	—	220	104	S*	E	E	E	acid leach slimes of silver refinery containing Cu, Au, Ag, Se, Te, Pt and Pd, *specimen corroded away or was lost, aeration
Silver Salt	—	70	21	—	E	—	E	possibly nitrate, aqueous solution; concentration unknown
Slurry	45	60	16	—	—	—	B	100 mesh and finer, 2% H_2SO_4, saturated with SO_2, pH 1.0-1.5
Soap Coagulating Serum	—	100-125	38-52	S	E	—	—	strong NaCl solution plus dilute H_2SO_4, rubber, soap and traces of auxiliary solution. Rubber contains 30 percent carbon black pH = 3.5 avg. Alloy C = 0.17 mpy in conversion tank
Soap Fat	—	465-480	240-249	E	E	—	—	steam, fatty acid, glycerol
Sodium Acetate	10	75	24	—	S	—	—	
Sodium Acid Fluoride	8	160	71	G	U	—	—	in agitated crystallizer
Sodium Acid Fluoride	8	140-180	60-82	S	U	—	—	
Sodium Acid Fluoride	—	60-120	16-49	—	B	—	—	in manufacture of fluosilicates. Alloy C = 20.3 mpy
Sodium Aluminate	10	75	24	S	—	—	—	
Sodium Bicarbonate	10 20	to B.P. 110-B.P.	to B.P. 43-B.P.	S S	S S	— —	— —	
Sodium Bisulfate	20	180	82	—	E	—	—	treated under vacuum with sulfuric acid to drain off SO_2 contaminants. Solution decomposed to Na_2SO_4. Alloy C = 0.3 mpy
Sodium Bisulfate	All	to B.P.	to B.P.	S	S	—	—	
Sodium Bisulfite	3-6	—	—	—	E	—	—	in quebracho bisulfiting tanks. Alloy C = 0.1 mpy
Sodium Bromide	All	to B.P.	to B.P.	S	S	—	—	
Sodium Carbonate	10 20 30 100	to B.P. 100-B.P. 100-B.P. 1500	to B.P. 38-B.P. 38-B.P. 816	S S S S	— — — —	— — — —	— — — —	
Sodium Carbonate	1	100	38	—	E	—	G	Na_2CO_3 7-12 g/l, $NaHCO_3$ 2-7 g/l, $NaClO_3$ 40 g/l, NaOCl 5-10 g/l, NaCl 10-40 g/l
Sodium Chlorate	55	230	110	—	E	—	—	plus 7 percent NaCl in vacuum evaporation in manufacture of $NaClO_3$. Alloy C = 0.1 mpy
Sodium Chlorate	Saturated	160-240	71-116	—	E	—	—	sodium chloride solution plus 2-5 grams/liter of sodium hypochlorite. Alloy C = 0.1 mpy
Sodium Chlorate	—	70-220	21-104	—	E	—	—	in crystallizer saturated with NaCl. No hypochlorites present. pH = 6.7. Alloy C = nil mpy
Sodium Chloride	0-10	107	42	—	E	—	E	brine solution waste stream containing 23 mg/l total dissolved solids consisting of 10,000 mg/l chloride and 4,400 mg/l sulfate, pH 1.
Sodium Chloride	7	375	191	—	E	—	—	containing 53% NaCl, 198 days, slight attack under spacer
Sodium Chloride	10	75	24	S	—	—	—	manufacture of sodium fluosilicate, 3.5 percent H_2SiF_6
Sodium Chloride	14	167	75	—	E	—	—	plus 2 grams/liter free chlorine. Alloy C = 0.001 mpy
Sodium Chloride	15	150	66	—	E	E	E	10% calcium chloride; feed brine in potash extraction pilot plant

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concen-tration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sodium Chloride	15	160-170	71-77	E	E	—	—	1030 hrs.
Sodium Chloride	18	176	80	—	E	—	—	plus 10 percent $MgCl_2$. Allox C = 0.1 mpy
Sodium Chloride	20	165	74	—	E	—	—	NaCl brine, 73 days, severe pitting, severe attack under spacer
Sodium Chloride	20	190	88	—	B	—	—	saturated with Cl_2, 28 days, severe attack under spacer
Sodium Chloride	20	200	93	—	B	—	—	saturated with Cl_2, 204 days, perforated
Sodium Chloride	20	205	96	—	U	—	—	saturated with Cl_2, 40 days, perforated
Sodium Chloride	24	140	60	G	—	—	—	plus 2 percent isopropanol and NaOH added to keep pH = 10. Alloy B = 2 mpy (vapor) 4 mpy in liquid
Sodium Chloride	26	80	27	—	E	—	E	satruated brine Duration of test — 447 days Aeration — extensive Agitation — rapid Type of test — field
Sodium Chloride	26	80	27	—	E	—	G	saturated brine, traces calcium chloride and calcium sulfate, pH 6.8-7.0, extensive aeration
Sodium Chloride	35	158	70	—	E	E	E	in water plus undesignated amines and a small amount of sodium carbonate.
Sodium Chloride	35	85-195	29-91	—	—	E	E	in water plus undesignated amines and a small amount of sodium carbonate.
Sodium Chloride	98	140	60	E	—	—	—	plus 2 percent methyl alcohol. pH adjusted to 10 with NaOH
Sodium Chloride	Saturated	220	104	B	E	G	B	plus acid, oxidizing impurities, pH about 6, 272 hrs.
Sodium Chloride	—	70	21	—	E	—	—	saturated NaCl brine, 208 days
Sodium Chloride	—	85	29	—	E	—	E	assorted concentration NaCl liquor containing $MgSO_4$, KCl, $MgCl_2$, moderate aeration
Sodium Chloride	—	86	30	—	E	E	E	NaCl liquor containing $MgSO_4$ KCl, $MgCl_2$, moderate aeration
Sodium Chloride	—	131	55	U	E	—	—	plus sulfonated waxes, pH = 5-8. Alloy C = 0.1 mpy
Sodium Chloride	—	135	57	—	E	—	—	saturated NaCl brine, 125 days
Sodium Chloride	—	140	60	—	E	—	—	saturated NaCl brine, 169 days
Sodium Chloride	—	158-165	70-74	—	E	—	—	NaCl = 320 grams/liter, NaOH = 0.1 grams/liter, Na_2CO_3 = 0.6 grams/liter, Na_2SO_4 = 8.0 grams/liter. Alloy C = 0.02 mpy
Sodium Chloride	—	160	71	—	E	—	—	saturated NaCl brine, 163 days
Sodium Chloride	—	187-191	86-88	—	E	—	—	sodium chloride brine. Liquid phase.
Sodium Chloride	—	191	88	—	E	—	—	
Sodium Chloride	—	210-255	99-124	—	E	—	—	assorted concentrations NaCl brine, pH approx. 7.5, liquid phase. Impurities: 1.6-16 gm/l $CaCl_2$; 15-100 gm/l $CaSO_4$; 0.2-20 gm/l $MgCl_2$, moderate aeration
Sodium Chloride	—	221-227	105-108	—	E	—	—	sodium chloride brine. Liquid phase.
Sodium Chloride	—	225	107	—	E	—	—	saturated brine containing 5-15% NaCl, aeration
Sodium Chloride	—	227	108	—	E	E	—	
Sodium Chloride	—	230-250	110-121	—	E	—	—	saturated NaCl brine
Sodium Chloride	—	240	116	—	E	—	—	NaCl brine saturated
Sodium Chloride	—	240-242	116-117	—	E	—	—	saturated brine (NaCl), aeration
Sodium Chloride	—	250-255	121-124	—	E	—	—	saturated sodium chloride brine, pH 8.5-10.0, with small amounts of: sodium sulfate, magnesium sulfate, magnesium chloride, sodium carbonate, sodium hydroxide, extensive aeration
Sodium Chloride	—	255	124	—	E	E	—	saturated sodium chloride brine, pH 8.5-10, with small amounts of sodium sulfate, magnesium sulfate, magnesium chloride, sodium carbonate, sodium hydroxide, extensive aeration
Sodium Chloride	—	255	124	—	E	E	—	NaCl Brine, pH approx. 7.5. Impurities: 1.6-16 g/l $CaCl_2$, 15-100 g/l $CaSO_4$, 0.2-20 g/l $MgCl_2$, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concen-tration, percent	Temperature		HASTELLOY® alloy			Type 316 Stain-less Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G		
Sodium Chloride	—	255	124	—	E	—	—	saturated brine (NaCl), containing 10% NaCl in suspension and 20 g/l $CaSO_3$. pH 6.5 Brine purification — salt production Aeration — 1.5 ppm O_2 Agitation — 6 ft./sec. Total days — 33
Sodium Chloride	—	258-260	126-127	—	E	—	—	saturated brine (NaCl), aeration
Sodium Chloride	—	265	129	—	E	E	—	saturated with 5-15% suspended NaCl solids plus some suspended $CaSO_4$, pH 7.5-8.0, moderate aeration
Sodium Chloride	—	265	129	—	E	—	—	saturated sodium chloride solution with 5-15% suspended NaCl solids plus some suspended $CaSO_4$, pH 7.5-8.0, moderate aeration
Sodium Chloride	—	522	272	—	E	—	—	in rotary kiln drier. Alloy C = 0.2 mpy
Sodium Chlorite	10	75	24	—	S	—	—	
Sodium Dialkyl Orthocarbonate	—	41-96	5-36	—	E	—	—	in oxidation reactor during production of tetra alkyl thiuram disulfide, liquid phase plus $NaNO_3$, HCl, NaCl, HNO_2. Alloy C = 0.02 mpy
Sodium Ferricyanide	10	75	24	S	—	—	—	
Sodium Flormaldehyde Sulfoxylate Liquor	25-60	176	80	E	E	—	—	in preconcentrator, Alloy C = 0.006 mpy
Sodium Fluoride	10	75	24	S	—	—	—	
Sodium Fluosilicate Dust	—	80-110	27-43	G	—	—	—	96 percent air, 3 percent H_2O, 0.06 percent HCl, sodium fluosilicate in rotary drier
Sodium Fluosilicate Slurry	—	130	54	—	E	—	—	in reaction tank with turbine agitator. Alloy C = 1.6 mpy
Sodium Glutamate, Mono	—	68-140	20-60	E	—	—	—	saturated with NaCl at pH of 5.0-6.4
Sodium Glutamate, Mono	—	75	24	E	—	—	—	saturated with NaCl at a pH of 5 to 6.4
Sodium Hydrosulfide	5-12	230	110	E	E	—	—	plus sodium sulfide and polysulfides as impurities in unknown amounts
Sodium Hydroxide Pulp Digester Liquor	1.5M	323	162	—	G	G	B	oxygenated, 7 hours, extensive aeration
Sodium Hydroxide	2-3	110	43	E	E	—	E	organic intermediate aluminum salts; pyridine, water
Sodium Hydroxide	2-3	102	83	—	E	E	E	water, ethanol and other fermentation products (esters, organic acids, fuel oil, carbon dioxide), sodium carbonate 1%, sulfur dioxide; pH normally 10 to 11. Cleaned occasionally with 4-8% acetic acid.
Sodium Hydroxide	10-15	90	32	—	E	E	E	plus NaCl and Na_2CO_3 Duration — 150 days Aeration — moderate Agitation — normal flow Type of test — field Process involved — reaction of HCl and $COCl_2$ with NaOH
Sodium Hydroxide	10 40	Room Room	Room Room	— —	E E	— —	— —	
Sodium Hydroxide	15	to 230	to 110	S	B	—	—	plus monochlortoluene saturated with approx. 2 percent each of HCl and Cl_2. Alloy C = 23 mpy
Sodium Hydroxide	—	90	32	—	S	—	—	10 to 15% NaOH, NaCl and Na_2CO_3, HCl, $COCl_2$, moderate aeration
Sodium Hydroxide	—	100	38	—	E	—	—	plus cresylic acid. Alloy C = 0.5 mpy
Sodium Hydroxide	—	160	71	—	E	—	E	dilute, chromate and chromic wastes, chlorides, all low concentrations
Sodium Hypochlorite	0.5 0.5 0.5	95 140 212	35 60 100	— — —	E E E	— — —	— — —	Dakin's solution. Alloy C = 0.1 mpy
Sodium Hypochlorite	1	140	60	—	G	—	—	Alloy C = 4.8 mpy
Sodium Hypochlorite	1-2	70	21	—	E	—	E	plus unidentified components. pH near 7
Sodium Hypochlorite	5	65	18	—	E	—	—	bottom of bleach make-up tank. Alloy C <0.1 mpy
Sodium Hypochlorite	10 10	75 125	24 52	— —	E S	— —	— —	
Sodium Hypochlorite	15	86	30	—	E	—	—	plus 3 percent caustic soda. Alloy C gained weight slightly

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

M — Molar

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sodium Hypochlorite	to 16	60-80	16-27	—	E	—	—	plus NaOH and Cl_2. Alloy C = 0.1 mpy
Sodium Hypochlorite	—	Room	Room	—	E	—	—	plus sodium silicate inhibitor. Alloy C = nil mpy
Sodium Hypochlorite	—	80	27	U	B	—	—	HCl, vent scrubber, 29 days
Sodium Hypochlorite	—	85-115	29-46	—	E	—	—	plus 6 percent Cl_2, 45 percent H_2SO_4 and sulfate turpentine oil
Sodium Hypochorite	—	90	32	U*	E	E	G	excess caustic soda. NaOCl concentration 94.3-110.6 grams/liter. Excess NaOH 6-21 grams/liter. *Specimen corroded away or was lost, aeration at surface
Sodium Hypochlorite	—	212	100	—	E	—	—	in wash tank for cellphane film with up to 1 percent NaCl. Alloy C <0.1 mpy
Sodium Hyposulfite	All	to B.P.	to B.P.	S	S	—	—	
Sodium Metasilicate	10 30	75 75	24 24	S S	— —	— —	— —	
Sodium Nitrate	10 30	75 75	24 24	— —	S S	— —	— —	
Sodium Nitrate (Crude)	12-68	234	112	—	E	—	—	in evaporater. pH = 5.5-7.6 plus NaCl, Na_2SO_4, and magnesium. Alloy C = 0.04 mpy
Sodium Oleate	58	338	170	—	E	—	—	also exposed to 12 percent amyl alcohol, 10 percent amyl chloride, 2 percent amylene, 18 percent water, 25 percent sodium chloride, 1 percent sodium hydride, and 0.1 percent sodium oleate. Alloy C = 0.2 mpy
Sodium Perchlorate	—	176	80	G	E	—	—	in reactor vessel during production. Alloy C = 0.13 mpy
Sodium Perborate	10	to B.P.	to B.P.	S	—	—	—	
Sodium Peroxide	10	to B.P.	to B.P.	S	S	—	—	
Sodium Phenolate	—	248	120	—	E	—	—	containing about 20 percent by volume of acids. Total alkalinity 20 percent by weight as NaOH. Alloy C = nil. In lower well of phenol tower.
Sodium Phosphates	—	125	52	—	E	—	E	saturated vapor from rotary dryer containing sodium phosphate, NaCl, Na_2SO_4, CO_2 and H_2O. pH varies from 1 to 11, extensive aeration
Sodium Phosphates	—	180	82	—	E	—	E	saturated vapor from rotary dryer containing sodium phosphate, NaCl, Na_2SO_4, CO_2 and H_2O. pH varies from 1 to 11, extensive aeration
Sodium Phosphate Tri-Basic	10 25	to B.P. to 125	to B.P. to 52	S E	— —	— —	— —	
Sodium-Potassium Alloys	—	32-1400	0-760	S	S	—	—	
Sodium Silicate	10	to B.P.	to B.P.	S	—	—	—	
Sodium Sulfate	18	235	113	—	E	E	—	1% H_2SO_4, hot wall test, 144 hours
Sodium Sulfate	25	100-140	38-60	E	—	—	—	plus 5-10 percent H_2SO_4 and traces of H_2S in neutralization of spent refining caustic.
Sodium Sulfate	All to 30	to B.P. to B.P.	to B.P. to B.P.	S S	— S	— —	— —	
Sodium Sulfate	Saturated	170	77	—	E	—	—	20 percent crystalline sulfate. pH = 9.10. Alloy C = 0.02 mpy
Sodium Sulfate	—	77-95	25-35	—	E	—	—	plus organic sulfonic acids, SO_2, 2 percent HCl, trace of acetic acid. pH = 1.5-2.0. Alloy C = 0.03 mpy
Sodium Sulfide	10	Room	Room	E	E	—	—	in storage tank. Alloy C = 0.1 mpy
Sodium Sulfide	10 20 30 40 50	to B.P. B.P. B.P. B.P. B.P.	to B.P. B.P. B.P. B.P. B.P.	B B B B B	— — — — —	— — — — —	— — — — —	
Sodium Sulfide	20	125	52	E	E	E	E	
Sodium Sulfide	50-60	338	170	—	U	—	U	
Sodium Sulfide	60	338	170	E	U	—	—	immersed in flaker food tank.
Sodium Sulfite	20	125	51	—	E	—	E	sodium hydroxide averaging 2.0%. pH 9.5 to 10.5
Sodium Sulfite	20	150	66	—	E	—	E	pH = 7 to 11

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS–CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sodium Sulfite	—	90	32	—	E	—	E	bisulfite solution (30% $NaHSO_3$-70% H_2O); pH 4 to 5, moderate aeration
Sodium Sulfite	—	230	110	—	E	—	—	plus 1 percent $ZnSO_4$. pH = 8.5-9 in evaporator. pH adjusted with NaOH for conversion of Glaubers salts. Alloy C = 0.1 mpy
Sodium Sulfite	—	235	112	—	E	—	E	slurry, 30% solids (Na_2SO_3, Na_2SO_4); 70% liquid (30% Na_2SO_5, 5% Na_2SO_3, 5% Na_2SO_4, 5% Na_2SO_3); pH = 5.7
Sour Gas Condensate	—	150	66	—	E	—	—	above top tray in crude oil stabilizer. Alloy C = 0.1 mpy
Soy Protein	18	190	88	G	E	E	E	concentrate 18% aqueous slurry pH 4.2 with hydrochloric acid, moderate aeration
Stack Gases	—	105	41	—	E	E	E	smelter gas in TCA scrubber and limestone slurry (15%, pH 5.2-7) which is converted to $CaSO_3$ and some $CaSO_4$ by SO_2 in the gas, extensive aeration
Stack Gases	—	130	54	—	E	—	E	containing chlorides, sulfates, fly ash, water. Saturated, aeration
Stack Gases	—	134	57	—	E	E	E	saturated with scrubber liquor containing 0.0084 grains P_2O_5
Stack Gases	—	140	60	—	E	—	G	containing chlorides, sulfates, fly ash, water.
Stack Gases	—	150	66	—	E	—	G	containing chlorides, sulfates, fly ash, water.
Stack Gases	—	158	70	—	E	E	E	from phosphate dryer. 35% H_2O, 16.5% O_2, 2.5% CO_2 plus some phosphate dust, chloride, NOX, balance nitrogen; furnace process to produce phosphoric acid; agitation — 18500-26500 ACFM; extensive aeration. Total days — 283
Stack Gases	—	300	149	—	E	E	E	containing SO_4, SO_3, S^-, Cl^-, H_2O
Stack Gases	—	610-620	321-327	—	E	E	E	containing 1300 ppm SO_2 and fly ash, aeration
Stannous Bisulfate	10	to B.P.	to B.P.	S	—	—	—	
Stannic Chloride	10	158	70	—	S	—	—	plus 10 percent HCl. Alloy C = 15 mpy
Stannic Chloride	10 to 50 50	to B.P. to 160 to B.P.	to B.P. to 71 to B.P.	S — —	— S —	— — —	— — —	
Stannous Chloride	All 100	to B.P. to 700	to B.P. to 371	S S	— —	— —	— —	
Starch	—	425	218	E	—	—	—	plus HCl in conversion process.
Steam	—	430	221	—	E	—	E	trace NH_3, NaOH, $NaClO_3$, NaCl, 129 days
Stearic Acid	0.2-20	150-300	65-148	—	E	—	—	in esterification kettle with sebacic acid, adipic acid, phthalic anhydride, and toluene sulfonic acid. Alloy C = 2 mpy in liquid, 1.2 mpy in vapors.
Stearic Acid	100 100	200 to 700	93 to 371	E* S	E —	— —	— —	*plus oleic acid and methyl and isobutyl stearates and oleates
Streptomycin Media	100	86	30	E	—	—	—	during sterilization with steam at 275 deg. F. Contains 1 percent cerelose, 1 percent alpha protein, 0.5 percent fermentable solids, 0.5 percent NaCl, 0.1 percent $CaCO_3$.
Strontium Chloride	33	160-210	71-99	B	—	—	—	plus some sodium chromate.
Sucrose	62	200	93	—	E	—	—	4.3% brown sugar; 1.3% salt (NaCl); 14.3% coconut oil; 18.2% water, pH 5.8, moderate aeration
Sugar	—	250-300	121-149	S	E	—	—	plus HCl, NH_4SO_4, NH_4Cl to pH = 0.5 in pressure vessel. Alloy C = 0.4 mpy
Sugar Syrup	4-60	160	71	—	—	E	E	hydrochloric acid, sulfurous acid, pH 4.2, 168 days
Sulfanilamide	—	75	24	E	E	—	—	mother liquor. Alloy C = nil mpy
Sulfite Liquor	100	260	127	—	E	—	—	8.23 percent SO_2 at a pH of 1.32
Sulfite Pulping Vapors	—	180	82	E	—	—	—	in vent line of sulfite blow tank containing large quantities of wet SO_2 and magnesium-base liquor.
Sulfoacetic Acid	—	167	75	E	—	—	E	16 hrs., lab test
Sulfoacetic Acid	—	212	100	G	—	—	U	1 hr. lab test, conc. 95% H_2SO_4 slowly added to acetic anhydride in a 2-liter beaker (1 mil H_2SO_4 to 1.5 mols acetic anhydride)
Sulfated Detergent	50	125	52	—	E	—	—	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sulfated Oils	—	125	52	E	—	—	—	5 percent H_2SO_4, NaCl and Na_2SO_4
Sulfonation of Fats and Oils	—	70	21	G	E	—	E	sulfonations of castor, soya, sperm and red oils, mineral oil and various other fatty acids, fats and oils with 96 Baume H_2SO_4, pH 1-4. Moderate aeration, agitation — 84 rpm turbine.
Sulfonation	98	248	120	G	B	—	U	sulfuric acid 98%, ammonia anhydrous, or sodium hydroxide 33%, formaldehyde, moderate aeration
Sulfonation Reactions	—	176-320	80-160	—	B	—	—	sulfuric acid 98%, ammonia anhydrous, or sodium hydroxide 33%, formaldehyde, moderate aeration
Sulfonation Acid (Spent)	—	272	133	—	G	G	U	11 days below liquid level
Sulfonation Acid (Spent)	—	341	172	—	B	G	B	8 days below liquid level
Sulfonation Acid (Spent)	—	392	200	—	G	E	E	10 days below liquid level
Sulfonation Acid (Spent)	—	392	200	—	G	G	S	start — 25% pct. SO_3, 6% $HFSO_3$, 3% I_2, 3% HI, 63% H_2SO_4. End — 6% $HFSO_3$, 4% I_2, 3% HIO_3 and 87% H_2SO_4, 56.5 days
Sulfonation Acid (Spent)	—	482	250	—	G	E	G	28 days below liquid level
Sulfonic Acid	50	60-250	16-121	B	—	—	—	plus 45 percent solvent naphtha, 5 percent water and trace of H_2SO_4 at bottom of still
Sulfur	—	74-284	23-140	—	E	—	—	plus some H_2SO_4, H_2S, SO_2, H_2SO_3 and water vapor in melting tank. Sample half in vapor, half in liquid. Alloy C = 0.52 mpy
Sulfur	—	850	454	—	G	—	—	plus selenium. 11.7 day test, 7.8 days of boiling. Alloy C = 2.8 mpy (liquid) 5.1 mpy (vapor)
Sulfur, Molten	—	775	412	—	E	—	—	
	—	300-315	149-157	G*	E*	—	—	*plus aerated water at pH of 1.5 to 3.5, 11-day test period in surface pipe line between well and gathering station. Alloy C = 0.9 mpy.
	—	284-302	140-150	—	E	—	—	6-day test period
	—	265-295	129-146	S	S	—	—	agitated, plus air and impurities including sulfuric acid, and ferric sulfate. Tested up to 12 days
Sulfur Dioxide	0.077	220	104	—	E	—	—	balance H_2O. Alloy C = 0.19 mpy
Sulfur Dioxide	1.8	55	13	G	E	—	—	in sea water plus 1.7 percent NaCl. Alloy C = 0.6 mpy
Sulfur Dioxide	3.6	106-118	41-48	—	E	—	—	about one-half saturated with spray water in scrubber tower. Alloy C = 0.2 mpy
Sulfur Dioxide	4-5	185-200	85-93	—	E	—	—	plus selenious acid mist and some sulfuric acid in slimes boiling kettle. Alloy C = 0.9 mpy
Sulfur Dioxide	4.7-5.0 (by volume)	70	21	U	E	—	—	plus 3.4 percent calcium bisulfite in sulfite acid settling tank. Alloy C = 0.1 mpy
Sulfur Dioxide	5	200-500	93-260	—	E	—	—	plus 15 percent O_2, balance N_2 (dew point 125 percent). In gas offtake wet windbox. Alloy C = 0.8 mpy
Sulfur Dioxide	5	400	204	—	G	—	—	in nickel convertor. Alloy C = 2.6 mpy
Sulfur Dioxide	10	85-95 125-135	29-35 52-57	U U	E G	— —	— —	saturated with water in bottom of scrubber. Recycle liquor containing H_2SO_4 in range of 0.30-0.75 percent. Alloy C = 0.1 mpy (90°F), 3 mpy (130°F)
Sulfur Dioxide	18	500-700	260-371	—	E	—	—	plus 3 percent O_2, trace SO_3 and moisture. Alloy C = 0.1 mpy
Sulfur Dioxide	—	60	16	—	E	—	—	plus S_2O_7 in compressor condensate for alkylation unit. Alloy C = 0.03 mpy with less than 1.0 mil pitting.
Sulfur Dioxide	—	115-170	46-77	G	E	—	E	gas up to 1.5% SO_2 aeration
Sulfur Dioxide	—	125	52	—	E	E	E	1000 ppm chloride, 2000 ppm fluoride, some SO_3 and pH 3, 800 ppm SO_2, 15% H_2O, 12% CO_2, 68% N_2, 5% O_2, moderate aeration
Sulfur Dioxide	—	130	54	—	—	E	E	in gas stream with spray from cooling tower containing H_2SO_3, aeration
Sulfur Dioxide	—	131	55	U*	S	—	B	*specimen corroded away or was lost, aeration, 5% SO_2, 3% SO_3, 7% O_2, balance N_2 saturated with water. Possible splashing with solution containing 1.3 g/l Cu, pH 6
Sulfur Dioxide	—	132	56	U	E	—	E	in flue gas from No. 6 fuel oil, shale dust, water
Sulfur Dioxide	—	140	60	—	G	E	E	SO_2 100-2000 ppm, H_2SO_4 100-500 ppm, balance wet air, heavy loading H_2O droplets, containing Ca salts and ore dust
Sulfur Dioxide	—	140	60	—	—	E	E	in gas stream with spray from cooling tower containing H_2SO_3, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sulfur Dioxide	—	145	63	—	E	G	B	burning coal with 3% S plus 940 ppm Cl, 19 days, field test, moderate aeration, violent agitation
Sulfur Dioxide	—	160	71	—	—	E	E	and MgO (scrubbing products of combustion from MgO recovery system), aeration
Sulfur Dioxide	—	176	80	U*	G	—	B	*specimen corroded away or was lost, extensive aeration, 5% SO_2, 6.5% O_2 and 88.5% N_2 (dry basis) saturated with water vapor.
Sulfur Dioxide	—	176	80	U*	B	S	B	*specimen corroded away or was lost, extensive aeration, 5% SO_2, 6.5% O_2 and 88.5% N_2 (dry basis) saturated with water vapor.
Sulfur Dioxide	—	230	110	G	E	—	—	in hydrocarbon alkylate plus sulfuric acid. Alloy C = 0.01 mpy
Sulfur Dioxide	—	300-350	148-177	G	G	—	—	elemental sulfur mist O_2, H_2O and traces of sulfuric acid. In precipitator for recovery of sulfur from pyrite gas. Alloy C = 5.0 mpy
Sulfur Dioxide, Moist	—	180	82	—	E	—	—	occasional splashing of Na_2SO_4 and H_2SO_4. Alloy C = 0.15 mpy
Sulfur Oxides (Di & Tri)	—	350	177	—	E	—	E	SO_2 16.2%, SO_3 1.8%, H_2O 2.0%, O_2 1.4%, moderate aeration
Sulfur Substituted Amylphenol	—	257	125	G	G	B	U	HCl (pH-2), unreacted chlorine amyl-phenol, sulfur monochloride and sulfur dioxide in trace quantities, extensive aeration
Sulfur Trioxide	—	100	38	B	E	—	—	plus SO_2, N_2, CO_2 at top of Jennson towers in exhaust gas. Alloy C = 0.1 mpy
Sulfuric Acid	0-3	200	93	S	E	—	—	plus 0-5 percent Na_2SO_4, 0-0.5 percent $ZnSO_4$, 0-0.2 percent CS_2, trace of H_2S. Alloy C = 1.0 mpy
Sulfuric Acid	0-4	140	60	—	E	—	G	hot sulfuric acid solution (pH 3.0) containing tungsten and molybdenum salts with 2-3 g/l fluorides, moderate aeration
Sulfuric Acid	0.1	164-177	73-81	U	E	—	—	plus 0.04 percent SO_2 and varying amounts of carbon on bottom tray of SO_2 scrubber in regeneration of alkylation acid. Alloy C = 0.8 mpy
Sulfuric Acid	0.19	140	60	—	—	E	E	hydrochloric acid 0.057%, pH 2 to 5, 2360 hrs., incineration of municipal waste
Sulfuric Acid	0.26	Room	Room	—	E	—	—	spent pickle solutions. Cold wash water with salts picked up in steel pickling (0.097 percent ferrous, 0.003 percent ferric). Alloy C = 0.05 mpy
Sulfuric Acid	0.4-8.0	170-220	77-104	—	E	—	—	plus copper sulfate to saturation. Alloy C = 0.6 mpy
Sulfuric Acid	1-5	220	104	—	E	—	—	plus vegetable, fats, greases. Alloy C = nil mpy
Sulfuric Acid	1 to 23	302	150	—	B	U	—	as scrubbing liquid, moderate aeration
Sulfuric Acid	2	118-126	48-52	E	—	—	—	max. pitting = 14 mpy. Saturated with NaCl
Sulfuric Acid	2.5	200-250	93-121	—	G	—	—	plus 0.1 percent copper sulfate and some alcohols. Alloy C = 8.2 mpy
Sulfuric Acid	2.8-9.3	83	28	S	E	—	E	aluminum sulfate 0.8-5.3%, potassium chromium sulfate 0-0.3%, water, moderate aeration
Sulfuric Acid	5	70-85	21-29	E	E	—	—	plus 20 oz. $Na_2Cr_2O_7$ per 18 gal. Alloy C = 0.07 mpy
Sulfuric Acid	5	90	32	S	—	—	—	plus $FeSO_4$ and 0.05 percent TiO_2 (0.008 percent solids)
Sulfuric Acid	5	90	32	—	E	—	E	3-4% zirconyl sulfate, 15 days
Sulfuric Acid	5	122	50	G	E	—	—	plus sulfate oils, traces of NaCl and Na_2SO_4. Alloy C = 0.3 mpy
Sulfuric Acid	5	137-153	58-67	—	E	E	S	aeration, lab test 29.5 days
Sulfuric Acid	5	175-185	80-85	U	E	—	—	plus 0.50 to 0.56 oz./gal. of copper. Alloy C = 1.9 mpy
Sulfuric Acid	5	180	82	S	E	—	—	plus ore containing MnO and MnO_2
Sulfuric Acid	5-15	113-131	45-55	—	E	—	—	plus 15-25 percent Na_2SO_4, 1-5 percent organic salts. Alloy C = 0.16 mpy
Sulfuric Acid	5 to 150 g/l	160	71	—	E	—	E	copper-10 to 60 g/l-ave. 40, silver 0 to 12 g/l-ave. 3.5. Solids consist of precious metals, silica, lead sulfate, and a few % or less of selenium, tellurium, arsenic, antimony and bismuth.
Sulfuric Acid	6-9	155-175	68-79	—	B	—	—	plus 0.35 oz/gal. $NaNO_3$. Alloy C = 34 mpy
Sulfuric Acid	7-8	155-165	68-74	—	G	—	—	plus 0.8-0.9 oz./gal. $NaNO_3$ in pickling tank. Alloy C = 2.1 mpy
Sulfuric Acid	7.5-8	200-210	93-99	—	E	—	—	plus 3 percent aluminum sulfate, 1 percent ferric sulfate plus traces of calcium and magnesium sulfates. Alloy C = 1.6 mpy
Sulfuric Acid	8	120-140	49-60	G	G	—	—	steel pickling tank. Alloy C = 4.7 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sulfuric Acid	9	80-120	27-49	U	E	—	—	plus 1 percent HF, 3 percent Na_2SO_4, 1 percent SiO_2, $2H_2O_2$, 0.5 percent Na_2SiF_6, balance water in separation of Na_2SiF_6. Alloy C = 1.2 mpy
Sulfuric Acid	10	113	45	E	E	—	—	plus Na_2SO_4 and glucose in rayon spin bath. Alloy C = 0.2 mpy
Sulfuric Acid	10	158	70	—	S	—	—	plus 10 percent cupric sulfate. Alloy C = 15 mpy
Sulfuric Acid	10	158	70	—	U	—	—	plus 10 percent sulfate.
Sulfuric Acid	10	158	70	—	G	—	—	plus 10 percent Na_2SO_4. Alloy C = 8 mpy
Sulfuric Acid	10	158	70	—	B	—	—	plus 10 percent ferrous sulfate. Alloy C = 34 mpy
Sulfuric Acid	10	100 150 200 Boiling	38 65 93 Boiling	U B U G	E G B U	E E E U	— — — —	sulfur dioxide purge
Sulfuric Acid	10	175	80	—	—	E	G	3% chromic acid in deionized water
Sulfuric Acid	10	175-180	80-82	—	—	E	E	3% chromic acid in deionized water
Sulfuric Acid	10	200	93	U	S	—	—	672 hrs.
Sulfuric Acid	10	Boiling	Boiling	—	S	S	—	120 hrs., lab test
Sulfuric Acid	10	225	107	G	U	—	U	nickel sulfide impurities, 240 hrs.
Sulfuric Acid	10-12	660	349	E	E	—	—	plus 10-12 percent sodium sulfate. Alloy C = 0.1 mpy
Sulfuric Acid	10-15	234	112	—	G	E	U	reacts with ferric oxide to produce ferric sulfate, field test, 10 days, aeration — moderate, agitation — 6 ft./sec.
Sulfuric Acid	10-20	186	86	U	S	E	E	10% $CuSO_4$, 52 ppm Cl^-, Avg. Baume 28.7, pH = 1, 90 days
Sulfuric Acid	12	105-195	85-91	—	G	—	—	at top of acid spray section of conveyor-type spray pickling machine. Alloy C = 4 mpy
Sulfuric Acid	13	80-210	27-99	—	S	—	—	plus 13 percent by volume $MnSO_4$ and Mn_2O_3 in process for leaching crude MnO_2. Alloy C = 18 mpy
Sulfuric Acid	14-16	175	79	—	S	—	U	saturated with SO_2, slight aeration
Sulfuric Acid	15	248	120	G	—	—	—	plus sugar from digestion of tuber barbasco. Process is for obtaining steriod used in hormone production.
Sulfuric Acid	15	238-266	115-130	S	B	—	—	dicyclopentadiend hydrate reaction 220 hrs., pilot plant
Sulfuric Acid	16	165	74	U	S	—	G	to 5% (final before discarding), ferrous sulfate 0.09% (original) to 0.54% (final). Inhibited with Activol 3591.
Sulfuric Acid	18	170-180	77-82	—	E	—	—	in pickling stainless foil with 3 percent HCl added. First pickle is followed by 15 min. in 10 percent cold HNO_3. Alloy C = 1 mpy
Sulfuric Acid	19-28	140	60	—	E	—	—	plus 1.6 to 4.8 percent copper sulfate for flash pickling of brass parts. Alloy C = 1.6 mpy
Sulfuric Acid	20	Room Temp.	Room Temp.	E	E	—	—	Zr-HF separation
Sulfuric Acid	20	59-194	15-90	B	S	—	—	plus cobalt sulfate, ferrous sulfate, traces of copper sulfate. Alloy C = 12 mpy
Sulfuric Acid	20	125	52	U	E	E	E	12% CO, 90 days, copper refining, moderate aeration
Sulfuric Acid	20	125	52	U	E	E	E	1-2% Cu, 7000 oz./ton Ag, 200 oz./ton Au, 0.5% Sb, 0.5% Co, 1.0% 12% Te, 2% Cu. Trace Ag, Au, Sb, Co, 90 days
Sulfuric Acid	20	140	60	G	G	—	E	saturated with copper sulfate. Pickling copper and brass, 120 days, aeration, moderate agitation
Sulfuric Acid	20	145	63	S	E	E	E	8% $CuSO_4$, 52 ppm Cl, 90 days, copper refining
Sulfuric Acid	20	170-180	77-82	—	S	—	—	plus 2 percent Fe (ferrous and ferric in spray pickling machine) Alloy C = 17.1 mpy
Sulfuric Aiid	20-30	170-180	77-82	—	S	—	—	plus 0.5-3.5 percent $CuSO_4$ and abrasive anode mud from electrolytic copper refining. Alloy C = 15 mpy
Sulfuric Acid	24	66-70	19-21	E*	—	—	—	plus 9.6 percent ferrous sulfate 12 percent Ti as sulfate *Max pitting = 3 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sulfuric Acid	25	150	66	—	E	E	—	120 hrs., lab test
Sulfuric Acid	25	Boiling	Boiling	—	B	G	—	340 g/l sodium sulfate
Sulfuric Acid	25-40	158	70	—	U	—	—	10-15% phosphoric acid, 0.5% fluorides, phosphate fertilizer plant, agitation and aeration — high
Sulfuric Acid	28	135.5	57.5	G	G	G	—	hydrofluoric acid 5.9%
Sulfuric Acid	28	267	131	G	G	—	B	tests for selection of material for an acetic acid recovery column for an acetaldehyde unit, 23 hrs.
Sulfuric Acid	30 30 30 30	100 150 200 Boiling	38 65 93 Boiling	B B U G	G U U U	E E G U	— — — —	sulfur dioxide purge
Sulfuric Acid	30	125-135	52-57	G	E	—	—	acid regeneration of resin. Alloy C = 0.8 mpy
Sulfuric Acid	30	190-210	88-99	B	E	—	—	plus 22 percent H_3PO_4 in ion exchanger. Alloy C = 0.3 mpy
Sulfuric Acid	30.3	104	40	—	E	—	—	plus 57.5 percent acetic acid, 12.3 percent H_2O at liquid-vapor interface. Alloy C = 0.1 mpy
Sulfuric Acid	31.6	110	43	—	E	—	E	(480 g/l), sodium sulfate 18.2% (277 g/l), sodium chlorate 1.3% (20 g/l), sodium chloride 0.2% (3.6 g/l), moderate aeration
Sulfuric Acid	35-38	70	21	—	E	—	—	plus nitric acid in paper parchmentizing solution.
Sulfuric Acid	36	130-160	54-71	S	E	—	—	plus 28 percent oxalic acid, 32 percent water, 4 percent ash. Alloy C = 0.5 mpy
Sulfuric Acid	39	120	49	—	E	—	—	recovery of sulfuric acid used in papermaking in evaporator. Alloy C = 1.3 mpy
Sulfuric Acid	40	65	18	—	E	—	G	distillation of H_2O from HF. 40% HF, 20% H_2O, 240 days, moderate aeration
Sulfuric Acid	40	Ambient	Ambient	—	E	—	—	saturated with Cl_2, 17 days
Sulfuric Acid	40-45	Room	Room	—	E	—	—	saturated with Cl_2. Alloy C = 1.6 mpy
Sulfuric Acid	40	176	80	—	U	G	—	28 day immersion test (plant) and various organics.
Sulfuric Acid	40	176	80	—	U	G	U	acetate fiber production, field test — 28 days
Sulfuric Acid	40	176-194	80-90	S	S	—	—	Zr-HF separation
Sulfuric Acid	40	257	125	G	U	—	—	20% ethanol, 1% ethyl ether, balance water, 432 hrs. lab test
Sulfuric Acid	41-63	68-203	20-95	U	B	—	—	plus propylene. Alloy C = 24 mpy
Sulfuric Acid	43 50 60 85	Ambient Ambient Ambient Ambient	Ambient Ambient Ambient Ambient	— — — —	E E E E	— — — —	— — — —	saturated with Cl_2, 8 day test
Sulfuric Acid	45	Ambient	Ambient	—	E	—	E	Cl_2, 113 days
Sulfuric Acid	45	Boiling	Boiling	—	E	—	—	plus 1% CP hydrofluoric acid; also 45% CP sulfuric acid both with nitrogen purge, 4 days
Sulfuric Acid	50	Ambient	Ambient	—	G	—	U	Cl_2, 3 days, lab test
Sulfuric Acid	50	Ambient	Ambient	—	E	—	—	40 days
Sulfuric Acid	50	Ambient	Ambient	—	G	—	U	saturated with N_2, 3 days, lab test
Sulfuric Acid	50	70	21	U*	E	—	—	109 days, saturated with Cl_2, *welded and annealed
Sulfuric Acid	50	70	21	— —	E* E**	— —	— —	saturated with Cl_2, *as-welded **welded and annealed Duration of test — 132 days Agitation — 4.1 ft./sec.
Sulfuric Acid	50	77	25	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	50	80	27	—	E	—	—	welded sample in acid saturated with chlorine. Alloy C = 0.6 mpy
Sulfuric Acid	50	122	50	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	50	158	70	—	E	—	U	saturated with Cl_2, 66 days, 4.1 ft./sec. flow rate
Sulfuric Acid	54	Ambient	Ambient	—	E	—	—	Cl_2, 36 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sulfuric Acid	54	—	—	—	E	—	—	saturated with Cl_2 containing high percentage of gunk. Alloy C = 0.7 mpy
Sulfuric Acid	55	122-144	50-62	—	G	—	—	plus isopropyl alcohol and other solvents. Alloy C = 10 mpy (test sample welded)
Sulfuric Acid	55	158	70	B	G	—	—	ethanol, ethanol generator tails, 360 hrs.
Sulfuric Acid	55	158	70	U	S	—	—	ethanol, 240 hrs., samples exposed in hydrolizer transline.
Sulfuric Acid	55	158	70	—	S	—	—	ethanol, ethanol generator, 480 hrs.
Sulfuric Acid	55	230	110	U	B	—	—	ethanol, velocity appreciable, field test — 72 hrs.
Sulfuric Acid	55	230	110	S	U	—	U	ethanol, static, 48 hrs., lab test
Sulfuric Acid	55-60	167	75	—	B	—	—	in spent parchmentizing solution. Alloy C = 41 mpy
Sulfuric Acid	56.7	167	75	—	S	—	—	0.34% ethanol, 1% carbon, 90 hrs., lab test
Sulfuric Acid	60	Ambient	Ambient	—	E	—	—	8 days
Sulfuric Acid	61	Ambient	Ambient	—	G	—	—	Cl_2, 132 days
Sulfuric Acid	62	60	16	—	E	—	—	plus Cl_2. Alloy C = 0.4 mpy
Sulfuric Acid	62	Ambient	Ambient	—	E	—	—	Cl_2, 116 days
Sulfuric Acid	63-98	140-223	60-106	G	—	—	—	in batch type sulfonator of alkylated aromatic.
Sulfuric Acid	64	Ambient	Ambient	—	E	—	—	8 days, saturated with Cl_2
Sulfuric Acid	65-69	60	16	S	E	—	—	plus nitric acid in paper parchmentizing solution.
Sulfuric Acid	65-68	18	-8	U	B	—	—	plus some NO_3 and $CaSO_4$ in parchmentizing process after nitrate bath.
Sulfuric Acid	66	160-200	71-93	G	—	—	—	in tank dissolving metallic zinc in acid.
Sulfuric Acid	68-70	180-195	82-91	—	S	—	—	plus calcium sulfates in evaporator. Alloy C = 15 mpy
Sulfuric Acid	70	60	16	—	E	—	—	saturated with Cl_2
Sulfuric Acid	70	77	25	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	70	122	50	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	70 75	140 86	60 30	S E	— —	— —	— —	lab test
Sulfuric Acid	70	245	118	S	U	U	—	considerable free carbon, static test did not consider the cold tube wall, one week
Sulfuric Acid	70	245	118	S	U	U	—	one week static test (plant)
Sulfuric Acid	71-100	200	93	—	G	—	G	sulfuric acid mist, air effluent containing 8% O_2, traces of SO_2, moderate aeration
Sulfuric Acid	72	Ambient	Ambient	—	E	—	—	Cl_2, 25 days
Sulfuric Acid	72	—	—	—	E	—	—	saturated with Cl_2. Alloy C = 0.9 mpy
Sulfuric Acid	75	200	93	E	—	B	—	one week, lab test
Sulfuric Acid	75	250	121	G	—	U	—	one week, lab test
Sulfuric Acid	75	300	149	S	—	U	—	one week, lab test
Sulfuric Acid	78 78	80-110 100-130	26-43 37-54	— E	E E	— —	— —	plus alkyl benzene sulfuric acid in detergent manufacture. Alloy C = 0.9 mpy
Sulfuric Acid	78	135	57	—	S	—	—	plus 32 percent sodium perchlorate and ClO_2 gas during pulp bleaching
Sulfuric Acid	79-93	50-90	10-32	E	E	—	—	phosphine, ammonia, and H_2S percent as impurities. Alloy C <0.1 mpy
Sulfuric Acid	80	220	104	G	S	—	—	in zinc sulfate production with basic $ZnCO_3$ and sulfur-bearing slurry. Alloy C = 5.3-13 mpy
Sulfuric Acid	82	Ambient	Ambient	—	E	—	—	Cl_2, 129 days
Sulfuric Acid	82	122	50	—	E	—	—	plus Cl_2. Alloy C = 0.21 mpy
Sulfuric Acid	84	Ambient	Ambient	—	G	—	—	Cl_2, 132 days
Sulfuric Acid	85	Ambient	Ambient	—	E	—	—	8 days, saturated with Cl_2
Sulfuric Acid	85-94	75	24	G	G	G	B	6-15% HF, 130 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sulfuric Acid	85	77	25	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	85-94	95	35	S	S	G	U	6-15% HF, 130 days
Sulfuric Acid	85	122	50	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	86	—	—	G	E	E	E	hydrofluoric acid 10%, water 4%
Sulfuric Acid	87	60	16	—	E	—	E	79 days, saturated with Cl_2
Sulfuric Acid	87	Ambient	Ambient	—	E	—	E	Cl_2, 3 days, lab test
Sulfuric Acid	87	60	16	— — —	E* E** E***	— — —	E* E** —	saturated with Cl_2, 79 days, *wrought **welded ***welded and annealed
Sulfuric Acid	87	80	27	—	E	—	—	saturated with chlorine. Alloy C = 0.2 mpy
Sulfuric Acid	87	158	70	—	E	—	E	saturated with air, 66 days, 4.1 ft./sec. flow rate
Sulfuric Acid	90	60	16	G	E	E	E	hydrofluoric acid 7%, water 3%
Sulfuric Acid	90	to 125	to 52	E	—	—	—	plus 9 percent acetic anhydride in liquid and vapor phases
Sulfuric Acid	93	68-140	20-60	E	—	—	—	plus peanut oil, corn oil, alkyl benzene, sulfuric acid monohydrate.
Sulfuric Acid	93	78-94	26-34	—	E	—	—	plus animal grease in sulfonation tank. Alloy C = 0.7 mpy
Sulfuric Acid	94	80	27	E	E	G	B	6%, HF, 130 days
Sulfuric Acid	96	Ambient	Ambient	—	E	—	—	Cl_2, 132 days
Sulfuric Acid	96	77	25	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	96	80-118	27-48	—	E	—	—	during quick sulfonation of vegetable oils. Final solution is 5-10 percent aqueous solution of fatty acids and acetic anhydride. Alloy C = 0.4 mpy
Sulfuric Acid	96	122	50	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	98	60-215	16-102	—	B	—	—	plus sodium nephathanate to 3° Bé. Alloy C = 44 mpy
Sulfuric Acid	98	64-106	18-41	E	—	—	—	plus 1 percent acetic anhydride. Alloy B = 0.2 mpy in vapor, 0.7 mpy in liquid
Sulfuric Acid	98	70-302	21-105	—	B	—	—	in sulfonation. Alloy C = 22 mpy (liquid), 30 mpy (vapor)
Sulfuric Acid	98	275	135	B	B	E	—	2% HF, 130 days
Sulfuric Acid	Conc.	100-160	38-71	E	G	—	—	plus anhydrous HCl. Alloy C = 2.1 mpy
Sulfuric Acid	6.0M	Boiling	Boiling	—	U	—	—	24 hrs., processes for the aqeuous reprocessing of spent fuel elements Sulfex and Thorex processes
Sulfuric Acid	—	120	49	—	—	E	E	produced from electrolysis of sodium sulfate solution. Product of SO_2 scrubbing. 1.0 N H_2SO_4 with 17% Na_2SO_4, 218 days
Sulfuric Acid	—	338	170	—	B	U	U	20% by volume of 50% H_2SO_4 · 50% HNO_3 added to H_2O and heated tc 200 deg. C for 18 hrs. then cooled and exposed in 16.5% NaOCl at 170 deg. C
Sulfuric Acid	—	338	170	—	B	S	B	20% by volume of 50% H_2SO_4 · 50% HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and later dried at 170 deg. C in 10% ClO_2
Sulfuric Acid	—	392	200	—	B	B	B	20% by volume of 50% H_2SO_4 · 50% HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and exposed in 20% by vol. of 50% HNO_3, 50% $HClO_4$ added to H_2O and heated to 200 deg. C for 12 hrs.
Sulfuric & Acetic Acids	Dilute	325	163	—	E	E	E	263 days
Sulfuric Acid Fumes	—	80-230	27-110	G	—	—	—	during manufacture of superphosphate. The fumes from mixture of fluoride phosphate rock and H_2SO_4.
Sulfuric Acid Mist	—	200	93	B	G	G	G	containing 8% O_2, traces of SO_2, moderate aeration
Sulfuric Acid Mixtures	0-4	143	62	—	E	—	E	gas up to 1.5% SO_2, 0.005% SO_3, 2 mg/scf H_2SO_4 mist, extensive aeration
Sulfuric Acid Mixtures	10-20	175	79	—	E	—	G	sulfuric acid 10%, chromic acid 3%, in deionized water
Sulfuric Acid Mixtures	21-50	121-176	49-80	—	G	—	U	sulfuric acid 28%, hydrofluoric acid 5.9% (pickling bath for silicon steels)
Sulfuric Acid, Saturated with Chlorine	40 54 61 72 96	Room Room Room Room Room	Room Room Room Room Room	— — — — —	E E E E E	— — — — —	— — — — —	Alloy C = 0.97 mpy Alloy C = 0.69 mpy Alloy C = 0.17 mpy Alloy C = 0.89 mpy Alloy C = 0.32 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

M — Molar
† — percent P_2O_5

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Sulfuric Acid Sludge	10-15	150-200	66-93	G	—	—	—	in large volume of oil.
Sulfuric Acid Sludge	16-22	180	82	S	—	—	—	
Sulfuric Acid Sludge	80-98	190	88	S	S	—	—	
Sulfuric Acid Vapors	—	200	93	B	E	—	—	plus 2 percent air, 5 percent CS_2, 0.2 percent H_2S, 93 percent H_2O. Alloy C = 0.2 mpy
Sulfuric Acid Vapors	—	60-120	16-49	E	—	—	—	plus H_2S in two stage neutralizer vented in atmosphere
Sulfurous Acid	All	to B.P.	to B.P.	—	S	—	—	
Sulfuryl Chloride	100	70	21	—	G	—	—	plus trace water. Alloy C = 2 mpy
Superphosphate Dust	—	to 325	to 163	E	E	—	—	over exhaust stack containing H_3PO_4, H_2SO_4, H_2SiF_6 air and moisture. Alloy C = 0.3 mpy
Superphosphoric Acid	94.8	340	171	G	G	G	S	wet process (as ortho acid). Total P_2O_5 68.54%; ortho P_2O_5 51.08%; Fe_2O_3 = 2.30%; SO_4 = 2.19%; Al_2O_3 = 1.92%; F = 0.33%. Concentration gradually reduced to 80% H_3PO_4 (54% P_2O_5)
Superphosphoric Acid	—	155	68	—	—	E	E	wet process. P_2O_5 70.5%, (H_3PO_4 equivalent 97.3%), SO_4 4.78%, Al_2O_3 3.05%, Fe_2O_3 1.67%, MgO 1.11%, SiO_2 0.72%, CaO 0.44%, F 0.25%
Superphosphoric Acid	—	400	204	—	B	—	—	wet process acid, concentrating to 70% P_2O_5.
Tall Oil	1 (by volume)	200	93	—	E	—	—	plus 0.5-1.0 percent H_2SO_4, 2-3 percent lignin in acid discharge line. Alloy C = 0.2 mpy
Tall Oil	—	300	149	G	E	—	—	during successive esterifications, amidizations and sulfurizations in high-temperature reactor. Alloy C = 0.1 mpy liquid and vapor phases
Tall Oil	—	300-550	149-288	G	E	—	—	during successive esterifications, amidizations, and sulfurizations of tall oil, 421 hours (liquid and vapor phase)
Tall Oil	— 100	to 554 550-650	to 290 288-343	S* —	E* E	— —	— —	*and its glycerolesters, amids and sulfurized products (liquid and vapor phases)
Tanning Liquor	—	75	24	—	E	—	—	40 percent chestnut extract, 30 percent bisulfated quebracho, 30 percent hemlock liquor
Tar Acid	—	212-392	100-200	—	E	—	—	plus benzoic acid, H_2SO_4, Na_2SO_4, at pH = 4 for 11 days then 76 days with tar acids containing Na_2SO_4, Na_2CO_3 at pH = 8. Alloy C <0.1 mpy
Tar Acid	—	212-392	100-200	—	E	—	—	washed cresylic acid distillation plus Na_2SO_4, $NaCO_3$ as impurities. pH = 6.8. Alloy C <0.1 mpy
Tar Acid	—	356	180	E	E	—	—	in distillation. Alloy C = 0.026 mpy
Tartaric Acid	All	to B.P.	to B.P.	S	S	—	—	
Tetrachloroethane	—	140-158	60-70	—	E	—	—	plus some dichloroethane, H_2O, HCl, Cl_2, acetylene and air in chlorination of acetylene. Alloy C <0.1 mpy
Textile Bleach	—	125	52	—	E	—	—	$NaClO_2$, NaO, $NaHCO_3$, NaOCl
Tin Chloride	—	240	116	S	G	—	—	$SnCl_4$
Tin Tetrachloride	—	220-240	104-116	—	G	—	—	plus small amounts of free Cl_2 in still. Alloy C = 8.7 mpy
Titanium Sulfate	10	to B.P.	to B.P.	S	—	—	—	
Toluene Sulfonic Acid	94	122-257	50-125	E	E	—	—	plus phthalic acid, alcohols, water, weak H_2SO_4, activated carbon, CO_2 in esterification of phtalic anhydride. Alloy C <0.1 mpy
Toluic Acid, Meta	72.5	250	121	—	E	—	—	plus 22 percent paratoluic acid, 2.6 orthotoluic acid, 2.6 benzoic acid. Alloy C <0.1 mpy
Triaryl Phosphate	220	260	127	E	E	—	U	phenols, phosphorous oxychloride and .1 to .3 wt. %. $MgCl_2$ as a catalyst. 168 hrs. field test
Trichloroacetic Acid	50	Boiling	Boiling	—	E	—	—	
Trichloroacetic Acid	All	to B.P.	to B.P.	S	S	—	—	
Trichlorobenzene Vapor, (Commerical) Ammonia & Chlorides	—	302	150	—	E	—	E	aeration
Trichloroethylene	90 100	to B.P. to B.P.	to B.P. to B.P.	S S	— E	— —	— —	vapor and liquid

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS–CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Trichloroethylene	—	212	100	E	E	—	—	alternately exposed to primary and secondary media in steam distillation and rectification of crude trichloroethylene. Alloy C = 0.08 mpy
Trichloroethylene	—	Boiling	Boiling	—	E	—	—	plus 1% water
Trichloroethylene (Crude)	—	212	100	E	E	—	—	plus steam in vapor phase during distillation process. Alloy C = 0.08 mpy
Trichloromonofluoro-methane and Dichlorodi-fluoro-methane	64	160	71	S	E	—	E	hydrogen chloride 20%; hydrogen fluoride 10%; carbon tetrachloride 1%; antimony pentachloride, oxygen, nitrogen, total 5% (all approx.); water not over 200 ppm.
Tricresyl Phosphate	88-90	580	304	—	E	—	—	plus 5 percent triphenyl phosphate, traces of HCl and organic chlorides. Alloy C = 0.1 mpy
Tricresyl Phosphate	88-90	700	371	—	E	—	—	plus 5 percent cresylic acid, 1 percent $MgCl_2$, 5 percent thiophenols. Traces of HCl, organic compounds, residue tar tank cleaned intermittently by sand blasting. Alloy C = 0.1 mpy
Tricresyl Phosphate	89-90	700	371	—	E	—	—	plus 5 percent cresylic acid, 5 percent thiophenols, traces of HCl, $MgCl_2$ and organic chlorides, 43-day test exposure. Alloy C = 0.2 mpy
Tricresyl Phosphate, Crude	—	570	299	E	—	—	—	90 days in distillation column
Tricresyl Phosphoric Acid, Crude	—	176	80	—	E	—	—	trace of cresylic acid. Alloy C = 0.05 mpy, 13,800-hr. test
Triethanolamine Hydrochloric Acid Slurry	—	90-220	32-104	S	E	—	—	30 percent HCl is added to triethanolamine in steel tank
Trifluoromethyl Diphenylamine	—	300	149	—	G	—	—	in thionation process plus some sulfur, iodine and monochlor benzene. Alloy C = 9 mpy
Thiocarbamide, Hydrochloric Acid	—	139	59	S	U	U	—	an aldehyde (unspecified), acetic acid (concentration unspecified). Mix neutralized with 23% sodium hydroxide.
Uranium Ore	—	113	45	—	E	—	—	pulped uranium ore containing 60 percent solids; 28-55 grams/liter H_2SO_4, 5-10 grams/liter ferric ions, some ferrous ions, about 0.1 percent $NaClO_3$. Alloy C = 1.3 mpy
Urea	28	355-360	179-182	—	S	—	—	plus 32.2 percent ammonia, 20.5 percent water, 19 percent CO_2, 0.3 percent inerts, plus air. In liquid urea reactor 3 ft. below top head. Alloy C = 17 mpy
Urea	58.4	350	177	—	B	—	G	ammonia 16.8%, carbon dioxide 14.8%, water 9.9%, aeration
Vagh Resin Solution	—	86	30	B	B	—	U	samples in 3-inch line to storage tank, 1440 hrs.
Vagh Varnish	—	140-158	60-70	S	S	—	U	Cl_2-H_2O (hydrochloric and hydrochlorous acid) production of Vagh varnish, 1608 hrs.
Vapor, Saturated	—	180	82	—	E	E	E	rotary dryer containing sodium phosphate, NaCl, Na_2SO_4, CO_2 and H_2O. pH varies from 1 to 11, 57 days, extensive aeration
Vapor, (Saturated) from Rotary Dryer	—	125	52	—	E	E	E	containing sodium phosphate, NaCl, Na_2SO_4, pH varies from 1 to 11, extensive aeration, 89 days, 200-269 fpm
Vapor from Top of Fatty Acid Still	—	512-525	267-274	—	E	E	E	tall oil purification, aeration
Vegetable Tanning Liquor	100	125-175	52-79	—	E	—	—	
Venturi, (Wet), Scrubbing Stream Removing Fly Ash from Boiler Burning Corn Cobs	—	143	62	—	E	E	E	gas; 83% N_2, 360 ppm SO_2, 80 ppm H_2SO_4. Ash; 6% Cl^-, extensive aeration
Vinyl Acetate	75	300	149	—	E	—	—	plus 24 percent acetic acid, 1 percent acetaldehyde, anhydride. Alloy C = nil mpy
Vinyl Chloride	100	60-80	16-27	S	E	—	—	containing unsettled droplets of sodium bisulfite; normal range 4-8 percent, maximum 15 percent. Tests made in scrubbed vinyl monomer phase. Alloy C <0.1 mpy
Vinyl Chloride	—	200	93	E	E	—	—	mixture of residues (tar), 3720 hrs., field test. Recovery of vinyl chloride
Vinyl Chloride Latex	—	75-140	24-60	E	E	—	—	plus small amounts of oxidizing persulfate in coagulation (0.2 percent chloride solution moderator, 10 percent of the time)

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Vinyl Chloride Liquid and Vapor	—	70	21	E	E	—	—	impurities — oxygen .05-2.0%, N_2 up to 10%, HCl 0-10 ppm, H_2O 0-11%, formaldehyde 0-5 ppm, aeration
Vinyl Chloride Vapor	—	122-248	50-120	—	E	—	—	above alumina bed in drier. Alloy C = 0.1 mpy.
	—	225	107	E*	E*	—	—	*Plus methyl methyl ethyl ketone. Alloy C = nil mpy
Wash Solutions for Phosphor & Yttrium Oxysulfides	—	—	—	—	E	E	E	complex solution, exact comp. unknown, Na_2SO_4 present, pH 12.86 except during 0.1 N HNO_3 wash. Production of TV tube phosphors. Aeration moderate, adjustable
Waste Gas	—	200	93	—	B	—	—	containing Cl_2, 98 days, moisture droplets with NaOH, NaCl
Waste Gas	—	200	93	—	G	—	—	containing Cl_2, 167 days, moisture droplets with NaOH, NaCl
Water, Brackish	—	—	—	—	E	—	—	in exhaust fumes aft of muffler of 40-ft. utility boat in New York harbor. 28-day test. Alloy C = 0.1 mpy
Water, Brackish	—	45	7	—	E	—	E	Newark Bay. Contains 0.70% NaCl, 100 ppm Ca ++ as $CaCO_3$, pH 6.7, 60 ppm HCl, moderate aeration
Water, Cold (Fresh)	—	54	12	—	E	—	E	at treatment plant. Aluminum sulfate 20 ppm; chlorine 2.0 ppm; potassium permanganate 0.3 ppm; clay 5 ppm; starch 1.0 ppm. Turbidity 5.0-50.0 units. pH 7.3 to 8.0
Water, Cold (Potable)	—	54	12	E	E	—	E	at treatment plant. Chlorine 0.8-1.0 ppm; aluminum sulfate 0.2 ppm; suspended alum floc (aluminum hydroxide) containing manganese dioxide. pH 7.3 to 7.6, saturated
Water, Distilled and Degassed	—	600	315	—	E	—	—	Alloy C < 0.1 mpy. Only very slight discoloration
Water Purification Solution	—	68	20	—	—	E	G	water purification solution. 1000 grams ground carbon, 2.5 gal. water (2.5% HCl)
Water, Residues of Insecticides and Breakdown Products	—	85	29	—	E	—	E	including parathion, inorganic salts including ammonium and sodium chlorides, organic reagents including urea, solvents; pH range 1.5 to 13.5, usually above 8, moderate aeration
Water, River and Lake	—	52	11	—	E	—	E	Lake Ontario, pH 8.0 to 8.5 contains algae, small fish, lake debris. Turbidity 5.0 to 50.0 units
Water, Saturated with Carbon Dioxide	—	400-425	204-218	—	E	—	—	plus 0.008 percent SO_2 and traces of dissolved air. Alloy C = 0.6 mpy (liquid), 0.3 mpy vapor phase
Water, Incinerator scrubber	—	170-190	77-88	E	E	—	E	aeration
Water, Scrubbed Sewage Sludge Incinerator Gases	—	—	—	—	E	—	E	
Water, Scrubber	—	140-165	60-74	S	E	—	E	aeration
Water, Scrubber	—	160-180	71-82	G	E	—	E	aeration
Water, Scrubber	—	300-400	149-204	B	E	—	G	aeration
Water, Sea	—	60-95	16-35	G	E	—	—	plus 1.8 percent total solids, 1-2.5 percent SO_2 absorbed with water in absorption sump. Alloy C < 0.1 mpy
Water, Sea	—	75	24	S	—	—	—	scrubber strong liquor, 1.8 percent SO_2, 1.7 percent NaCl
Water, Sea	—	82	28	E	E	—	—	20,000 ppm. Cl ions at a pH of 6.6. Contains from 2.5 to 104.5 mg O_2 per liter. Test at suction end of pump casing under high agitation
Water, Sea	—	95-500	35-260	U	E	—	—	in asphalt plant gas scrubber. Plus O_2, SO_2, hydrocarbons. Alloy C = 0.8 mpy
Water, Sea	—	203	95	—	G	—	—	saturated with Cl_2. Alloy C = 3 mpy
Water, Sea	—	325	163	—	E	—	—	in discharge line of tubular heat exchanger. Velocity = 5 ft. per sec.
Water, Steep	—	125-135	52-57	—	E	—	—	plus 0.10-0.14 percent SO_2. Alloy C < 0.1 mpy (liquid and vapor)
Water, Steep	—	150	66	G	—	—	—	plus 0.02 percent SO_2, 0.5-1.0 percent lactic acid, pH 3.5-4.5
Wash Water from Rayon Staple Bleach Machine	—	145-150	63-66	—	E	E	E	aeration
Wash Water from Rayon Staple Bleach Machine	—	162-168	72-75	—	E	E	E	aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Waste Effluent	—	78	26	—	—	E	—	containing sulfuric acid, esters, lime, waxes, oils, formaldehyde, moderate aeration
Whey Salts	—	176-212	80-100	—	E	—	—	plus lactic acid, NaCl, and lactose in 70 percent ethyl alcohol. Alloy C = nil mpy
Wood Fractions	—	70-100	21-38	E	—	—	—	alternately: crude pine tar oil, pyroligneous acid (2-5 percent acetic acid, 1 percent methanol; phenols)
Xylene	—	194-302	90-150	G	E	—	—	in maleic acid dehydration column. Plus impurities such as benzene, 1 percent maleic acid as maleic anhydride and traces of water. Alloy C · 0.1 mpy
Xylene	—	325-350	163-177	G	E	—	—	effluent mixture containing water, acetic acid, benzoic acid, toluic acid, tolualdehyde, acetophenone and hydrocarbons as primary constituents under 25-in. vacuum. Alloy C = nil mpy
Xylol Solvent Vapors	—	77-293	25-145	E	—	—	—	plus 2 percent PCl_3 and HCl
Zeolite Water Softener	—	—	—	—	E	—	—	300 ppm chlorides, 10-38 ppm carbonates, 0.6 ppm bicarbonates in dome of deaerator in steam. Extensive aeration and high agitation. Alloy C = 0.1 mpy
Zinc Carbonate Slurry	—	70-180	21-82	E	E	—	—	2 lb. per gallon $ZnCO_3$ plus 10 percent Na_2CO_3, sulfides and sulfuric acid as impurities. Process is conversion of Na_2CO_3 to Na_2SO_4. Alloy C = 0.03 mpy
Zinc Chloride	71	225	107	—	E	—	—	
Zinc Chloride	80	Boiling	Boiling	—	E	—	—	
Zinc Chloride	All 100	to B.P. to 700	to B.P. to 371	S S	— —	— —	— —	
Zinc Chloride, Chromated	5	to 260	to 127	E	B	—	—	solution made by mixing 80 percent $ZnCl_2$ and 20 percent Na_2CrO_4. Maximum pitting = 2 mpy
Zinc Chloride Flux	25	75-80	24-27	U	E	—	—	in reservoir tank prior to welding. Alloy C = 0.007 mpy
Zinc Di-hydrogen Phosphate	Conc.	Room	Room	—	E	—	—	plus small amount nitrosyl chloride. Alloy C = 0.16 mpy
Zinc Fluosilicate	30 30 36 50	75 150 75 150	24 66 24 66	— — — —	E U E U	— — — —	— — — —	plus 1 to 10 percent free H_2SiF_6
Zinc Fluosilicate	—	100-116	38-47	U	E	—	—	above steam chest of single stage evaporator. Plus to 1 percent HCl, 1 percent free H_2SiF_6, 40-day period
Zinc Hydrosulfite	4.5 lbs./gal.	232	111	—	E	—	—	in manufacture. Alloy C = 0.1 mpy
Zinc Sulfate	30-34	100-220	38-104	U	E	—	—	$Na_2Cr_2O_7 \cdot H_2O$ and lead peroxide added to remove iron and manganese. Alloy C = 1.5 mpy
Zinc Sulfate	34	232	111	—	E	—	—	as $ZnSO_4 \cdot 6H_2O$ plus 8.8 percent $ZnCl_2$, 1 percent ferrous sulfate, and water. Alloy C gained weight slightly
Zinc Sulfate	to 40	to B.P	to B.P	S	S	—	—	
Zinc Sulfate, Acid Solution	—	68-122	20-50	—	E	—	—	plus (at start) 252 g/l H_2SO_4, 56.6 g/l Zn, 0.04 g/l Fe. At finish 213 g/l H_2SO_4, 48.3 g/l Zn, 0.41 g/l Fe and 0.46 g/l Cu
Zinc Sulfate, Anhydrous	—	219-232	103-111	—	E	—	—	2.42 lb. anhydrous $ZnSO_4$ plus 1.04 lb. $ZnCl_2$ per gallon of water. Alloy C = 0.03 mpy
Zinc Sulfate Drier Fumes	—	110	43	G	—	—	—	above rotary drum drier
Zinc Sulfate Monohydrate	40	—	—	E	E	—	—	plus traces of Fe, Na, Cd, Cu, considerable O_2. In flash evaporator for concentration of food liquor. Alloy C = 0.5 mpy
Zinc Sulfate Monohydrate	—	220	104	S	E	—	—	93 percent H_2SO_4 plus 34 percent $ZnSO_4$
Zinc Chloride	—	269-293	132-145	E	E	E	U	aeration
Zircex Liquid Phase Hydrochlorination	—	795	424	U B	U S	— —	— —	$AlCl_3$, NH_4Cl plus gaseous HCl, 7 days, in liquid in vapor

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G	Type 316 Stainless Steel	Conditions
Zirconium Chloride	25.5	145-185	63-85	U	E	—	—	plus 0.52 percent fluorides, 1.44 percent ammonia, 20.9 percent phosphate, 2.4 percent uranium, balance water in phosphate filter. Alloy C <0.1 mpy
Zirconium Chloride	—	Room	Room	E	E	—	—	contains HCNS, production of HF (Zr free) 2-5 days
Zirconium Tetrachloride Fumes	—	60-110	16-43	E	E	—	—	atmospheric fumes during manufacture containing some HCl and Cl_2. About 7 ft. from fume outlet. Alloy C <0.1 mpy
Zircex Solutions	0.5M	Boiling	Boiling	U	S	—	—	0.5 M HNO_3, 0.4 M UCl_3, Alloy B tested for 3 hours, Alloy C tested for 669 hours
Zircex Solutions	3M	Boiling	Boiling	G	G	—	—	Alloy C tested for 161 hours, Alloy B for 3 hours
Zircex Solutions	3M	Boiling	Boiling	U	U	—	—	3M H+, 0.4 UCl_3, 2.8 M NO_3^-, Alloy C tested for 161 hours, Alloy B for 3 hours
Zircex Solutions	5M	Boiling	Boiling	—	U	—	—	3M H+, 0.4 UCl_3, 2.8 M NO_3^-, 160 hours.

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)
M — Molar

COMPARATIVE STRESS-CORROSION CRACKING DATA

Alloy	Time, hrs. to crack in boiling 42% Magnesium Chloride
Type 304 Stainless Steel	1-2
Type 316L Stainless Steel	1-2
HASTELLOY® alloy M-532	10
20 CB-3®* alloy	22
Alloy 825	46
CABOT® alloy No. 625	No Cracks—1000
HASTELLOY alloy G	No Cracks—1000
HASTELLOY alloy C-276	No Cracks—1000

*Registered trademark of Carpenter Technology Corporation

COMPARATIVE CREVICE-CORROSION TEST DATA IN 10% FERRIC CHLORIDE

Alloy	Average Corrosion Rate, mils (mm) per year* 77 deg. F (25 deg. C)	122 deg. F (50 deg. C)	167 deg. (75 deg.
HASTELLOY® alloy C-276	0.2 (<0.01)	0.2 (<0.01)	1.4 (0.04
HASTELLOY alloy C-4	0.3 (<0.01)	0.5 (0.01)	20 (0.51)
CABOT® alloy No. 625	1.5 (0.04)	124 (3.15)	510 (12.95
HASTELLOY alloy G	14 (0.36)	85 (2.16)	550 (13.97
HASTELLOY alloy M-532	35 (0.89)	625 (15.88)	325 (8.26)
20 CB-3 alloy	205 (5.21)	380 (9.65)	700 (17.78)
Type 316L Stainless Steel	312 (7.92)	460 (11.68)	780 (19.81)
Alloy 825	730 (18.54)	707 (17.96)	680 (17.27)

*Average corrosion rate on duplicate samples even though most corrosion occurred under crevice. Tests were for 100 hours with grooved block.

Crevice-Corrosion Data in 10% Ferric Chloride at Room Temperature for 10 Days

Alloy	Number of Attacked Crevices*	Maximum Depth of Penetration mils	mm
HASTELLOY® alloy C-276	0	0	0
CABOT® alloy No. 625	11	3	0.08
HASTELLOY alloy G-3	11	13	0.33
HASTELLOY Alloy G	16	17	0.43
Alloy No. 904L	23	19	0.48
Type 317L Stainless Steel	16	77	2.0
20 Cb-3 alloy	24	76	1.9
Type 316 Stainless Steel	24	76	1.9 (Perforated)
CABOT alloy No. 825	24	125	3.2 (Perforated)

*Maximum possible number of crevices was 24.

Crevice-Corrosion Tests in Simulated SO_2 Scrubber Environment*

Alloy	Corrosion Rate per year, mils	mm	Number of Attacked Crevices**	Maximum depth of Crevice Attack, mils	mm
HASTELLOY® alloy C-276	0.2	<0.01	2	1	<0.03
HASTELLOY alloy G-3	1.0	<0.03	20	2	0.05
CABOT® alloy No. 625	1.3	<0.04	18	6	0.15
Alloy No. 904L	57	1.4	24	6	0.15
Type 317LM Stainless Steel	179	4.5	24	10	0.25
CABOT alloy No. 825	216	5.5	24	10	0.25

*100-hour exposure at 150°F (66°C), 45,000 ppm chlorides, pH 2, SO_2/O_2 (1:1) was bubbled through the solution.
**Maximum possible number of crevices was 24.

Comparative Immersion Pitting and Crevice-Corrosion Temperatures in Oxidizing NaCl-HCl Solution

The chemical composition of the solution used in this test is as follows: 4% NaCl + 0.1% $Fe_2(SO_4)_3$ + 0.01 M HCl. This solution contains 24,300 ppm chlorides and is acidic (pH2). In both pitting and crevice-corrosion testing the solution temperature was varied in 5°C increments to determine the lowest temperature at which pitting corrosion initiated (observed by examination at a magnification of 40X of duplicate samples) after a 24-hour exposure period (Pitting Temperature), and the lowest temperature at which crevice-corrosion initiated in a 100-hour exposure period (Crevice- Corrosion Temperature).

Alloy	Pitting Temperature, °C	°F	Crevice-Corrosion Temperature, °C	°F
HASTELLOY alloy C-276	150	302	80	176
CABOT alloy No. 625	101	214	25	77
HASTELLOY alloy G-3	75	167	25	77
HASTELLOY alloy G	75	167	25	77
FERRALIUM* alloy 255	50	122	35	95
Alloy No. 904L	45	113	20	68
Type 317LM Stainless Steel	35	95	15	59
Type 317L Stainless Steel	25	77	10	50
CABOT alloy No. 825	25	77	≤−5	≤23
20 Cb-3 alloy	20	68	≤−5	≤23
Type 316 Stainless Steel	20	68	≤−5	≤23

(continued)

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

HASTELLOY alloy G-3 is an improved wrought version of HASTELLOY alloy G. Alloy G-3 has the same excellent general corrosion resistance as alloy G, along with greater resistance to heat affected zone attack and excellent weldability. HASTELLOY alloy G-3 has outstanding resistance to hot sulfuric and phosphoric acids. Alloy G-3 will withstand the corrosive effects of both oxidizing and reducing agents and can handle both acid and alkaline solutions. Alloy G-3 has excellent resistance to mixed acids, sulfate compounds, contaminated nitric acid and flue gases. Alloy G-3 is resistant to stress-corrosion cracking as measured by the boiling $MgCl_2$ Test (ASTM G30 and G36). In oxidizing acid chloride pitting media, alloy G-3 has good resistance to localized attack.

Aqueous Corrosion Data for HASTELLOY Alloy G-3

Media	Concentration, percent by weight	Test Temp., °F (°C)	Average Penetration Rate per year			
			Alloy G-3		Alloy G	
			mils	mm	mils	mm
Acetic Acid	99	Boiling	0.6	<0.02	—	—
Ferric Chloride	10*	Room	0.1	<0.01	14	0.36
	10*	122 (50)	30	0.76	85	2.1
Ferric Chloride + 10% NaCl	5	Room	Nil	Nil	—	—
	5	122 (50)	Nil	Nil	—	—
Formic Acid	30	Boiling	4	0.10	—	—
	40	Boiling	4	0.10	—	—
	60	Boiling	5	0.13	—	—
	88	Boiling	6	0.15	—	—
Hydrochloric Acid	1	150 (66)	0.3	<0.01	0.2	<0.01
	20	Room	5.7	0.14	—	—
Nitric Acid	10	Boiling	0.8	0.02	0.8	0.02
	65	Boiling	10	0.25	22	0.56
Phosphoric Acid	30	Boiling	2.4	0.06	4	0.10
	50	Boiling	4	0.10	7	0.18
	55	Boiling	5	0.13	—	—
	70	300 (149)	8.6	0.22	—	—
	85	Boiling	27	0.69	20	0.51
Seawater Saturated with Chlorine Gas		68 (20)	1.1	<0.03	—	—
		95 (35)	2.5	0.06	—	—
		150 (66)	9.4	0.24	—	—
Sulfuric Acid	5	Boiling	12	0.30	11	0.28
	10	Boiling	19	0.48	14	0.36
	15	Boiling	26	0.66	—	—
	20	Boiling	32	0.81	—	—
Sulfuric Acid + 3% HCl + 1% $FeCl_3$ + 1% $CuCl_2$	7	Room	Nil	—	—	—
	7*	Room	1	<0.03	—	—
Sulfuric Acid + 6% HNO_3	44	86 (30)	0.2	<0.01	—	—
Sulfuric Acid + 42 g/l $Fe_2(SO_4)_3$	50	Boiling	12	0.30	—	—
	50**	Boiling	17	0.43	—	—

*With crevice bolt
**All weld metal (shielded metal arc welded)
—Not tested

TABLE 5.18: NICKEL-BASE ALLOYS—CABOT WROUGHT PRODUCTS (continued)

LOCALIZED CORROSION RESISTANCE IN PULP AND PAPER INDUSTRY ENVIRONMENTS

Alloys	Ammonia-Base Spent Sulfite Liquor* pH ≃ 1.9, Cl^- — 200 ppm, T ≃ 155 deg. F (69 deg. C)		First Stage Bleach Unit Environment* pH ≃ 1.8, Cl_2 + HCl + H_2SO_4, T ≃ 95 deg. F (35 deg. C)	
	Exposure — 246 Days		Exposure — 258 Days	
	Smooth Areas	Creviced Areas	Smooth Areas	Creviced Areas
Type 316 Stainless Steel	Pitting	Crevice Attack	Pitting	Severe Crevice Attack
Alloy 825	No Pitting	Crevice Attack	No Pitting	Severe Crevice Attack
HASTELLOY® alloy G	No Pitting	No Attack	No Pitting	Slight Crevice Attack
CABOT® alloy No. 625	No Pitting	No Attack	No Pitting	Incipient Localized Attack
HASTELLOY alloy C-276	No Pitting	No Attack	No Pitting	No Attack

*Actual Field Test Results, U-Bend Specimens T — Temperature

AVERAGE COMPARATIVE FIELD CORROSION DATA IN SO_2 CONTAINING CHLORIDES*

Field tests of corrosion test spools in a variety of SO_2 pollution control environments resulted in no selective corrosion on any of the HASTELLOY® alloy G or C-276 samples. All other alloys tested showed pitting and/or crevice corrosion to varying degrees. A complete summary of the data is shown in the table below.

Chloride Content, PPM	Average Test Temperature, deg. F (deg. C)	Average pH	Type 316 Stainless Steel	20 CB-3®** alloy	Alloy 825	CABOT alloy No. 625	HASTELLOY alloy G	HASTELLOY alloy C-276
			Average Depth of Pitting or Crevice Corrosion — mils (mm)					
Low pH Conditions — Under 4.6 pH								
165	105 (41)	2.5-7	4 (0.10)	6 (0.15)	4 (0.10)	0	0	0
550	120 (49)	4.5	6 (0.15)	3 (0.08)	6 (0.15)	0	0	—
1000	120 (49)	4	23 (0.58)	>45 (>1.14)	3 (0.08)	0	0	—
1500	127 (53)	3.5-5.7	7 (0.18)	3 (0.08)	2 (0.05)	0	0	—
Low Chloride Conditions — 4.9 to 5.4 pH								
500	130 (54)	5	5 (0.13)	6 (0.15)	3 (0.08)	0	0	—
500	120 (49)	5.4	17 (0.43)	1 (0.03)	0	0	0	0
550	130 (54)	4.9	0	0	0	0	0	—
Low Chloride Conditions — 5.5 to 6.5 pH								
125	120 (49)	6.5	0	0	0	0	0	—
200	120 (49)	5.5	0	0	0	0	0	0
200	120 (49)	5.9	0	0	0	0	0	0
500	120 (49)	5.5	7 (0.18)	0	0	0	0	0
500	120 (49)	6	0	0	0	0	0	0
850	120 (49)	6	1 (0.03)	1 (0.03)	0	0	0	—
1000	115 (46)	6.2	1 (0.03)	0	0	0	0	0
High Chloride Conditions — 4.5 to 5.5 pH								
2250	120 (49)	5	11 (0.28)	2 (0.05)	3 (0.08)	3 (0.08)	0	—
2900	110 (43)	4.5	4 (0.10)	7 (0.18)	7 (0.18)	1 (0.03)	0	0
2900	110 (43)	5.5	3 (0.08)	1 (0.03)	2 (0.05)	0	0	0
High Chloride Conditions — pH above 5.7								
1500	127 (53)	5.7	0	0	0	0	0	—
2900	110 (43)	8.5	0	0	0	0	0	0
3000	120 (49)	7	1 (0.03)	0	0	0	0	0
10000	120 (49)	6	2 (0.05)	0	0	0	0	0
High-Temperature Conditions								
2100	160 (71)	7	10 (0.25)	1 (0.03)	2 (0.05)	0	0	0
2100	160 (71)	6.5	28 (0.71)	10 (0.25)	10 (0.25)	0	0	0
2300	150 (66)	6	22 (0.56)	16 (0.41)	9 (0.23)	0	0	0

*Determined from exposure in actual field conditions with spool-type specimens.
**Registered trademark of Carpenter Technology Corporation.

TABLE 5.19: NICKEL-BASE ALLOYS–STAINLESS FOUNDRY & ENGINEERING

ILLIUM 98 and ILLIUM B perform very well in processes which involve the use of sulfuric, phosphoric, hydrofluoric, nitric, acetic and fluosilicic acids as well as sodium chloride brine. They resist erosion to abrasion in corroding environment. These alloys have high mechanical rigidity. The 98 alloy is nonhardenable while the B alloy is hardenable.

Results of ILLIUM 98 and ILLIUM B in Tested Applications

ENVIRONMENT	Temp. °F	Corrosion Rate Inches Per Year ILLIUM 98	Corrosion Rate Inches Per Year ILLIUM B
Sulfuric Acid			
98% Sulfuric Acid	212°	0.015	0.005
95% Sulfuric Acid	212°	0.016	0.0065
90% Sulfuric Acid	212°	0.0195	0.0095
Phosphoric Acid			
101% Phosphoric, (Super Phosphoric)	300°	0.0053	
98% Phosphoric with sulfuric and fluorine compounds	390-460°	0.0066	
98% Phosphoric acid vapors	375-410°	0.044	
55% Phosphoric, 3% sulfuric, and fluorine compounds	237°	0.024	
39% Phosphoric with sulfuric, hydrofluoric and fluorine compounds	180°	0.0027	
Hydrofluosilicic Acid			
13% Hydrofluosilicic Acid	160°	0.0017	N.R.[1]
11% Hydrofluosilicic Acid	160°	0.0021	N.R.[1]
Hydrofluoric Acid			
0 to 100% Hydrofluoric, 100-0% Sulfuric Acid (in stripping column)	10-300°	0.001	N.R.[1]
10% Hydrofluoric, 86% Sulfuric Acids, 4% Water	60°	0.0001	N.R.[1]
7% Hydrofluoric, 90% Sulfuric Acids, 3% Water	60°	None Detected	N.R.[1]
Sodium Chloride Brine (Saturated)			
Saturated brine in evaporator	188°	<0.0001	<0.0001
Saturated brine in evaporator heat exchanger	233°	<0.0001	<0.0001
Saturated brine in evaporator discharge	248°	0.0002	0.0001

[1]NR — Not recommended for this service.

ILLIUM G is highly rated for its resistance to a wide variety of corrosive chemicals. It withstands the corrosion of both oxidizing and reducing agents, acid and alkaline, up to moderately high temperatures. It is especially resistant to most sulfur compounds. Generally it is not recommended for halogen; halogen acids or halogen salt solutions; it is, however, highly resistant to seawater and to fluorine compounds in an oxidizing environment.

Results of ILLIUM G in Tested Applications

Code: R = Recommended for use—quantitative test results not furnished
A = Not more than 0.004" penetration per annum] — less than 1 mg/cm²/day
B = 0.004" to 0.015" penetration per annum]
C = 0.015" to 0.050" penetration per annum—approx. 1 to 3 mg/cm²/day
D = 0.050" to 0.125" penetration per annum
E = Over 0.125" penetration per annum

Substance or Process	Conditions	Temp. °F.	Rate
Acetic Acid			
—Concentrated		Boiling	A
—50%		Boiling	A
— 5%		Boiling	A
Concentrated	Plus 20% by Vol. 25% Formic Acid	Boiling	A
—80%	Plus approximately 2% $KMnO_4$	230°	A
Aluminum Sulfate	H_2SO_4 boil of clay	300°	E
	Effluent from clay boil	210°	A
Ammonia		70°	A
Ammonium Bromide—30%		120°	A
Ammonium Carbonate—25%		70°	A
Ammonium Chloride—30%		330°	A
—25%		70°	A
Ammonium Hydroxide			
—Concentrated	Still solution	70°	A
—Concentrated	Agitated solution	70°	B
—28%	Agitated solution	70°	A
Ammonium Sulfide			
Saturated		70°	A

(continued)

TABLE 5.19: NICKEL-BASE ALLOYS—STAINLESS FOUNDRY & ENGINEERING (continued)

Substance or Process	Conditions	Temp. °F.	Rate
Arsenic Acid—75% to 90%	Solution concentrated by boiling	Boiling	A
Boric Acid—"liquor"		150°	A
— 4%		70°	A
Butyric Acid—80%		70°	A
Calcium Hypochlorite	2% available chlorine	70°	C
Carbon Tetrachloride		Boiling	A
	Saturated with free sulfur	Boiling	A
	Plus 3% by volume of Bromine	Boiling	E
Chlorine	Moist	200°	E
	Dry		R
Chrome Tanning Solution	Concentrated	76°	A
	33%	76°	A
Chromic Acid—50%		Boiling	E
—25%		Boiling	E
—25%	Plus 5% by Vol. H_2SO_4	180°	E
—35%		70°	A
—Varying	Pump handling 1½% to 36% acid	70°	R
Citric Acid			R
Copper Sulfate—25%	(See also H_2SO_4 mixtures)	70°	A
—9% to 18%	Solution concentrated by boiling	Boiling	A
Ethyl Acetate—Crude		167°	B
Ethyl Acetate	Distillation	212°	B
Ethyl Gasoline		70°	A
Fatty Acids			R
Ferric Chloride—43%		176°	E
Ferrous Sulfate	(See also H_2SO_4 mixtures)		R
Formaldehyde—40%		70°	A
Formic Acid—80%		Boiling	A
—25%		70°	A
Fruit Juices			R
Gasoline	With H_3PO_4, SiO_2 and steam in vapor phase of polymerization tower	500°	A
Hydrochloric Acid—Conc.		100°	E
Concentrated		70°	E
—32%		105°	E
Hydrochloric Acid—			
—22%		120°	E
—22%		70°	D
—16%		120°	E
—10%	Aerated solution	100°	C
—10%		70°	A
— 7%		120°	E
— 7%		70°	B
— 5%		70°	A
— 1%	Wash liquor		R
—	Concentrated fumes	113°	A
Hydrofluoric Acid			
—Anhydrous		70°	A
—Anhydrous	Plus 5% by Vol. 98% H_2SO_4	70°	A
Hydrofluoric Acid			
—Anhydrous	Plus 77% by Vol. 98% H_2SO_4	70°	A
—Anhydrous	Plus 57% by Vol. 98% H_2SO_4	70°	A
— 5%		70°	A
Hydrofluosilicic Acid — 8%		85°	A
Hydrogen Peroxide			R
Lactic Acid—10%		160°	A
—10%		70°	A
Lithopone Sludge			R
Magnesium Citrate			R
Malic Acid		70°	A
Mine Water (acid)			R
Mercury	See Note 1	70°	A
"Nickle plating solution"	?	?	R
Nitre Cake Solution	15% H_2SO_4	?	R
Oleic Acid—Comm.		70°	A
Olive Oil		70°	A
Oxalic Acid—15%		Boiling	B
— 8%		70°	A
Phosphate Rock Acidulation	Hot gases (SO_2, SO_3, CO	150°	B
Pickling Solutions	10% to 12% H_2SO_4		R
	Spent solution		A
	Cold water wash tank solution		A
	Hot water wash tank solution		A
Picric Acid—Conc.		70°	A
Potassium Aluminum Sulfate—30%		250°	B
—15%		70°	A
Potassium Dichromate—5%	(See also H_2SO_4 mixtures)	70°	A
Potassium Hydroxide —30%		Boiling	A
Potassium Permanganate — 2%	(See also H_2SO_4 mixtures)	70°	A
Pyrogallic Acid—30%		70°	A
Pyroligneous Acid—pure	Tar removed	70°	A
Rayon—Viscose process Coagulating Bath	Various solutions generally containing 10% to 15% H_2SO_4 with sodium sulfate and other salts	70° to 200°	A & R
Sea Water—Gulf of Mexico	Completely immersed	Atmos.	A
	Partially immersed	Atmos.	A
	Intermittent immersion (tides)	Atmos.	A
Sewage	Meter parts		R
Silver Nitrate—50%		120°	A
Sludge Acid	Refinery waste—37% H_2SO_4	160°	B
	Refinery waste—25% H_2SO_4	140°	A
Sodium Acid Fluoride	Saturated sol'n containing HF	120°	C

(continued)

TABLE 5.19: NICKEL-BASE ALLOYS–STAINLESS FOUNDRY & ENGINEERING *(continued)*

Substance or Process	Conditions	Temp. °F.	Rate
Sodium Acid Sulfate	(See also H_2SO_4 mixtures)		
—24%		104°	A
	Pump in service	150°	R
Sodium Aluminum Sulfate	Strong crude	70°	A
Sodium Chloride			
—Saturated		70°	C
—16%	"Salt spray test"	85°	A
Concentrated	Kept alkaline with NaOH	140°	A
—36%	Plus traces of free Cl_2	122°	B
Sodium Hydroxide—70%		194°	A
—48%			A
—36%		80°	A
—25%		70°	A
— 5%		100°	A
—Concentrated	Plus NaCl, Na_3SO_4 $NaClO_3$	160°	A
	Effluent from cell, also contains NaCl, Na_3SO_4, Na_2CO_3, $NaClO_3$	120°	A
Sodium Hypochlorite	15% available Cl_2	87°	E
—	Bleaching solution (?)	77°	D
—	Bleaching solution (?)	70°	A
Sodium Metaphosphate—1.3%		Boiling	A
Sodium Nitrate—40%		70°	A
Sodium Sulfide— 8%		70°	R
Sodium Thiosulfate—Commercial			R
Stannic Chloride—24%		70°	B
Sulfonation Process (Petroleum products)	25% H_2SO_4, then 25% Na_2SO_4, 25% NaOH	110°	R
Sulfur (Molten)	See Note 2	350°	A
Sulfur Dioxide	Plus SO_3 and CO_2 gases	150°	B
Sulfuric Acid			
—Fuming (109%)		125°	R
Sulfuric Acid—Mixtures with			
Acetic Anhydride	Equal parts with 98% H_2SO_4	250°	C
Sulfuric Acid—Mixtures With			
Chlorine	63% H_2SO_4 saturated with Cl_2	104°	C
Copper Sulfate—50%	Equal parts with 25% H_2SO_4	Boiling	B

Substance or Process	Conditions	Temp. °F.	Rate
Sulfuric Acid—Mixtures With			
Copper Sulfate—10%	Equal parts with 25% H_2SO_4	Boiling	B
— 5%	Equal parts with 25% H_2SO_4	Boiling	B
—16%	"Mixed with H_2SO_4"	138°	A
Ferrous Sulfate—Sat.	Equal parts with 25% H_2SO_4	Boiling	B
—10%	Equal parts with 10% H_2SO_4	Boiling	A
— 5%	Equal parts with 25% H_2SO_4	Boiling	A
— 5%	Equal parts with 10% H_2SO_4	Boiling	A
Hydrochloric Acid —Concentrated	5.8% of sol'n Cont. 1.8% H_2SO_4	70°	C
Nitric Acid —25%	Equal parts with 25% H_2SO_4	Boiling	B
—10%	Equal parts with 25% H_2SO_4	Boiling	B
—Concentrated	7½% of sol'n with 92½% Conc. H_2SO_4	54°	A
Sodium Dichromate —45%	23% of sol'n with 77% of 78% H_2SO_4	21°	E
Sodium Sulfate—10%	Equal parts with 25% H_2SO_4	Boiling	B
— 5%	Equal parts with 25% H_2SO_4	Boiling	B
Potassium Dichromate — 5%	Equal parts with 25% H_2SO_4	Boiling	E
Potassium Permanganate — 5%	Equal parts with 25% H_2SO_4	Boiling	B
Sulfurous Acid—0.75%		175°	A
Tartaric Acid—25%		70°	A
Tetraphosphoric Acid—	Concentration not reported	140°	A
	Concentration not reported	248°	A
	Concentration not reported	356°	A
Urea	Under 1125 lbs. per sq. in. pressure	318°	A
Vegetable Juices			R
Yeast Wort		94°	A
Zinc Chloride	From shorted dry cells	70°	A

Note No. 1—MERCURY—In common with other complex alloys, **Illium G** exhibits a tendency to take up Mercury through some intergranular capillarity. This tendency prohibits its use for thermometer bulbs, etc., where exact volumes and dimensions must be kept.

Note No. 2—MOLTEN SULFUR—Tests conducted in molten sulfur indicate that **Illium G**, unlike many other corrosion resistant alloys, does not gain in weight or dimensions from immersion in the fluid over long periods of time.

TABLE 5.20: NICKEL-BASE ALLOYS–WALL COLMONOY

Corrosive media in which Colmonoy nickel alloys are generally resistant:

Acetic Acid (cold)
Alcohols
Alum
Aluminum Acetate
Aluminum Chloride
Ammonia (anhydrous)
Ammonium Bicarbonate
Ammonium Carbonate
Ammonium Chloride*
Ammonium Hydroxide
Ammonium Nitrate*
Ammonium Oxalate*
Ammonium Persulfate*
Ammonium Phosphate*
Ammonium Sulfide
Amyl Acetate
Arsenic Acid
Azo Dyestuffs

Barium Hydrate
Barium Nitrate
Benzoic Acid
Benzyl Alcohol
Black Liquor, Soda
Black Liquor, Sulphate
Boric Acid
Butyric Acid

Calcium Carbonate (cold)
Calcium Chlorate (dilute)
Calcium Chloride
Calcium Hydroxide
Cane Sugar Liquors
Carbolic Acid (Phenol)
Carbonic Acid l
Carbon Dioxide
Carbon Disulfide
Carbon Tetrachloride
Caustic Potash
Caustic Soda
Chlorine (anhydrous)
Chromic Acid
Citric Acid (to 15%)
Copper Acetate
Copper Carbonate
Core Oils
Cotton Seed Oil

Developers, Photographic
Di-Methyl Ethers

Ethyl Chloride
Ethylene Glycol

Fatty Acids
Formaldehyde
Formic Acid (5%)
Ferrous Sulphate
Ferrous Ammonium Citrate

Gallic Acid
Gasoline
Gelatine
Glutamic Acid
Glycerine (Glycerol)

Helium
Hydrocarbons
Hydrochloric Acid (dilute and cold)
Hydrofluoric Acid (cold)
Hydrogen
Hydrogen Peroxide*
Hydrogen Sulfide (anhydrous)

Kerosene

Lead (up to 900° F)
Liquid Sodium, Potassium, or Nak (up to 900° F)
Linalyl Acetate
Lye
Lysol

Malic Acid
Manganese Carbonate
Manganese Chloride
Magnesium Chloride
Magnesium Hydroxide
Magnesium Nitrate
Magnesium Sulfate*
Mercury
Molasses
Molten Glass
Monoethanolamine

Naphtha
Natural Gas
Nitric Acid*
Nickel Sulfate*

Oleic Acid

Palmitic Acid
Peroxide Bleach Liquors
Petroleum Oils
Phosphoric Acid*
Phosphorus Bromide
Potassium Carbonate (cold)
Potassium Chlorate
Potassium Hydroxide

Resins
Rosin

Shellac
Silver Nitrate
Silver Chloride
Sodium Citrate
Sodium Hydroxide
Sodium Nitrate*
Sodium Peroxide
Sodium Silicate
Stannous Chloride*
Steam (up to 1000° F)
Sulfur Dioxide*
Sulfuric Acid*

Tannic Acid
Tar
Tartaric Acid*
Toluene or Toluol
Trichloroethylene
Turpentine

Uric Acid

Vanadium Oxide
Varnish
Vegetable Oils
Vent Gas
Vinegar (cold)
Vinyl Chloride*
Viscose

Water (hot and cold)
Whiskey
Wines

Xylene or Xylol

Yeast

Zinc Chloride
Zinc Sulfate

*Resistant under certain conditions.

TABLE 5.21: NICKEL-BASE AND OTHER HIGH ALLOY PIPE AND TUBING—COLT INDUSTRIES

TRENT ALLOY Characteristics Corrosion Chart

A = average, G = good, E = excellent, NR = not recommended, X = call for specific data

MATERIAL	UNS SPEC NUMBER	DESCRIPTION	MAJOR APPLICATIONS	CORROSION RESISTANCE: SULFURIC ACID	HYDROCHLORIC ACID	HYDROFLUORIC ACID	PHOSPHORIC ACID	NITRIC ACID	ORGANIC ACID	ALKALIES	SALTS	SEAWATER
ALLOY 200	UNS N02200 ASTM B-162 Testing & Tolerances to A-530 Ni 99.50	Commercially pure wrought nickel, good mechanical properties, excellent resistance to many corrosives.	Food processing equipment, chemical shipping drums, caustic handling equipment and piping, electronic parts, aerospace and missile components, rocket motorcases.	A	A	G-E	A	NR	G-E	G-E	G-E	G-E
ALLOY 400	UNS N04400 ASTM B-127 Testing & Tolerances to A-530 Cr 15.50 Ni 76.00	Solid-solution alloy that can be hardened only by working. It has high strength and toughness over a wide temperature range and excellent resistance to many corrosive environments.	Valves and pumps, electrical and electronic components, chemical processing equipment, pressure vessels and piping, boiler feedwater heaters and other heat exchangers.	G	A	G-E	G	NR	G	G-E	G-E	X
ALLOY 600	UNS N06600 ASTM B-516 Tube, ASTM B-517 Pipe Cr 17 Ni 72	High nickel, high chromium content for resistance to oxidizing and reducing environments; for severely corrosive environments at elevated temperatures.	Furnace mufflers, electronic components, chemical and food processing equipment, heat treating equipment, nuclear steam-generator tubing.	A	NR	A	A	A	G-E	G-E	G-E	A
ALLOY 601	UNS N06601, ASME Code Case 1500 Cr 23.00 Ni 61.00	Excellent high-temperature properties, resistance to oxidizing, carburizing, and sulfur-containing atmospheres.	Heat exchangers, heat-treating baskets and fixtures, radiant tubes, thermocouple tubes, combustion cans, aircraft engine parts.	A	NR	A	A	A	G-E	G-E	G-E	A
ALLOY 625	UNS N06625 ASTM B-704 Tube, ASTM B-705 Pipe Cr 21.50 Mo 9.00 Ni 61.00	High strength and toughness from cryogenic temperatures to 1800°F (980°C) good oxidation resistance, exceptional fatigue strength and good resistance to many corrosives.	Chemical and pollution control equipment, ducting, hot brine handling equipment, fuel nozzles, after burners.	G-E	E	G-E	G-E	G-E	E	E	G-E	E
ALLOY G	UNS N06007 ASTM B-626 Tube, ASTM B-619 Pipe Cr 22.50 Mo 6.50 Ni 44.00 Cu 2.00	Excellent resistance in many media. Resists pitting, crevice corrosion and intergranular corrosion.	Manufacture and use of phosphoric and sulfuric acids, flue-gas scrubbers and other pollution control equipment, evaporators, heat exchangers.	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E
ALLOY G-3	UNS N06985 ASTM B-626 Tube, ASTM B-619 Pipe Cr 21.00 Mo 4.00 Ni 72.00	Similar to G, better for welding, no anneal required.	Pollution control equipment, evaporators, heat exchangers, flue-gas scrubbers, and phosphoric and sulfuric acid environments.	E	G-E	E	E	G-E	G-E	E	G-E	G-E
ALLOY 904 L	UNS N08904 ASTM B-674 Tube, ASTM B-673 Pipe Cr 21.00 Mo 4.70 Ni 22.50 Cu 1.50	Resistant to corrosion in a wide range of both oxidizing and reducing environments, also has increased resistance to pitting and crevice corrosion and to general corrosion in reducing acids.	Stack-gas scrubbers and other pollution control equipment, tanks, piping systems, heat exchangers, also used in bleaching equipment.	G	A	G	G-E	A	G-E	G-E	G-E	X
ALLOY 20	UNS N08020 ASTM B-468 Tube, ASTM B-464 Pipe Cr 19.00 Mo 2.00 Ni 32.50 Cu 3.00	Resistant to stress corrosion cracking in boiling 20 to 40% sulfuric acid as well as other media.	Mining tanks, heat-exchangers, process piping, metal cleaning and pickling tanks.	G	NR	A	G-E	G	G-E	G-E	G-E	X
ALLOY 800	UNS N08800 ASTM B-515 Tube, ASTM B-514 Pipe Cr 21.00 Ni 32.50	Strong and resistant to oxidation and carburization at elevated temperatures. Resists sulfur attack, internal oxidation, scaling and corrosion in a wide variety of atmospheres.	Heat exchangers, process-piping, carburization fixtures and retorts, nuclear steam generator tubing and other components.	A	NR	X	A	G-E	G-E	A	A	A
ALLOY 800H	UNS N08810 ASTM B-515 Tube, ASTM B-514 Pipe Cr 21.00 Ni 32.50	Similar to 800 with better high temperature strength. Higher design strength values for use above 1150°F (620°C). Improved creep and stress-to-rupture properties in 1100°F to 1800°F (595°C to 980°C) range.	Chemical and power plant super heater and re-heater tubing, heaters and furnace tubing, process piping.	A	NR	X	A	G-E	G-E	A	A	A
ALLOY 825	UNS N08825 ASTM B-704 Tube, ASTM B-705 Pipe Cr 21.50 Mo 3.00 Ni 42.00 Cu 2.20	Excellent resistance to wide variety of corrosives. Resists pitting and intergranular type corrosion, reducing acids and oxidizing chemicals.	Spent nuclear fuel element recovery, chemical tanks, evaporators, other processing equipment, hydrofluoric acid, production pollution control and radwaste systems.	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E	G-E
ALLOY B	UNS N10001 ASTM B-626 Tube, ASTM B-619 Pipe Cr 1.00 Mo 26.00 Ni 41.50	Resistant to corrosive effects of hydrochloric acid, it also possesses useful high temperature properties.	Hydrofluoric acid, pollution control, and radwaste operations, spent nuclear fuel element recovery, chemical tanks and other processing equipment.	G-E	E	G-E	G-E	NR	G-E	G-E	G-E	G-E
ALLOY B-2	UNS N10665 ASTM B-626 Tube, ASTM B-619 Pipe Cr 1.00 Mo 26.00 Ni 64.00	Improved resistance to knife-line and heat-affected zone attack, resists the formation of grain-boundary carbide precipitates in the weld affected zone.	Chemical processing equipment, other equipment handling hydrocloric acid.	G-E	E	G-E	G-E	NR	G-E	G-E	G-E	G-E
ALLOY C-276	UNS N10276 ASTM B-626 Tube, ASTM B-619 Pipe Cr 14.50 Mo 15.00 Ni 55.75	Resists the formation of grain-boundary precipitates in the weld heat-affected zone, also has excellent resistance to pitting, stress-corrosion cracking and atmospheres up to 1900°F (1038°C).	Heat-exchangers, chemical processing equipment, sea-water applications, pollution control equipment.	G-E	E	G-E	G-E	E	E	E	G-E	E
ALLOY C-4	UNS N06455 ASTM B-626 Tube, ASTM B-619 Pipe Cr 14.00 Mo 14.00 Ni 62.50	Has outstanding high-temperature stability as evidenced by high ductility and corrosion resistance even after long time aging in the 1200°F to 1900°F (649°C to 1038°C).	Chemical processing equipment	G-E	E	G-E	G-E	E	E	E	E	E
ALLOY X	UNS N06002 ASTM B-626 Tube, ASTM B-619 Pipe Cr 20.50 Mo 8.00 Ni 50.00	Nickel-base alloy that possesses exceptional strength and oxidation resistance up to 2200°F (1200°C).	Furnace rolls, jet engine and all pipes, after burner components, cabin heaters, other aircraft parts.	G	G	G	G	G	G	G	G	G
ALLOY 330	UNS N08330 ASTM B-535 Pipe Cr 17.00 Ni 34.00	Resistant to oxidation and carburization, and good high temperature strength and corrosion resistance.	Furnace muffles, retorts, conveyor systems, heat-treating baskets, other furnace fixtures.	A	NR	X	A	G-E	G-E	A	A	A
ALLOY 2205	UNS S31803 ASTM A-789 Tube, ASTM A-790 Pipe Cr 21.00 Mo 2.50 Ni 4.50	Highly resistant to stress corrosion in chloride-containing media and hydrogen sulfide solutions. Also resists pitting.	Favorable fatigue and corrosion fatigue factors suggest it's use in petrochemical and offshore applications including centrifuges, mixers, pumps and agitators.	X	X	X	X	X	X	X	X	X

TABLE 5.22: NICKEL-BASE RODS, ELECTRODES AND WIRES—CABOT STELLITE

Nickel-Base Alloys

Nickel-Base Alloys	Form	Nominal chemical composition, percent Cr	C	Si	Mn	Mo	Fe	Ni	Co	B	W	Hardness, Rockwell
DELORO alloy No. 40	**A**	11	0.45	2.55	—	—	2.25	Bal.	1.5*	2.5*	—	C-42
DELORO alloy No. 50	**A**	12	0.35	3.5	—	—	3	Bal.	—	2.5	—	C-51
DELORO alloy No. 60	**A**	15	0.75	4	—	—	4	Bal.	—	3.5	—	C-57
	D, E	12	0.7	3.8	—	—	—	Bal.	—	2.3	—	C-48
HASTELLOY alloy C	**B**	17	0.1	—	—	17	6	Bal.	—	—	5	B-96, C-37**
	C											B-96, C-35**
HAYNES alloy No. 711	**A**	27	2.7	1	1*	8	23	Bal.	12	—	3	C-40, C-43***
	B											C-42
HAYNES alloy No. 716	**A**	26	1.1	1.5*	1*	3	29	23	11	0.5	3.5	C-30, C-32***
	B											C-24
HAYNES alloy No. 721	**A**	17	0.4	1*	1*	17	5.5	Bal.	6.5*	—	4.5	C-27***; C-39**
	B											C-22, C-38**
HAYNES alloy No. N-6	**D**	29	1.1	1.5*	1*	5.5	3*	Bal.	3*	0.6	2	C-37
	E											C-28

* Maximum
** Work-hardened
***Gas-tungsten arc only

Code:
A—Bare Cast Rod
B—Covered Electrodes
C—Tube Wire—Sub-Arc
D—Tube Wire (Gas Tungsten Arc)
E—Tube Wire (Gas Metal Arc)

Comparative Corrosion Data*

Media	Concentration and Temperature	Gas Tungsten Arc Deposits HASTELLOY alloy C	DELORO alloy No. 40	DELORO alloy No. 50	DELORO alloy No. 60	STELLITE alloy No. 6	HAYNES alloy No. 716
Acetic Acid	30%, Boiling	E	U	U	U	E	E
Nitric Acid	65%, 150 deg. F (66 deg. C)	S	U	U	U	U	U
Formic Acid	80%, Boiling	E	S	S	G	E	E
Sulfuric Acid	5%, 150 deg. F (66 deg. C)	E	U	U	U	E	U

*Five 24-hr. test periods. Determined in laboratory tests. It is recommended that samples be tested under actual plant conditions.

Code:
E—Less than 5 mpy (<0.13 mm/y)
G—5 mpy (0.13 mm/y) to 20 mpy (0.51 mm/y)
S—Over 20 mpy (>0.51 mm/y) to 50 mpy (1.27 mm/y)
U—More than 50 mpy (>1.27 mm/y)

TABLE 5.23: TANTALUM—NRC

Temperatures at which various media attack Tantalum

Medium	State	Remarks
Air	gas	At temperatures over 300°C
Alkaline solutions	aqueous	At pH > 9, moderate temperatures some corrosion
Ammonia	gas	Pits at high temperatures and pressure
Bromine	gas	At temperatures over 300°C
Chlorine, dry	gas	At temperatures over 250°C
Chlorine, wet	gas	At temperatures over 350°C
Fluorides, acid media	aqueous	All temperatures and concentrations
Fluorine	gas	At all temperatures
Hydrobromic acid, 25%	aqueous	Begins to corrode at temperatures over 190°C
Hydrocarbons	gas	React at temperatures around 1500°C
Hydrochloric acid, 25%	aqueous	Begins to corrode at temperatures over 190°C
Hydrofluoric acid	aqueous	Corrodes at all temperatures and concentrations
Hydrogen	gas	Causes embrittlement, especially at temperatures over 400°C
Hydrogen bromide	gas	At temperatures over 400°C
Hydrogen chloride	gas	At temperatures over 350°C
Hydrogen fluoride	gas	At all temperatures
Iodine	gas	At temperatures over 300°C
Nitrogen	gas	At temperatures over 300°C
Oxalic acid, sat. soln.	aqueous	At temperatures of about 100°C
Oxygen	gas	At temperatures over 350°C
Phosphoric acid, 85%	aqueous	Corrodes at temperatures over 180°C, at higher temperatures for lower concentrations
Potassium carbonate	aqueous	Corrodes at moderate temperatures depending on concentration
Potassium hydroxide 10%	aqueous	Corrodes at about 100°C
Potassium hydroxide	molten	Dissolves metal rapidly (over 360°C)
Potassium pyrosulfate	molten	Dissolves metal rapidly (over 300°C)
Sodium carbonate	aqueous	Corrodes at moderate temperatures depending on conc.
Sodium hydroxide 10%	aqueous	Corrodes at about 100°C
Sodium hydroxide	molten	Dissolves metal rapidly (over 320°C)
Sodium pyrosulfate	molten	Dissolves metal rapidly (over 400°C)
Sulfuric acid 98%	aqueous	Begins to corrode at temperatures over 175°C; lower concentrations begin to corrode at higher temperatures
Sulfuric acid (oleum) (over 98% H_2SO_4)	fuming	Corrodes at all temperatures
Sulfuric trioxide	gas	At all temperatures
Water	aqueous	Corrodes at pH > 9; reacts at high temperatures

Comparison of corrosion rates for Tantalum, Niobium, Titanium, 304 Stainless Steel and Platinum

Medium	Temp.		Corrosion Rate (mils/yr.)				
	°C	°F	Ta	Nb	Ti	s.s. 304	Pt
Acetic Acid	100	212	nil	—(a)	nil	20	nil
$AlCl_3$ (10% soln)	100	212	nil	—	nil	20	nil
NH_4Cl (10% soln)	100	212	nil	nil	<0.5	> 20	nil
HCl, 20%	21	70	nil	0.04	—	—	nil
	100	212	nil	—	175	high	—
, conc.	21	70	nil	0.1	—	—	—
	100	212	nil	4(b)	rapid	rapid	1
HNO_3, 20%	100	212	nil	nil	nil	—	nil
, 70%	100	212	nil	nil	nil	7	nil
, 65%	170	338	< 1	—	< 5	> 50	—
H_3PO_4, 85%	25	76	nil	< 1	8	> 50	—
	100	212	nil	3(b)	40	—	—
H_2SO_4, 10%	25	76	nil	nil	7	> 50	nil
, 40%	25	76	nil	0.1	60	≫ 50	nil
, 98%	25	76	nil	0.2	—	—	nil
, 98%	50	122	nil	0.8(b)	—	—	nil
, 99%	100	212	nil	115(b)	high	—	nil
, 98%	200	392	3	rapid	rapid	—	—
, 98%	250	482	rapid	—	—	—	—
H_2SO_4, fuming (15% SO_3)	23	73	0.5	(assume rapid)		—	—
	70	158	rapid	—	—	—	—
Aqua regia	25	78	nil	nil	35	—	800
Chlorine, wet	75	167	nil	nil	nil	—	0.1
H_2O, Cl_2 sat	25	76	nil	nil	5	> 50	nil
, sea	25	76	nil	nil	nil	50	nil
Oxalic acid	21	70	nil	0.6(b)	—	—	—
	96	205	0.1	—	—	—	—
NaOH, 5%	21	70	nil	1.1	—	—	—
	100	212	0.7	rapid	—	< 1	nil
, 10%	100	212	< 1	—	8	< 1	nil
, 40%	80	176	rapid	—	5	5	nil
HF, 40%	25	76	rapid	rapid	rapid	—	nil

(a) — indicates no data
(b) embrittled

TABLE 5.24: TANTALUM AND TANTALUM-COLUMBIUM ALLOY—CABOT KBI

The corrosion resistance of tantalum is generally compared with that of glass, although it withstands higher temperatures and offers the intrinsic advantages of a metal from a fabrication standpoint. Tantalum equipment is frequently used in conjunction with glass, glass-lined steel and other nonmetallic materials in chemical equipment. It is used extensively in repairing damage and flaws in glass-lined steel equipment. Heat transfer equipment constructed of tantalum includes straight-tube heat exchangers, condensers, bayonet heaters, spiral coils and U-tubes. Tantalum is also used in thermocouple wells, dig pipes, orifices, valves, diaphragms, and in other special areas. The leading anticorrosion applications are in the manufacture of hydrochloric acid and hydrogen peroxide, recovery of sulfuric acid, in bromine heaters and stills, in condensing ethyl bromide, and in the preparation of certain high-purity chemicals.

Corrosion Resistance of Tantalum

(Reagent grade chemicals used when appropriate)

S = no attack up to about 150°C (302°F), or as specified

V = variable depending on concentration and temperature

X = not resistant

Chemical	
Acetic acid	S
Acetic anhydride	S
Air, below 300°C (570°F)	S
Air, above 300°C (570°F)	X
Aluminum chloride	S
Aluminum sulfate	S
Amines	S
Ammonia	V
Ammonium chloride	S
Ammonium hydroxide	V
Ammonium nitrate	S
Ammonium phosphate	S
Ammonium sulfate	S
Amyl acetate or chloride	S
Aqua regia	S
Barium hydroxide	S
Body fluids	S
Bromine, dry, below 300°C (570°F)	S
Bromine, wet	S
Calcium bisulfite	S
Calcium chloride	S
Calcium hydroxide	S
Calcium hypochlorite	S
Chloric acid	S
Chlorinated brine	S
Chlorinated hydrocarbons	S
Chlorine, dry, below 250°C (480°F)	S
Chlorine, wet	S
Chlorine oxides	S
Chloroacetic acid	S
Chromic acid	S
Chrome plating solutions	S
Citric acid	S
Cleaning solution	S
Copper salts	S
Ethylene dibromide	S
Ethyl sulfate	S
Fatty acids	S
Ferric chloride	S
Ferrous sulfate	S
Fluoride salts	V
Formic acid	S
Hydriodic acid	S
Hydrobromic acid	S

Chemical	
Hydrochloric acid	S
Hydrofluoric acid	X
Hydrogen	V
Hydrogen bromide	S
Hydrogen chloride	S
Hydrogen fluoride	X
Hydrogen iodide	S
Hydrogen peroxide	S
Hydrogen sulfide	S
Hypochlorous acid	S
Iodine, below 300°C (570°F)	S
Lactic acid	S
Magnesium chloride	S
Magnesium sulfate	S
Mercury salts	S
Methyl sulfuric acid	S
Mixed acids (H_2SO_4-HNO_3)	S
Nickel salts	S
Nitric acid	S
Nitric acid, fuming	S
Nitric oxides	S
Nitrogen, below 300°C (570°F)	S
Nitrous acid	S
Nitrosyl chloride	S
Oleum (fuming sulfuric acid)	X
Organic chlorides	S
Oxalic acid	S
Oxygen, below 300°C (570°F)	S
Perchloric acid	S
Phenol	S
Phosphoric acid, <4 ppmF	S
Phosphorous, below 700°C (1290°F)	S
Phosphorous chlorides	S
Phosphorous oxychloride	S
Pickling acids, except HNO_3-HF	S
Phthalic anhydride	S
Potassium carbonate	V
Potassium chloride	S
Potassium dichromate	S
Potassium hydroxide, dilute	V
Potassium hydroxide, conc.	X
Potassium iodide-iodine	S
Potassium pyrosulfate, molten	X

Chemical	
Sodium bisulfate, molten	X
Sodium bisulfate, solution	S
Sodium bromide	S
Sodium carbonate	V
Sodium chlorate	S
Sodium chloride	S
Sodium hydroxide, dilute	V
Sodium hydroxide, conc.	X
Sodium hypochlorite	S
Sodium nitrate	S
Sodium pyrosulfate, molten	X
Sodium sulfate	S
Sodium sulfide	V
Sodium sulfite	S
Sulfamic acid	S
Sulfur, below 500°C (930°F)	S
Sulfur chlorides	S
Sulfur dioxide	S
Sulfur trioxide	X
Sulfuric acid, to 175°C (350°F)	S
Sulfuric acid, over 175°C (350°F)	V
Sulfurous acid	S
Sulfuryl chloride	S
Thionyl chloride	S
Tin salts	S
Zinc chloride	S
Zinc sulfate	S

Liquid metals	
Bismuth to 900°C (1650°F)	S
Gallium to 450°C (840°F)	S
Lead to 1000°C (1830°F)	S
Lithium to 1000°C (1830°F)	S
Magnesium to 1150°C (2100°F)	S
Mercury to 600°C (1110°F)	S
Potassium to 900°C (1650°F)	S
Sodium to 900°C (1650°F)	S
Sodium-potassium alloys to 900°C (1650°F)	S
Zinc to 500°C (930°F)	X
Tin	V
Uranium	V

(continued)

TABLE 5.24: TANTALUM AND TANTALUM-COLUMBIUM ALLOY—CABOT KBI (continued)

KBI-40 Alloy is a solid solution of 60% tantalum and 40% columbium. As such, it has many application possibilities in common with both its elemental components, particularly tantalum. It is interchangeable with the higher-priced tantalum in many applications, including: plate and shell-and-tube heat exchangers, reactors, condensers, bayonet heaters, thermowells, spiral coils, U-tubes, rupture discs, distillation columns, and piping.

CORROSION RESISTANCE OF KBI 40 ALLOY*

Ammonium nitrate	S	Hydrofluoric acid	X	Sodium hydroxide, dilute	V
Bromine, dry, below 200° C	S	Nitric acid	S	Sodium hydroxide, conc.	X
Bromine, wet	S	Nitric acid, fuming	S	Sodium nitrate	S
Chlorinated brine	S	Organic chlorides	S	Sodium sulfide	V
Chlorinated hydrocarbons	S	Phosphoric acid, 4 ppm F	S	Sulfuric acid, to 160° C	S
Ferric chloride	S	Phosphorous chlorides	S	Sulfurous acid	S
Ferrous sulfate	S	Pickling acids, except HNO_3-HF	S	Zinc sulfate	S
Ferrous salts	V	Potassium dichromate	S		
Hydrochloric acid	S	Potassium hydroxide, dilute	V		

*Key: S = Totally resistant to about 150° C (302° F) or as specified
V = Varies depending on concentration and temperature
X = Not resistant

KBI-40 Corrosion Information

The following tests have been conducted with reagent grade chemicals; actual field testing could differ because of impurities. Field testing is highly recommended. (Rate is in mils/yr.)

Solution	Salt	Temperature, °C	Pure Ta	KBI-40	Pure Cb
5% HCl	10% NaCl	101 boil	nil	nil	1
10% HCl	—	102 boil	nil	nil	<1
10% HCl	—	190	nil	nil	—
10% HCl	0.005% $FeCl_3$	190	nil	—	—
10% HCl	10% NaCl	102 boil	nil	nil	7
15% HCl	10% NaCl	109 boil	nil	nil	16
15% HCl	0.005-0.040% $FeCl_3$	109 boil	nil	nil	—
20% HCl	—	110 boil	nil	nil	—
20% HCl	0.005-0.040% $FeCl_3$	110 boil	nil	nil	30
20% HCl	—	190	<1	2	—
20% HCl	0.005-0.040% $FeCl_3$	190	nil	<1	—
20% HCl	—	150	nil	nil	64
30% HCl	—	92 boil	nil	nil	—
30% HCl	0.005% $FeCl_3$	92 boil	nil	nil	—
30% HCl	—	190	1	36	—
30% HCl	0.005% $FeCl_3$	190	1	31	—
36% HCl	—	81 boil	nil	<1	—
36% HCl	0.005% $FeCl_3$	81 boil	nil	nil	—
36% HCl	—	190	8	141	—
35% HCl	0.005% $FeCl_3$	190	8	259	—
65% HNO_4	0.1% $FeCl_3$	121 boil	nil	nil	<1
10% H_2SO_4	0.1% $FeCl_3$	101 boil	nil	nil	<1
10% H_2SO_4	0.01% $FeCl_3$	101 boil	nil	nil	2
20% H_2SO_4	—	102 boil	nil	nil	—
20% H_2SO_4	—	190	nil	nil	—
30% H_2SO_4	0.01-0.1% $FeCl_3$	107 boil	nil	nil	5
30% H_2SO_4	5-15% $AlCl_3$	107 boil	nil	nil	7
40% H_2SO_4	—	113 boil	nil	<1	—
40% H_2SO_4	—	190	nil	nil	—
40% H_2SO_4	0.01-0.1% $FeCl_3$	113 boil	nil	<1	—

(continued)

TABLE 5.24: TANTALUM AND TANTALUM-COLUMBIUM ALLOY—CABOT KBI (continued)

Solution	Salt	Temperature, °C	Pure Ta	KBI-40	Pure Cb
50% H_2SO_4	—	123 boil	nil	<1	—
50% H_2SO_4	0.01-0.1% $FeCl_3$	123 boil	nil	<1	—
50% H_2SO_4	—	110	nil	nil	—
50% H_2SO_4	—	120	nil	<1	—
50% H_2SO_4	0.01-0.1% $FeCl_3$	120	nil	nil	—
50% H_2SO_4	0.01-0.1% $FeCl_3$	123 boil	nil	<1	—
60% H_2SO_4	—	100	nil	nil	—
60% H_2SO_4	—	141 boil	<1	<2	—
60% H_2SO_4	—	190	<1	<2	—
60% H_2SO_4	0.01-0.1% $FeCl_3$	90-100	nil	nil	—
60% H_2SO_4	0.01% $FeCl_3$	120	nil	<1	—
60% H_2SO_4	0.05-0.1% $FeCl_3$	120	nil	nil	—
60% H_2SO_4	0.01-0.1% $FeCl_3$	141 boil	<1	1	—
70% H_2SO_4	—	100	nil	nil	—
70% H_2SO_4	—	165 boil	<1	8	—
77% H_2SO_4	—	100	nil	nil	—
77% H_2SO_4	—	175	2	32	—
77% H_2SO_4	—	189 boil	2	40	—
85% H_2SO_4	—	260	5	—	—
93% H_2SO_4	—	260	15	—	—
96% H_2SO_4	—	260	21	—	—
60% H_2SO_4	10% NaCl	141 boil	nil	1	49
70% H_2SO_4	10% NaCl	165 boil	<1	8	—
ASTM G-28 (50% H_2SO_4 + 42g/liter $Fe_2(SO_4)_3$*)		123 boil	nil	<1	—
Green Death (12% H_2SO_4 + 1.2% HCl + 1% $FeCl_3$ + 1% $CuCl_2$)		101 boil	nil	nil	—

Boiling temperatures may vary with salt additions. *Highly oxidizing acid solutions.

TABLE 5.25: TITANIUM—INDUSTRIAL TITANIUM

COMMERCIALLY PURE TITANIUM IS BEING USED SUCCESSFULLY IN ALL OF THE FOLLOWING MEDIA.

SALTS

Aluminum Hydroxide
Aluminum Potassium Sulphate
Aluminum Sulphate
Amonium Chloride
Amonium Hydroxide
Amonium Sulphate
Aniline Hydrochloride
Antimony Trichloride
Barium Carbonite
Barium Chloride
Barium Nitrate
Barium Sulphate
Calcium Carbonate
Calcium Chloride
Calcium Hydroxide
Calcium Hypochlorite
Carbon Tetrachloride
Copper Carbonate
Copper Chloride
Copper Cyanide
Copper Nitrate
Copper Sulphate
Cupric Chloride
Ethylene Chloride
Ferric Chloride
Ferrous Chloride
Hydrogen Peroxide
Hydrogen Sulphide
Lead Acetate
Manganese Carbonate
Manganese Chloride
Magnesium Carbonate
Magnesium Chloride
Magnesium Hydroxide
Magnesium Nitrate
Magnesium Sulphate
Mercuric Chloride
Mercuric Cyanide
Nickle Chloride
Potassium Bichromate
Potassium Bromide
Potassium Carbonate
Potassium Chloride
Potassium Chlorate
Potassium Ferricyanide
Potassium Ferrocyanide
Potassium Hydroxide
Potassium Iodine
Potassium Nitrate
Potassium Oxalate
Potassium Permanganate
Potassium Sulphate
Potassium Sulphide
Silver Chloride
Silver Cyanide
Silver Nitrate
Sodium Acetate
Sodium Benzoate
Sodium Bicarbonate
Sodium Bichromate
Sodium Bisulphate
Sodium Borate
Sodium Carbonate
Sodium Chlorate
Sodium Chloride
Sodium Citrate
Sodium Flouride
Sodium Hydroxide
Sodium Nitrate
Sodium Phosphate
Sodium Silicate
Sodium Sulphate
Sodium Sulphite
Stannic Chloride
Stannous Chloride
Sulphur Dioxide
Titanium Tetrachloride
Zinc Chloride
Zinc Sulphate

ACIDS

Acetic Acid
Acetic Anhydride
Acetic Vapors
Carbonic Acid
Chloroacetic Acid
Chromic Acid
Chromic Acid C.P.
Citric Acid
Hydrocyanic
Lactic Acid
Malic Acid
Nitric Acid
Nitrous Acid
Oleic Acid
Oxalic Acid
Phosphoric Acid
Pyrogallic Acid
Salicylic Acid
Stearic Acid
Sulphurus Acid
Sulphurous Spray
Tannic Acid
Tartaric Acid
Uric Acid

MISCELLANEOUS

Alcohol— Methyl, Propyl Butyl Ethyl
Aniline
Beer
Blood
Chlorinated Water
Chlorine Gas — Moist Only
Chloroform
Flue Gases
Fluorine
Formaldehyde
Fruit Juices
Furfural
Gasoline
Hydrocarbons
Meat Juices
Mercury
Petroleum Ether
Phenol
Salt
Salt Brine
Water — Hot, Sea, Salt Brakish, Steam
Whiskey

TABLE 5.26: TITANIUM AND TITANIUM ALLOYS—TIMET

Titanium Corrosion Rate Data – Commercially Pure Grades

C = Concentration %
T = Temperature °F (°C)
R = Corrosion rate, mpy (mm/y)

MEDIA	C	T	R
Acetaldehyde	75	300 (149)	0.02 (0.001)
	100	300 (149)	nil
Acetate, n-propyl	–	188 (87)	nil
Acetic acid	5 to 99.7	255 (124)	nil
	33-vapor	boiling	nil
	65	250 (121)	0.1 (0.003)
	58	266 (130)	15.0 (0.381)
Acetic acid	99.7	255 (124)	0.1 (0.003)
Acetic acid + 109 ppm Cl	31.2	boiling	10.2 (0.259)
Acetic acid + 106 ppm Cl	62.0	boiling	10.7 (0.272)
Acetic anhydride	99.5	boiling	0.5 (0.013)
Acidic gases containing CO_2, H_2O, Cl_2, SO_2, SO_3, H_2S, O_2, NH_3,	–	100-500 (38-260)	<1.0 (<0.025)
Adipic acid + 15-20% glutaric + 2% acetic acid	25	390 (199)	nil
Adipic acid	67	450 (232)	nil
Adipyl chloride (acid chlorobenzene solution)	–	–	nil
Adiponitrile	vapor	700 (371)	0.3 (0.008)
Aluminum chloride, aerated	10	212 (100)	0.09 (0.002)*
Aluminum chloride, aerated	25	212 (100)	124 (3.15)*
Aluminum chloride, non-aerated	10	302 (150)	1.3 (0.033)*
	25	212 (100)	258 (6.55)*
Aluminum	molten	1250 (677)	6480 (164.6)
Aluminum fluoride	saturated	room	nil
Aluminum nitrate	saturated	room	nil
Aluminum sulfate	saturated	room	nil
Aluminum sulfate + 1% H_2SO_4	saturated	room	nil
Amines, synthesis of organic	–	300-400 (149-204)	15 (0.381)
Ammonium acid phosphate	10	room	nil
Ammonium aluminum chloride	molten	662-716 (350-380)	very rapid
Ammonia anhydrous	100	104 (40)	<5.0 (<0.127)
Ammonia, steam, water	–	431 (222)	440 (11.2)
Ammonium acetate	10	room	nil
Ammonium bicarbonate	50	212 (100)	nil
Ammonium bisulfite, pH 2.05	spent pulping liquor	159 (71)	0.6 (0.015)
Ammonium carbamate	50	212 (100)	nil
Ammonium chloride	saturated	212 (100)	<0.5 (<0.013)
Ammonium chlorate (+215-250 g/l NaCl) (+36 g/l $NaClO_4$)	300 g/l	122 (50)	0.1 (0.003)
Ammonium fluoride	10	room	4.0 (0.102)
Ammonium hydroxide	28	room	0.1 (0.003)
Ammonium nitrate	28	boiling	nil
Ammonium nitrate + 1% nitric acid	28	boiling	nil
Ammonium oxalate	saturated	room	nil
Ammonium perchlorate	20	190 (88)	nil
Ammonium sulfate	10	212 (100)	nil
Ammonium sulfate + 12% H_2SO_4	saturated	room	0.4 (0.010)
Aniline	100	room	nil
Aniline + 2% $AlCl_3$	98	316 (158)	>50 (>1.27)
Aniline + 2% $AlCl_3$	98	600 (316)	840 (21.3)

MEDIA	C	T	R
Aniline hydrochloride	5	212 (100)	nil
Aniline hydrochloride	20	212 (100)	nil
Antimony trichloride	27	room	nil
Aqua regia	3:1	room	nil
Aqua regia	3:1	175 (79)	34.8 (0.884)
Arsenous oxide	saturated	room	nil
Barium carbonate	saturated	room	nil
Barium chloride	5	212 (100)	nil
Barium chloride	20	212 (100)	0.01 (0.000)
Barium chloride	25	212 (100)	nil
Barium hydroxide	saturated	room	nil
Barium hydroxide	27	boiling	some small pits
Barium nitrate	10	room	nil
Barium fluoride	saturated	room	nil
Benzaldehyde	100	room	nil
Benzene (traces of HCl)	vapor & liquid	176 (80)	0.2 (0.005)
Benzene (traces of HCl)	liquid	122 (50)	1.0 (0.025)
Benzene	liquid	room	nil
Benzene + trace HCl, NaCl and CS_2	–	176 (80)	0.2 (0.005)
Benzoic acid	saturated	room	nil
Bismuth	molten	1500 (816)	high
Bismuth/lead	molten	572 (300)	good resistance
Boric acid	saturated	room	nil
Boric acid	10	boiling	nil
Bromine	liquid	86 (30)	rapid
Bromine, moist	vapor	86 (30)	<0.1 (<0.003)
Bromine, gas dry	–	70 (21)	dissolves rapidly
Bromine - water solution	–	room	nil
Bromine-methyl alcohol solution	500 ppm	140 (60)	1.2 (0.030) some cracking
Bromine in methyl alcohol	5	–	757 (19.2)
N-butyric acid	undiluted	room	nil
Calcium bisulfite	cooking liquor	79 (26)	0.02 (0.001)
Calcium carbonate	saturated	boiling	nil
Calcium chloride	5	212 (100)	0.02 (0.005)*
Calcium chloride	10	212 (100)	0.29 (0.007)*
Calcium chloride	20	212 (100)	0.61 (0.015)*
Calcium chloride	55	220 (104)	0.02 (0.001)*
Calcium chloride	60	300 (149)	<0.1 (<0.003)*
Calcium chloride	62	310 (154)	2.0 and 16 (0.051 and 0.406)*
Calcium chloride	73	350 (177)	84 (2.13)*
Calcium hydroxide	saturated	room	nil
Calcium hydroxide	saturated	boiling	nil
Calcium hypochlorite	2	212 (100)	0.05 (0.001)
Calcium hypochlorite	6	212 (100)	0.05 (0.001)
Calcium hypochlorite	18	70 (21)	nil
Calcium hypochlorite	saturated slurry	–	nil
Carbon dioxide	100	–	excellent
Carbon tetrachloride	99	boiling	0.18 (0.005)
Carbon tetrachloride	liquid	boiling	nil
Carbon tetrachloride	vapor	boiling	nil
Chlorine gas, wet	>0.7 H_2O	room	nil
Chlorine gas, wet	>0.95 H_2O	284 (140)	nil
Chlorine gas, wet	>1.5 H_2O	392 (200)	nil
Chlorine gas, wet	liquid water on surface	room	nil
Chlorine saturated water	saturated	207 (97)	nil

(continued)

TABLE 5.26: TITANIUM AND TITANIUM ALLOYS–TIMET (continued)

MEDIA	C	T	R
Chlorine header sludge and wet chlorine	–	207 (97)	0.03 (0.001)
Chlorine gas, dry	<0.5 H_2O	room	may react
Chlorine dioxide	5 in steam gas + H_2O and air	180 (82)	<0.1 (<0.003)
Chlorine dioxide	15 + some HOCl and wet Cl_2	110 (43)	nil
Chlorine dioxide in steam	5	210 (99)	nil
Chlorine monoxide	up to 15 + some HOCl, Cl_2 & H_2O	110 (43)	nil
Chlorine trifluoride	100	<86 (30)	vigorous reaction
Chloracetic acid	30	180 (82)	<5.0 (<0.127)
Chloracetic acid	100	boiling	<5.0 (<0.127)
Chlorosulfonic acid	100	room	7.5-12.3 (0.191-0.312
Chloroform	vapor & liquid	boiling	0.01 (0.000)
Chloropicrin	100	203 (95)	0.1 (0.003)
Chromic acid	10	boiling	0.1 (0.003)
Chromic acid	15	75 (24)	0.2 (0.006)
Chromic acid	15	180 (82)	0.6 (0.015)
Chromic acid	50	75 (24)	0.5 (0.013)
Chromic acid	50	180 (82)	1.1 (0.028)
Chromium plating bath containing fluoride	240 g/l plating salt	171 (77)	58.3 (1.48)
Chromic acid + 5% nitric acid	5	70 (21)	<0.1 (<0.003)
Citric acid	10	212 (100)	0.36 (0.009)
Citric acid	25	212 (100)	0.03 (0.001)
Citric acid	50	140 (60)	0.01 (0.000)
Citric acid	50 aerated	212 (100)	<5.0 (<0.127)
Citric acid	50	boiling	5-50 (0.127-1.27)
Citric acid	62	300 (149)	corroded
Copper nitrate	saturated	room	nil
Copper sulfate	50	boiling	nil
Copper sulfate + 2% H_2SO_4	saturated	room	0.7 (0.018)
Cupric carbonate + cupric hydroxide	saturated	ambient	nil
Cupric chloride	20	boiling	nil
Cupric chloride	40	boiling	0.2 (0.005)
Cupric chloride	55	246 (119) (boiling)	0.1 (0.003)
Cupric cyanide	saturated	room	nil
Cuprous chloride	50	194 (90)	<0.1 (<0.003)
Cyclohexylamine	100	room	nil
Cyclohexane (plus traces of formic acid)	–	302 (150)	0.1 (0.003)
Dichloroacetic acid	100	212 (100)	<0.5 (<0.013)
Dichloroacetic acid	100	boiling	0.29 (0.007)
Dichlorobenzene + 4-5% HCl	–	355 (179)	4 (0.102)
Diethylene triamine	100	room	nil
Ethyl alcohol	95	boiling	0.5 (0.013)
Ethyl alcohol	100	room	nil
Ethylene dichloride	100	boiling	0.2-5.0 (0.005-0.127)
Ethylene diamine	100	room	nil
Ferric chloride	10-20	room	nil
Ferric chloride	10-30	212 (100)	<0.5 (<0.127)
Ferric chloride	10-40	boiling	nil
Ferric chloride	50	236 (113) (boiling)	nil
Ferric chloride	50	302 (150)	0.1 (0.003)
Ferric sulfate $.9H_2O$	10	room	nil
Ferrous chloride + 0.5% HCl + 3% resorcinal pH 1	30	175 (79)	0.2 (0.006)
Ferrous sulfate	saturated	room	nil
Fluoboric acid	5-20	elevated	rapid

MEDIA	C	T	R
Fluorine, commercial	gas-liquid alternated	gas–109 liquid (43) –320 (–196)	18-34 (0.457-0.864)
Fluorine, HF free	[12] liquid [12] gas	–320 (–196)	0.08 (0.002)
Fluorine, HF free	liquid	–320 (–196)	<0.43 (0.011)
Fluorine, HF free	gas	–320 (–196)	0.42 (0.011)
Fluorosilicic acid	10	room	1870 (47.5)
Food products	–	ambient	no attack
Formaldehyde	37	boiling	nil
Formamide vapor	–	572 (300)	nil
Formic acid, aerated	10	212 (100)	0.18 (0.005)**
Formic acid, aerated	25	212 (100)	0.04 (0.001)**
Formic acid, aerated	50	212 (100)	0.04 (0.001)**
Formic acid, aerated	90	212 (100)	0.05 (0.001)**
Formic acid, non-aerated	10	212 (100)	nil**
Formic acid, non-aerated	25	212 (100)	96 (2.44)**
Formic acid, non-aerated	50	boiling	126 (3.20)**
Formic acid, non-aerated	90	212 (100)	118 (3.00)**
Formic acid, -O	9	122 (50)	<5 (<0.127)
Furfural	100	room	nil
Gluconic acid	50	room	nil
Glycerin	–	room	nil
Hydrogen chloride, gas	air mixture	ambient	nil
Hydrochloric acid aerated	5	95 (35)	1.5 (0.038)
Hydrochloric acid, aerated	10	95 (35)	40 (1.02)
Hydrochloric acid, aerated	20	95 (35)	175 (4.45)
Hydrochloric acid, aerated	37.5	95 (35)	1990 (50.6)
Hydrochloric acid	1	boiling	>100 (>2.54)
Hydrochloric acid	3	boiling	550 (14.0)
Hydrochloric acid	5	boiling	400 (10.2)
Hydrochloric acid, nitrogen saturated	3	374 (190)	>1120 (>28.5)
Hydrochloric acid, nitrogen saturated	5	374 (190)	>1120 (>28.5)
Hydrochloric acid, nitrogen saturated	10	374 (190)	>1120 (>28.5)
Hydrochloric acid, oxygen saturated	3	374 (190)	>1120 (>28.5)
	5	374 (190)	>1120 (>28.5)
	10	374 (190)	>1120 (>28.5)
chlorine saturated	5	374 (190)	<1 (<0.025)
	10	374 (190)	>1120 (>28.5)
Hydrochloric acid, 200 ppm Cl_2	36	room	17.0 (0.432)
Hydrochloric acid, + 1% HNO_3	5	100 (38)	nil
+ 1% HNO_3	5	200 (93)	3.6 (0.091)
+ 5% HNO_3	5	100 (38)	0.84 (0.025)
+ 5% HNO_3	5	200 (93)	1.2 (0.030)
+ 10% HNO_3	5	100 (38)	nil
+ 10% HNO_3	5	200 (93)	7.2 (0.183)
+ 3% HNO_3	8.5	176 (80)	2.0 (0.051)
+ 5% HNO_3	1	boiling	2.9 (0.074)
+ 5% HNO_3 + 1.7 g/l $TiCl_4$	1	boiling	nil
Hydrochloric acid,			
+ 2.5% $NaClO_3$	10.2	176 (80)	0.37 (0.009)
+ 5.0% $NaClO_3$	10.2	175 (79)	0.25 (0.006)
Hydrochloric acid,			
+ 0.5% CrO_3	5	100 (38)	nil
+ 0.5% CrO_3	5	200 (93)	1.2 (0.031)
+ 1% CrO_3	5	100 (38)	0.72 (0.018)
+ 1% CrO_3	5	200 (93)	1.2 (0.031)
Hydrochloric acid,			
+ 0.05% $CuSO_4$	5	100 (38)	1.56 (0.040)
+ 0.05% $CuSO_4$	5	200 (93)	3.6 (0.091)
+ 0.5% $CuSO_4$	5	100 (38)	3.6 (0.091)

(continued)

TABLE 5.26: TITANIUM AND TITANIUM ALLOYS—TIMET (continued)

MEDIA	C	T	R
Hydrochloric acid, + 0.5% $CuSO_4$	5	200 (93)	2.4 (0.061)
+ 1% $CuSO_4$	5	100 (38)	1.2 (0.031)
+ 1% $CuSO_4$	5	200 (93)	3.6 (0.091)
+ 5% $CuSO_4$	5	100 (38)	0.8 (0.020)
+ 5% $CuSO_4$	5	200 (93)	2.4 (0.061)
+ 0.05% $CuSO_4$	5	boiling	2.5 (0.064)
+ 0.5% $CuSO_4$	5	boiling	3.3 (0.084)
Hydrochloric acid, + 0.05% $CuSO_4$	10	150 (66)	0.68-1.32 (0.017-0.025)
+ 0.20% $CuSO_4$	10	150 (66)	nil
+ 0.5% $CuSO_4$	10	150 (66)	nil-0.68 (0.023)
+ 1% $CuSO_4$	10	150 (66)	0.68 (0.023)
+ 0.05% $CuSO_4$	10	boiling	11.6 (0.295)
+ 0.5% $CuSO_4$	10	boiling	11.4 (0.290)
+ 0.2% $CuSO_4$ + 0.2% organic amine	10	boiling	9.0 (0.229)
Hydrofluoric acid	1.48	room	rapid
Hydrofluoric acid, anhydrous	100	room	5.0-50 (0.127-1.27)
Hydrofluoric-nitric acid	1-HF -15HNO_3	room	rapid
Hydrogen peroxide	3	room	<5 (<0.127)
Hydrogen peroxide	6	room	<5 (<0.127)
Hydrogen perxoide	30	room	<12 (<0.305)
Hydrogen sulfide, steam and 0.077% mercaptans	7.65	200-230 (93-110)	nil
Hydroxy-acetic acid	–	104 (40)	1.2 (0.031)
Hypochlorous acid + Cl_2O and Cl_2 gases	17	100 (38)	0.001 (0.000)
Iodine, dry gas	–	70 (21)	<4 (<0.102)
Iodine in water + potassium iodide	–	room	nil
Iodine in alcohol	saturated	room	pitted
Lactic acid	10-85	212 (100)	<5.0 (<0.127)
Lactic acid	10	boiling	<5.0 (<0.127)
Lead	–	1500 (816)	attacked
Lead	–	615-1100 (324-593)	good
Lead acetate	saturated	room	nil
Linseed oil, boiled	–	room	nil
Lithium, molten	–	600-900 (316-482)	nil
Lithium chloride	50	300 (149)	nil
Magnesium	molten	1400 (760) & 1750 (954)	limited resistance
Magnesium chloride	5-20	212 (100)	<0.4 (<0.010)*
Magnesium chloride	5-40	boiling	nil
Magnesium hydroxide	saturated	room	nil
Magnesium sulfate	saturated	room	nil
Manganous chloride	5-20	212 (100)	nil
Maleic acid	18-20	95 (35)	.06 (0.002)
Mercuric chloride	1	212 (100)	0.01 (0.000)
Mercuric chloride	5	212 (100)	0.42 (0.011)
Mercuric chloride	10	212 (100)	0.04 (0.001)
Mercuric chloride	saturated	212 (100)	<5 (<0.127)
Mercuric cyanide	saturated	room	nil
Mercury	100	up to 100 (38)	satisfactory
Mercury	100	room	nil
Mercury	–	700 (371)	119.4 (3.03)
Methyl alcohol	91	95 (35)	nil
Mercury + Fe	–	700 (371)	3.12 (0.079)
Mercury + Cu	–	700 (371)	2.48 (0.063)
Mercury + Zr	–	700 (371)	1.28 (0.033)
Mercury + Mg	–	700 (371)	3.26 (0.083)
Nickel chloride	5	212 (100)	0.17 (0.004)
Nickel chloride	20	212 (100)	0.11 (0.003)
Nickel nitrate .6H_2O	50	room	nil
Nitric acid, aerated	10	room	0.19 (0.005)
Nitric acid, aerated	20	room	9.69 (0.246)
Nitric acid, aerated	30	room	0.17 (0.004)
Nitric acid, aerated	40	room	0.08 (0.002)
Nitric acid, aerated	50	room	0.08 (0.002)
Nitric acid, aerated	60	room	0.02 (0.001)
Nitric acid, aerated	70	room	0.18 (0.005)
Nitric acid, aerated	10	104 (40)	0.10 (0.003)
Nitric acid, aerated	20	104 (40)	0.21 (0.005)
Nitric acid, aerated	30	122 (50)	0.61 (0.015)
Nitric acid, aerated	40	122 (50)	0.64 (0.016)
Nitric acid, aerated	50	140 (60)	1.46 (0.037)
Nitric acid, aerated	60	140 (60)	1.56 (0.040)
Nitric acid, aerated	70	158 (70)	1.56 (0.040)
Nitric acid, aerated	40	392 (200)	24 (0.610)
Nitric acid, aerated	70	518 (270)	48 (1.22)
Nitric acid, aerated	20	554 (290)	12 (0.305)
Nitric acid, non-aerated	35	176 (80)	2-4 (0.051-0.102)
Nitric acid, non-aerated	70	176 (80)	1-3 (0.025-0.076)
Nitric acid	17	boiling	3-4 (0.076-0.102)
Nitric acid	35	boiling	5-20 (0.127-0.508)
Nitric acid	70	boiling	2.5-37 (0.064-0.940)
Nitric acid, white fuming	–	room	0.1 (0.003)
Nitric acid, white fuming	liquid or vapor	room	nil
Nitric acid, white fuming	–	180 (82)	6.0 (0.152)
Nitric acid, white fuming	–	252 (122)	<5.0 (<.127)
Nitric acid, white fuming	–	320 (160)	<5.0 (<.127)
Nitric acid, red fuming	<about 2% H_2O	room	ignition sensitive
Nitric acid, red fuming	>about 2% H_2O	room	not ignition sensitive
Nitric acid + 0.1% CrO_3	40	boiling	0.12-0.99 (0.003-0.025)
Nitric acid + 10% $FeCl_3$	40	boiling	4.8-7.4 (0.122-0.188)
Nitric acid + 0.1% $K_2Cr_2O_3$	40	boiling	nil-0.62 (nil-0.016)
Nitric acid + 10% $NaClO_1$	40	boiling	0.12-1.40 (.003-0.036)
Nitric acid, saturated with zirconyl nitrate	33-45	245 (118)	nil
Nitric acid + 15% zirconyl nitrate	65	260 (127)	nil
Nitric acid + 179 g/l $NaNO_3$ and 32 g/l NaCl	20.8	boiling	5-11.6 (0.127-0.295)
Nitric acid + 170 g/l $NaNO_3$ and 2.9 g/l NaCl	27.4	boiling	19-115 (0.483-2.92)
Oil well crudes, varying amounts of abrasion	–	ambient	0.26-23.2 (0.007-0.589)
Oxalic acid	1	98.6 (37)	12 (0.025)
Oxalic acid	1	boiling	4247 (107.9)
Oxalic acid	25	140 (60)	470 (11.9)
Oxalic acid	saturated	room	20 (0.508)
Perchloryl fluoride + liquid ClO_3	100	86 (30)	0.07 (0.002)
Perchloryl fluoride + 1% H_2O	99	86 (30)	liquid 11.4 (0.290) vapor 0.1 (0.003)
Phenol	saturated solution	70 (21)	4.0 (0.102)
Phosphoric acid	10-30	room	0.8-2 (0.020-0.051)
Phosphoric acid	30-80	room	2-30 (0.051-0.762)
Phosphoric acid	1	boiling	10 (0.254)
Phosphoric acid	10	boiling	400 (10.2)
Phosphoric acid	30	boiling	1030 (26.2)
Phosphoric acid	10	176 (80)	72 (1.83)
Phosphoric acid + 3% nitric acid and 16% water	81	190 (88)	15 (0.381)
Phosphorus oxychloride	100	room	0.14 (0.004)
Phosphorus trichloride	saturated	room	nil
Photographic emulsions	–	–	<5.0 (<0.127)
Pthalic acid	saturated	room	nil
Potassium bromide	saturated	room	nil
Potassium chloride	saturated	room	nil
Potassium chloride	saturated	140 (60)	<.01 (0.000)
Potassium dichromate	–	–	nil
Potassium ethyl zanthate	10	room	nil
Potassium ferricyanide	saturated	room	nil

(continued)

TABLE 5.26: TITANIUM AND TITANIUM ALLOYS—TIMET (continued)

MEDIA	C	T	R
Potassium hydroxide + 13% potassium chloride	13	85 (29)	nil
Potassium hydroxide	50	80 (29)	0.4 (0.010)
Potassium hydroxide	10	boiling	<5.0 (<0.127)
Potassium hydroxide	25	boiling	12 (0.305)
Potassium hydroxide	50	boiling	108 (2.74)
Potassium hydroxide	50 to anhydrous	465-710 (241-377)	40-60 (1.02-1.52)
Potassium iodide	saturated	room	nil
Potassium permanganate	saturated	room	nil
Potassium perchlorate (Ti specimen cathodic)	20	room	0.12 (0.003)
Potassium perchlorate, + $NaClO_4$, 600-900 g/l KCL, 0-500 g/l NaCl, 0-250 g/l $NaClO_3$, 6-24 g/l	0-30	122 (50)	0.1 (0.003)
Potassium sulfate	10	room	nil
Potassium thiosulfate	1	–	nil
Propionic acid	vapor	374 (190)	rapid
Pyrogaltic acid	355 g/l	room	nil
Salicylic acid sodium salt	saturated	room	nil
Seawater	–	76 (24)	nil
Seawater, 4½-year test	–	–	nil
Sebacic acid	–	464 (240)	0.3 (0.008)
Silver nitrate	50	room	nil
Sodium	100	to 1100 (593)	good
Sodium acetate	saturated	room	nil
Sodium aluminate	25	boiling	3.6 (0.091)
Sodium bifluoride	saturated	room	rapid
Sodium bisulfate	saturated	room	nil
Sodium bisulfate	10	150 (66)	72 (1.83)
Sodium bisulfite	10	boiling	nil
Sodium bisulfite	25	boiling	nil
Sodium carbonate	25	boiling	nil
Sodium chlorate	saturated	room	nil
Sodium chlorate + NaCl 80-250 g/l + $Na_2Cr_2O_2$ 14 g/l carbon 0.3-0.9 g/l	0-721 g/l	104 (40)	0.1 (0.003)
Sodium chloride	saturated	room	nil
Sodium chloride pH 1.5	23	boiling	nil*
Sodium chloride pH 1.2	23	boiling	28 (0.711)*
Sodium chloride, titanium in contact with teflon	23	boiling	Corrosion in crevice
Sodium chloride, pH 1.2 some dissolved chlorine	23	boiling	nil*
Sodium citrate	saturated	room	nil
Sodium cyanide	saturated	room	nil
Sodium dichromate	saturated	room	nil
Sodium fluoride	saturated	room	0.3 (0.008)
Sodium hydrosulfide + unknown amounts of sodium sulfide and polysulfides	5-12	230 (110)	<0.1 (<0.003)
Sodium hydroxide	5-10	70 (21)	0.04 (0.001)
Sodium hydroxide	10	boiling	0.84 (0.021)
Sodium hydroxide	28	room	0.1 (0.003)
Sodium hydroxide	40	176 (80)	5.0 (0.127)
Sodium hydroxide	50	135 (57)	0.5 (0.0127)
Sodium hydroxide	73	265 (129)	7.0 (0.178)
Sodium hydroxide	50-73	370 (188)	>43 (>1.09)
Sodium hypochlorite	6	room	nil
Sodium hypochlorite + 12-15% NaCl + 1% NaOH + 1-2% sodium carbonate	1.5-4	150-200 (66-93)	1.2 (0.030)
Sodium nitrate	saturated	room	nil
Sodium nitrite	saturated	room	nil
Sodium perchlorate	900 g/l	122 (50)	0.1 (0.003)
Sodium phosphate	saturated	room	nil
Sodium silicate	25	boiling	nil
Sodium sulfate	10-20	boiling	nil
Sodium sulfate	saturated	room	nil
Sodium sulfide	10	boiling	1.08 (0.027)
Sodium sulfide	saturated	room	nil
Sodium sulfite	saturated	boiling	nil
Sodium thiosulfate	25	boiling	nil
Sodium thiosulfate + 20% acetic acid	20	room	nil
Soils, corrosive	–	ambient	nil
Stannic chloride	5	212 (100)	0.12 (0.003)
Stannic chloride	24	boiling	1.76 (0.045)
Stannic chloride, molten	100	150 (66)	nil
Stannic cloride	saturated	room	nil
Steam + air	–	180 (82)	0.01 (0.000)
Steam + 7.65% hydrogen sulfide + 0.17% mercaptans	–	200-230 (93-110)	nil
Stearic acid, molten	100	356 (180)	0.1 (0.003)
Succinic acid	100	365 (185)	nil
Succinic acid	saturated	room	nil
Sulfanilic acid	saturated	room	nil
Sulfamic acid	3.75 g/l	boiling	nil
Sulfamic acid	7.5 g/l	boiling	108 (2.74)
Sulfamic acid + .375 g/l $FeCl_3$	7.5 g/l	boiling	1.2 (0.030)
Sulfur, molten	100	464 (240)	nil
Sulfur monochloride	major	395 (202)	>43 (>1.09)
Sulfur dioxide, water saturated	near 100	room	0.1 (0.003)
Sulfur dioxide gas + small amount SO_3 and approx. 3% O_2	18	600 (316)	0.2 (0.006)
Sulfuric acid, aerated with air	1	140 (60)	0.3 (0.008)
Sulfuric acid, aerated with air	3	140 (60)	0.5 (0.013)
Sulfuric acid, aerated with air	5	140 (60)	190 (4.83)
Sulfuric acid, aerated with air	10	95 (35)	50 (1.27)
Sulfuric acid, aerated with air	40	95 (35)	340 (8.64)
Sulfuric acid, aerated with air	75	95 (35)	42 (1.07)
Sulfuric acid, aerated with air	75	room	427 (10.8)
Sulfuric acid, aerated with air	75	boiling	6082 (154.5)
Sulfuric acid, aerated with air	1	212 (100)	0.2 (0.005)
Sulfuric acid, aerated with air	3	212 (100)	920 (23.4)
Sulfuric acid, aerated with air	5	212 (100)	810 (20.6)
Sulfuric acid, aerated with air	80	room	316 (8.03)
Sulfuric acid, aerated with air	80	boiling	7460 (189.5)
Sulfuric acid, aerated with air	concentrated	room	62 (1.57)
Sulfuric acid, aerated with air	concentrated	boiling	212 (5.38)
Sulfuric acid, aerated with nitrogen	1	212 (100)	282 (7.16)
Sulfuric acid, aerated with nitrogen	3	212 (100)	830 (21.1)
Sulfuric acid, aerated with nitrogen	5	212 (100)	1060 (26.9)
Sulfuric acid	1	boiling	700 (17.8)
Sulfuric acid	5	boiling	1000 (25.4)
Sulfuric acid, + 0.25% $CuSO_4$	5	200 (93)	nil
+ 0.25% $CuSO_4$	30	100 (38)	2.4 (0.061)
+ 0.25% $CuSO_4$	30	200 (93)	3.48 (0.088)
+ 0.5% $CuSO_4$	30	100 (38)	2.64 (0.067)
+ 0.5% $CuSO_4$	30	200 (93)	32.4 (0.823)
+ 1.0% $CuSO_4$	30	100 (38)	0.78 (0.020)

(continued)

TABLE 5.26: TITANIUM AND TITANIUM ALLOYS–TIMET (continued)

MEDIA	C	T	R
Sulfuric acid, aerated + 1.0% $CuSO_4$	30	200 (93)	34.8 (0.884)
+ 0.5% CrO_3	5	200 (93)	nil
+ 0.5% CrO_3	30	200 (93)	nil
+ 1.0% $CuSO_4$	30	boiling	65 (1.65)
Sulfuric acid vapors	96	100 (38)	nil
Sulfuric acid vapors	96	150 (66)	nil
Sulfuric acid vapors	96	200-300 (93-149)	0.4-0.5 (0.010-0.013)
Sulfuric acid, + 10% HNO_3	90	room	18 (0.457)
+ 30% HNO_3	70	room	25 (0.635)
+ 50% HNO_3	50	room	25 (0.635)
+ 70% HNO_3	30	room	4.0 (0.102)
+ 90% HNO_3	10	room	nil
+ 90% HNO_3	10	140 (60)	0.45 (0.011)
+ 50% HNO_3	50	140 (60)	15.7 (0.399)
+ 20% HNO_3	80	140 (60)	62.5 (1.59)
Sulfuric acid saturated with chlorine	45	75 (24)	0.13 (0.003)
Sulfuric acid saturated with chlorine	62	60 (16)	0.07 (0.002)
Sulfuric acid saturated with chlorine	5	374 (190)	<1 (<0.025)
Sulfuric acid saturated with chlorine	82	122 (50)	>47 (>1.19)
Sulfuric acid + 4.79 g/l Ti^{+4}	40	212 (100)	passive
Sulfurous acid	6	room	nil
Tannic acid	25	212 (100)	nil
Tartaric acid	10-50	212 (100)	<5 (<0.127)
Tartaric acid	10	140 (60)	0.10 (0.003)
Tartaric acid	25	140 (60)	0.10 (0.003)
Tartaric acid	50	140 (60)	0.02 (0.001)
Tartaric acid	10	212 (100)	0.13 (0.003)
Tartaric acid	25	212 (100)	nil
Tartaric acid	50	212 (100)	0.2-0.49 (0.005-0.0121)
Terepthalic acid	77	425 (218)	nil
Tetrachloroethane, liquid and vapor	100	boiling	0.02 (0.001)
Tetrachloroethylene + H_2O	–	boiling	5 (0.127)
Tetrachloroethylene	100	boiling	nil
Tetrachloroethylene, liquid and vapor stabilized with ethyl alcohol	100	boiling	0.02 (0.001)
Tin, molten	100	930 (499)	resistant
Titanium tetrachloride	99.8	572 (300)	62 (1.57)
Titanium tetrachloride	concentrated	room	nil
Trichloroacetic acid	100	boiling	573 (14.6)
Trichloroethylene	99	boiling	0.1-5 (0.003-0.127)
Uranium chloride	saturated	70-194 (21-90)	nil
Uranyl ammonium phosphate filtrate + 25% chloride + 0.5% fluoride, 1.4% ammonia + 2.4% uranium	20.9	165	<0.1 (<0.003)
Uranyl nitrate containing 25.3 g/l Fe^{+3}, 6.9 g/l Cr^{+3}, 2.8 g/l Ni^{+2}, 5.9 molar NO_3, 4.0 molar H^+, 1.0 molar Cl	120 g/l U	boiling	0.012 (0.000)
Uranyl sulfate + 3.1 molar Li_2SO_4, + 100-200 ppmO_2	3.1 molar	482 (250)	0-0.78 (<0.020)
Uranyl sulfate + 3.6 molar Li_2SO_4, 50 psi O_2	3.8 molar	662 (350)	0.22-17 (0.006-0.432)
Urea-ammonia reaction mass	–	elevated temp. and pressure	no attack
Urea + 32% ammonia, + 20.5% H_2O, 19% CO_2	28	360 (182)	3.1 (0.079)
Water, degassed	–	600 (316)	nil
Water, river, saturated with Cl_2	–	200 (93)	nil
Water, synthetic sea	–	95 (35)	nil
X-ray developer solution	–	room	nil
Zinc, subjected to zinc ammonium chloride preflux	100	molten	withstood several thousand contact cycles
Zinc chloride	20	220 (104)	nil*
Zinc chloride	50	302 (150)	nil*
Zinc chloride	75	392 (200)	24 (0.610)*
Zinc chloride	80	392 (200)	8000 (203.2)*
Zinc sulfate	saturated	room	nil

* May corrode in crevices

** TiCode-12 (Ti-Pd) immune

Corrosion Rate Data TiPd

C = Concentration %
T = Temperature °F (°C)
R = Corrosion rate, mpy (mm/y)

MEDIA	C	T	R
Aluminum Chloride	10	212 (100)	<1 (<0.025)
	25	212 (100)	1 (0.025)
Calcium Chloride	62	310 (154)	nil
	73	350 (177)	nil
Chlorine, wet	–	room	slight gain
Chlorine, H_2O Sat'd.	–	room	<1 (<0.025)
Chromic acid	10	boiling	slight gain
Ferric chloride	30	boiling	slight gain
Formic acid	50	boiling	3 (0.076)
Hydrochloric acid, H_2 saturated	1-15	room	<1 (<0.025)
	20	room	4 (0.102)
	25	room	11 (0.279)
	1	158 (70)	3 (0.076)
	5	158 (70)	3 (0.076)
	10	158 (70)	7 (0.178)
	15	158 (70)	13 (0.330)
	20	158 (70)	61 (1.55)
	25	158 (70)	169 (4.29)
	3	374 (190)	1 (0.025)
	5	374 (190)	4 (0.102)
	10	374 (190)	350 (8.89)
	15	374 (190)	1620 (41.1)
Hydrochloric acid, Air saturated	1 and 5	158 (70)	<1 (<0.025)
	10	158 (70)	2 (0.050)
	15	158 (70)	6 (0.152)
	20	158 (70)	26 (0.660)
	25	158 (70)	78 (1.98)
Hydrochloric acid, O_2 saturated	3	374 (190)	5 (0.127)
	5	374 (190)	5 (0.127)
	10	374 (190)	368 (9.34)
Hydrochloric acid, Cl_2 saturated	3 and 5	374 (190)	<1 (<0.025)
	10	374 (190)	1140 (29.0)
Hydrochloric acid	5	boiling	7 (0.178)
	10	boiling	32 (0.813)
	15	boiling	267 (6.78)
	20	boiling	770 (19.6)
Hydrochloric acid + 5 g/l $FeCl_3$	10	boiling	11 (0.279)
+ 16 g/l $FeCl_3$	10	boiling	3 (0.076)
+ 16 g/l $FeCl_3$	20	boiling	113 (2.87)
+ 16 g/l $CuCl_2$	10	boiling	5 (0.127)
+ 16 g/l $CuCl_2$	20	boiling	146 (3.71)
Nitric acid	30	374 (190)	94 (2.39)
	30	482 (250)	slight gain
	65	boiling	26 (0.66)
	65	374 (190)	slight gain
	65	482 (250)	slight gain

(continued)

TABLE 5.26: TITANIUM AND TITANIUM ALLOYS—TIMET (continued)

MEDIA	C	T	R
Nitric acid, Unbleached	60	boiling	15.5 (0.394)
Phosphoric acid	10	boiling	5.8 (0.147)
Sodium chloride Brine	–	200 (93)	0.0005 (0.000)
Sodium chloride	10	374 (190)	<1 (<0.025)
Sulfuric acid, N_2 saturated	5	room	<1 (<0.025)
	10	room	1 (0.025)
	40	room	9 (0.229)
	60	room	34 (0.864)
	80	room	645 (16.4)
	95	room	68 (1.73)
Sulfuric acid, N_2 saturated	5	158 (70)	6 (0.152)
	10	158 (70)	10 (0.254)
	40	158 (70)	87 (2.21)
	60	158 (70)	184 (4.67)
	80	158 (70)	226 (5.74)
	96	158 (70)	62 (1.57)
	1	374 (190)	5 (0.127)
	5	374 (190)	5 (0.127)
	10	374 (190)	59 (1.50)
	20	374 (190)	355 (9.02)
Sulfuric acid, O_2 saturated	1	374 (190)	5 (0.127)
	5	374 (190)	3 (0.076)
	10	374 (190)	5 (0.127)
	20	374 (190)	59 (1.50)
	30	374 (190)	2440 (62.0)
Sulfuric acid, Cl_2 saturated	1 and 5	374 (190)	<1 (<0.025)
	10	374 ((190)	2 (0.051)
	20	374 (190)	15 (0.381)
	30	374 (190)	3060 (77.7)
Sulfuric acid, Air saturated	5	158 (70)	3 (0.076)
	10	158 (70)	4 (0.102)
	40	158 (70)	37 (0.940)
	60	158 (70)	392 (9.96)
	80	158 (70)	447 (11.4)
	96	158 (70)	83 (2.11)
Sulfuric acid	5	boiling	20 (0.0511)
	10	boiling	59 (1.50)
	20	boiling	207 (5.26)
Sulfuric acid + 0.5 g/l $Fe_2(SO_4)_3$	10	boiling	7 (0.178)
+ 16 g/l $Fe_2(SO_4)_3$	10	boiling	<1 (<0.025)
+ 16 g/l $Fe_2(SO_4)_3$	20	boiling	6 (0.152)
+ 40 g/l $Fe_2(SO_4)_3$	40	boiling	87 (2.21)
Sulfuric acid + 15% $CuSO_4$	15	boiling	25 (0.635)
Sulfuric acid + 10% $FeSO_4$ 11% Solids, and 170 g/l TiO_2	23	to 212 (100)	84 (2.13)

MEDIA	C	T	R
Sulfuric acid + 0.01% $CuSO_4$	30	boiling	1090 (27.7)
+ 0.05% $CuSO_4$	30	boiling	1310 (33.3)
+ 0.50% $CuSO_4$	30	boiling	79 (2.01)
+ 1.0% $CuSO_4$	30	boiling	69 (1.75)

Corrosion Rate Data for TiCode-12

C = Concentration %
T = Temperature °F (°C)
R = Corrosion rate, mpy (mm/y)

MEDIA	C	T	R	Remarks
Ammonium hydroxide	30	boiling	nil	no hydrogen pick-up 500 hours
Aluminum Chloride	10	boiling	nil	
Aqua regia	(1 part HNO_3 - 3 parts HCl)	boiling	24 (0.610)	
Ammonium Chloride	10	boiling	nil	500 hours
Chlorine cell off-gas	–	190 (88)	.035 (0.001)	3700 hours
Citric acid	50	boiling	0.5 (0.013)	
Formic acid	45	boiling	nil	natural aeration
Formic acid	88	boiling	nil	natural aeration
Formic acid	90	boiling	20.5 (0.521)	natural aeration
Hydrochloric acid	5	120 (49)	0.1 (0.003)	
Hydrochloric acid	5	150 (66)	0.2 (0.005)	
Hydrochloric acid	5	200 (93)	1176 (29.9)	
Hydrochloric acid	2	200 (93)	1.2 (0.031)	
HCl + 2g/l $FeCl_3$	3.32	196 (91)	1.0 (0.025)	
HCl + 2g/l $FeCl_3$	4.15	196 (91)	2.3 (0.058)	
Sulfuric acid	0.54	boiling	0.6 (0.015)	
Sulfuric acid	1.08	boiling	35.4 (0.899)	
Sulfuric acid	1.62	boiling	578 (14.7)	
Vapor above boiling HNO_3	–	–	0.8 (0.020)	
$MgCl_2$	saturated	boiling	nil	500 hours
Sodium Sulfate	10	boiling	nil	acidified to pH 1
5% NaOCl + 2% NaCl + 4% NaOH	–	boiling	2.4 (0.061)	500 hours
NaCl	saturated	600 (316)	nil	500 hours

Titanium Alloys Used in Industry

Timet Designation	ASTM Grade	Ultimate Tensile Strength (min.)	Yield Strength (min.) 0.2% Offset	Nominal Composition
Ti-35A	1	35,000 psi	25,000 psi	C.P. Titanium*
Ti-50A	2	50,000 psi	40,000 psi	C.P. Titanium*
Ti-75A	4	80,000 psi	70,000 psi	C.P. Titanium*
Ti-6Al-4V	5	130,000 psi	120,000 psi	6% Al, 4% V
Ti-Pd	7	50,000 psi	40,000 psi	0.15% Pd
TiCode-12®	12	70,000 psi	50,000 psi	0.3% Mo, .8% Ni

*Commercially Pure (Unalloyed) Titanium

TABLE 5.27: ZINC ALLOY—NEW JERSEY ZINC

The following are the ASTM Specification B 86 requirements for Zamak 3 die castings:

Ingredient	Alloy AG 40 A (Zamak 3)* % by Weight
Aluminum	3.5 - 4.3
Copper	.25 Max.
Magnesium**	.020 - .05
Lead	.005 Max.
Cadmium	.004 Max.
Tin	.003 Max.
Iron	.100 Max.
Zinc	Remainder

*Zinc alloy die castings may contain nickel, chromium, silicon, and manganese in amounts of .02, .02, .035, and .5% respectively. No harmful effects have ever been noted due to the presence of these elements in these concentrations and therefore, analyses are not required for these elements.

**Magnesium may be as low as .015% provided that the lead, cadmium, and tin do not exceed .003, .003, and .001% respectively.

THE CORROSION RESISTANCE OF ZINC ALLOY DIE CASTINGS

Zamak alloys have the strong resistance to atmospheric corrosion and weathering that has been associated for centuries with rolled zinc and zinc-coated iron. This corrosion resistance was confirmed by 10 years of test data compiled by NJZ's research department and the appearance of die cast test bars after 20 years of exposure at the several ASTM exposure sites.

Corrosion of Zinc, Galvanized Iron, and Zamak 3
(Penetration in Inches per Year)

	Palmerton, Pa.	New York City
Rolled Zinc	.000064	.00028
Galvanized Iron	.000052	.00027
Zamak 3	.000078	.00022

The above data establish that zinc weathers slowly and uniformly, with the corrosion rate influenced by the degree of industrial contamination and the frequency of fogs and mists.

HYDROCARBON FUELS AND LUBRICANTS In the absence of moisture, zinc alloy die castings are strongly resistant to attack by acid-free hydrocarbons. In the presence of water some corrosion takes place which, while not seriously detrimental to the strength of the casting may, in the case of fuel handling devices, create some binding or clogging effect.

It may be commented, in general, that no lubricants of animal fat origin should ever be used with zinc alloy die cast parts. This restriction applies also to those proprietary oils which contain varying quantities of animal oils in the formula.

INK Printing inks appear to have little or no effect on zinc. The use of zinc engravings and lithographic plates in the printing industry gives ample evidence on this point.

(continued)

TABLE 5.27: ZINC ALLOY—NEW JERSEY ZINC (continued)

ALCOHOL While pure ethyl and methyl alcohol are considerably less corrosive to zinc than water, mixtures of alcohol and water are more corrosive than water alone. This fact, combined with the probable presence of iron rust, makes undesirable the use of zinc alloy die castings in automobile cooling systems except in the presence of a suitable inhibitor.

Alcohol-water mixtures represented by beverages are a special case, as the use of zinc alloy die castings in direct contact with potable alcoholic mixtures is not recommended.

GLYCERINE Pure glycerine produces a smooth, light etch on the surface of the Zamak alloys. There is evidence, however, that glycerine-operated door checks and similar devices can be satisfactorily made of zinc alloy die castings.

Glycerine-alcohol mixtures produce only a light surface etching on the Zamak alloys when a pure grade of glycerine is used. The presence of water or the use of a low grade glycerine will result in pitting.

INSECTICIDES In dry form insecticides have relatively little action on zinc. In water solution, those materials which contain copper, arsenic or lead tend to accelerate the corrosion of zinc by electro-chemical replacement. It is not recommended that zinc alloy die castings be used in insecticide spray devices.

SOAPS AND CREAMS Ordinary good grade laundry soaps have a definite inhibiting effect on the corrosion of zinc in hot water. This is particularly well illustrated in the practically perfect surface found on washing machine drain cocks after years of service.

In recent years soaps have largely been replaced by detergents, some of which are corrosive to zinc die castings.

TRICHLORETHYLENE - CARBON TETRACHLORIDE In short periods of exposure necessary for degreasing prior to electroplating, neither trichlorethylene nor carbon tetrachloride will have any visible effect on zinc alloy die castings. Dry carbon tetrachloride has no visible effect on continued exposure of much longer duration. Dry trichlorethylene over a period of four months shows a very slight etching action.

ILLUMINATING GAS Dry illuminating gas has no apparent effect on the Zamak alloys.

FOODS AND BEVERAGES It is the considered opinion of medical authorities who have studied the subject that zinc salts in moderation are not toxic. Where moisture and acidity are encountered, zinc salts may accumulate. In sufficient quantity these salts are irritating and may cause nausea. Such applications of zinc alloys should be scrupulously avoided.

TABLE 5.28: ZINC COATING–ALCOA

Corrosion Tests

12-YEAR INSPECTION RESULTS OF ATMOSPHERIC EXPOSURE TESTS ON METALLIZED ZINC COATED CARBON STEEL PANELS

PANEL TYPE		1	2	3	4
TYPE OF PANEL PREPARATION *		1	1	1	1
ZINC COATING THICKNESS, inches		0.003	0.003	0.003	0.006
TYPE OF SEAL COAT **		None	WP+AV—1	CR—2	None
TEST SITE	ENVIRONMENT				
BRAZOS RIVER, TEXAS	SALT-AIR	Base metal not attacked. Sprayed metal intact, but shows a general, light gray stain and very thin white rust on front of panels. Back is similar, with thick white rust along bottom edge.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat shows many pinpoint blisters on front. Seal coat on back unaffected. Bottom edge of panels shows thick white rust.	Base metal not attacked. Sprayed metal intact, but shows thin white rust and light gray stains on front. Back of panels in similar condition, with bottom edge showing thick white rust. CR seal coat dissipated on two panels.	Same as Type 1.
COLUMBUS, OHIO	URBAN	Base metal shows red rust on 3% of the front of the panels. Sprayed metal shows red rust stain on 60% of the remainder of the front. Back of panels shows a general very thin white rust.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat unaffected.	Base metal shows red rust staining. Sprayed metal shows red rust staining on 60% of the front surface. CR seal coat dissipated on front. Seal coat on back unaffected.	Base metal not attacked. Sprayed metal intact, but shows very thin white rust on front and back of panels.
EAST CHICAGO, INDIANA	INDUSTRIAL	Base metal 10% exposed on front of panels and 1% on back, showing red rust in these areas. Sprayed metal shows red rust stain on 25% of the front of the panels, and 5% red rust staining on back.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat on front of panels shows a general light gray deposit stain. Back of panels shows a thin deposit stain.	Base metal not attacked. Sprayed metal intact. CR seal coat on front of panels completely dissipated, showing a general light gray deposit stain. Seal coat on back unaffected.	Base metal not attacked. Sprayed metal on front of panels shows a general light deposit stain. Back of panels show a general very thin white rust.
KURE BEACH, NORTH CAROLINA (80-ft lot)	SEVERE MARINE	Base metal exposed due to mechanical damage. Sprayed metal shows red rust over 65% of the front of the panel. Back of panels shows red rust along bottom edge. Edges of panels show thick white rust.	Base metal not attacked. Sprayed metal shows many pinpoint nodes and some medium sized nodes of white rust on front of panels. Vinyl seal coat 75% dissipated on front. Sprayed metal on back shows many pinpoint nodes of white rust. Vinyl seal coat 50% dissipated on back.	Base metal shows red rust. Sprayed metal on front of panels shows red rust on 50% of the surface. CR seal coat is dissipated on panel fronts. Back of panels show a general, thin white rust.	Base metal not attacked. Sprayed metal shows general white rust on front of panels, and general, thin white rust on the back. Edges of panels show thick white rust and a few pinpoints of red rust.
KURE BEACH, NORTH CAROLINA (800-ft lot)	SALT-AIR	Base metal not attacked. Sprayed metal on front of panels shows very thin white rust, which is present as horizontal stripes. Back of panels shows a very thin white rust.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat unaffected.	Base metal not attacked. Sprayed metal on front of panels shows a very thin white rust. Sprayed metal intact on back. CR seal coat is completely dissipated on both front and back of panels.	Base metal not attacked. Sprayed metal shows traces of very thin white rust on front and back of panels.
NEW YORK CITY AREA	INDUSTRIAL	Base metal shows red rust on front of panels. Sprayed metal on front is completely dissipated. On back of panels sprayed metal is 15% dissipated and the underlying base metal shows red rust. Reminder of sprayed metal on backs show white rust.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat is unaffected.	Base metal on front of panels shows red rust. Sprayed metal on front is stained with red rust. CR seal coat is completely dissipated on front. Sprayed metal intact on back. Seal coat on back unaffected.	Base metal not attacked. Sprayed metal on front of panels shows a thin deposit stain. Sprayed metal on back shows a very thin white rust.
POINT REYES, CALIFORNIA	SALT-AIR	Base metal not attacked. Sprayed metal on front of panels shows large light blue-green stains. Sprayed metal on back of panels shows general dark gray stains.	Base metal not affected. Sprayed metal shows white rust nodes and green stain on 15-20% of the front of panels. Vinyl seal coat dissipated on same 15-20% of panel fronts. Sprayed metal shows white rust nodes on 3-8% of back of panels with vinyl seal coat dissipated in these areas. Edges show green stain and white rust nodes.	Base metal not attacked. Sprayed metal on front of panels shows general thin white rust with green stains. Sprayed metal on back shows blotchy white rust. CR seal coat completely dissipated on both sides. Edges show thick white rust.	Same as Type 1.

(continued)

TABLE 5.28: ZINC COATING—ALCOA (continued)

12-YEAR INSPECTION RESULTS OF ATMOSPHERIC EXPOSURE TESTS ON METALLIZED ZINC COATED CARBON STEEL PANELS

PANEL TYPE		5	6	7	8
TYPE OF PANEL PREPARATION *		1	1	1	1
ZINC COATING THICKNESS, inches		0.006	0.006	0.009	0.009
TYPE OF SEAL COAT **		WP+AV—1	CR—2	None	WP+AV—1
TEST SITE	ENVIRONMENT				
BRAZOS RIVER, TEXAS	SALT-AIR	Base metal not attacked. Sprayed metal intact. Vinyl seal coat shows general, thin, light gray stain on front, with gray stain over 5-15% at the back surface of panels. Bottom edges show thick white rust.	Same as Type 3.	Same as Type 1.	Same as Type 5.
COLUMBUS, OHIO	URBAN	Same as Type 2.	Base metal not attacked. Sprayed metal intact. CR seal coat dissipated on front of panels showing very thin white rust. Seal coat on back of panels unaffected.	Same as Type 4.	Base metal not attacked. Sprayed metal intact. Vinyl seal coat on front of panels shows a very light deposit stain. Seal coat on back of panels unaffected.
EAST CHICAGO, INDIANA	INDUSTRIAL	Same as Type 2.	Same as Type 3.	Same as Type 4.	Same as Type 2.
KURE BEACH, NORTH CAROLINA (80-ft lot)	SEVERE MARINE	Panels Missing.	Base metal not attacked. Sprayed metal on front of panels shows general white rust. Back of panels show a general, thin white rust. Edges of panels show thick white rust.	Base metal not attacked. Sprayed metal on front of panels shows general thick white rust. Back of panels shows general thin white rust. Edges of panels show thick white rust.	Base metal not attacked. Sprayed metal on front of panels shows general white rust with many small and medium sized nodes. Vinyl seal coat 90% dissipated on front. Sprayed metal on back shows general thin white rust and many small nodes. Vinyl sealer on back is 50% dissipated. Edges of panels show thick white rust.
KURE BEACH, NORTH CAROLINA (800-ft lot)	SALT-AIR	Same as Type 2.	Base metal not attacked. Sprayed metal intact on front of panels. Sprayed metal on back shows general very thin white rust. Edges show white rust.	Base metal not attacked. Sprayed metal intact.	Same as Type 2.
NEW YORK CITY AREA	INDUSTRIAL	Base metal not attacked. Sprayed metal intact. Vinyl seal coat on front of panels shows a thin deposit stain. Vinyl seal coat on backs of panels unaffected.	Base metal not attacked. Sprayed metal on front of panels shows a very thin deposit stain. CR seal coat is completely dissipated on front of panels. CR seal coat on back unaffected.	Same as Type 4.	Same as Type 5.
POINT REYES, CALIFORNIA	SALT-AIR	Base metal not attacked. Sprayed metal shows white rust nodes and green stain over 15-20% of the front of the panels. Vinyl seal coat on front dissipated in these same areas. Sprayed metal and vinyl seal coat on back in similar condition.	Same as Type 3.	Same as Type 1.	Base metal not attacked. Sprayed metal shows white rust nodes and green stain over 10-15% of the front of the panels. Vinyl seal coat dissipated in these same areas on front. Sprayed metal on back shows white rust nodes and green stain on 5-10% of the panel surface. Vinyl seal coat is dissipated in these areas. Edges show some of the same corrosion product.

(continued)

TABLE 5.28: ZINC COATING—ALCOA (continued)

12-YEAR INSPECTION RESULTS OF ATMOSPHERIC EXPOSURE TESTS ON METALLIZED ZINC COATED CARBON STEEL PANELS

PANEL TYPE		9	10	11	12	13
TYPE OF PANEL PREPARATION *		1	2	2	2	2
ZINC COATING THICKNESS, inches		0.009	0.012	0.012	0.012	0.015
TYPE OF SEAL COAT **		CR—2	None	WP+AV—1	CR—2	None
TEST SITE	ENVIRONMENT					
BRAZOS RIVER, TEXAS	SALT-AIR	Same as Type 3.	Same as Type 1.	Same as Type 5.	Same as Type 3.	Same as Type 1.
COLUMBUS, OHIO	URBAN	Same as Type 6.	Same as Type 1.	Not Tested.	Not Tested.	Not Tested.
EAST CHICAGO, INDIANA	INDUSTRIAL	Same as Type 3.	Same as Type 4.	Not Tested.	Not Tested.	Not Tested.
KURE BEACH, NORTH CAROLINA (80-ft lot)	SEVERE MARINE	Same as Type 6.	Same as Type 4.	Base metal not attacked. Sprayed metal on front of panels shows general white rust. Vinyl seal coat 90% dissipated on front. Sprayed metal on back shows thick white rust on half of the surface. Vinyl seal coat is 50% dissipated on back. Edges of panels show thick white rust.	Same as Type 6.	Same as Type 4.
KURE BEACH, NORTH CAROLINA (800-ft lot)	SALT-AIR	Same as Type 6.	Same as Type 7.	Same as Type 2.	Same as Type 6.	Same as Type 7.
NEW YORK CITY AREA	INDUSTRIAL	Same as Type 6.	Same as Type 4.	Not Tested.	Not Tested.	Not Tested.
POINT REYES, CALIFORNIA	SALT-AIR	Same as Type 3.	Same as Type 1.	Same as Type 8.	Same as Type 3.	Same as Type 1.

* *Types of base metal preparation*
1. Coarse silica sand
2. Coarse silica and steel flash

** *Types of seal coat*
WP — Wash primer
AV — Aluminum vinyl
CR — Chlorinated rubber
–1 — One coat of specified seal coat
–2 — Two coats of specified seal coat

(continued)

TABLE 5.28: ZINC COATING—ALCOA (continued)

12-YEAR INSPECTION RESULTS OF SEA WATER EXPOSURE TESTS ON METALLIZED ZINC COATED CARBON STEEL PANELS

PANEL TYPE		1	2	3	4
BASE METAL PREPARATION *		2	2	2	2
ZINC COATING THICKNESS, inches		0.003	0.003	0.006	0.006
TYPE OF SEAL COAT **		CR—1	CR—2	None	CR—1
TEST SITE	ENVIRONMENT				
FREEPORT, TEXAS	TOTAL IMMERSION	Base metal shows deep corrosion pits over 20% of the panel surface, front and back. Sprayed metal shows general red and white rust over the entire surface. CR seal coat is completely dissipated.	Base metal shows deep corrosion pits over 4-6% of the panel surface, front and back. Sprayed metal shows general red and white rust over the entire surface. CR seal coat is completely dissipated.	Base metal shows deep corrosion pits over 1% of the panel surface, front and back. Sprayed metal shows thin white rust and large red rust stains, front and back.	Same as Type 2.
WRIGHTSVILLE BEACH, NORTH CAROLINA (below-low-tide)	TOTAL IMMERSION	Base metal shows deep corrosion pits and loss of steel at the edges. Sprayed metal shows red rust. CR seal coat completely dissipated.	Same as Type 1.	Base metal shows corrosion pits and loss of steel at the edges. Sprayed metal shows scattered red rust.	Same as Type 1.
WRIGHTSVILLE BEACH, NORTH CAROLINA (mean-tide)	ALTERNATE EXPOSURE TO ATMOSPHERE AND SEA WATER	Base metal shows deep corrosion pits and loss of steel at the edges. Sprayed metal shows red rust and rust stains. CR seal coat completely dissipated.	Same as Type 1.	Base metal shows deep corrosion pits and loss of steel at the edges. Sprayed metal shows red rust and rust stains.	Same as Type 1.

PANEL TYPE		5	6	7	8
BASE METAL PREPARATION *		2	2	2	2
ZINC COATING THICKNESS, inches		0.006	0.009	0.009	0.009
TYPE OF SEAL COAT **		CR—2	None	CR—1	CR—2
TEST SITE	ENVIRONMENT				
FREEPORT, TEXAS	TOTAL IMMERSION	Same as Type 2.	Base metal not attacked. Sprayed metal shows general white rust over 90% of the panel surface, front and back.	Same as Type 2.	Test panels Lost—1965
WRIGHTSVILLE BEACH, NORTH CAROLINA (below-low-tide)	TOTAL IMMERSION	Same as Type 1.	Base metal shows no loss of steel. Sprayed metal shows red rust staining over entire surface.	Base metal shows a few corrosion pits and some loss of steel at the edges. Sprayed metal shows rust stains. CR seal coat completely dissipated.	Base metal not attacked. Sprayed metal shows white rust over entire surface. CR seal coat completely dissipated.
WRIGHTSVILLE BEACH, NORTH CAROLINA (mean-tide)	ALTERNATE EXPOSURE TO ATMOSPHERE AND SEA WATER	Same as Type 1.	Base metal shows a small amount of corrosion. Sprayed metal shows red rust and rust stains.	Same as Type 1.	Base metal not attacked. Sprayed metal completely corroded showing white rust. CR seal coat completely dissipated.

(continued)

TABLE 5.28: ZINC COATING–ALCOA (continued)

12-YEAR INSPECTION RESULTS OF SEA WATER EXPOSURE TESTS ON METALLIZED ZINC COATED CARBON STEEL PANELS

PANEL TYPE		9	10	11	12	13
BASE METAL PREPARATION *		2	2	2	2	2
ZINC COATING THICKNESS, inches		0.012	0.012	0.012	0.015	0.018
TYPE OF SEAL COAT **		None	CR—1	CR—2	None	None
TEST SITE	ENVIRONMENT					
FREEPORT, TEXAS	TOTAL IMMERSION	Test panels Lost—1965	Test panels Lost—1965	Test panels Lost—1965	Test panels Lost—1965	Test panels Lost—1965
WRIGHTSVILLE BEACH, NORTH CAROLINA (below-low-tide)	TOTAL IMMERSION	Same as Type 8.	Same as Type 8.	Same as Type 8.	Same as Type 8.	Same as Type 8.
WRIGHTSVILLE BEACH, NORTH CAROLINA (mean-tide)	ALTERNATE EXPOSURE TO ATMOSPHERE AND SEA WATER	Base metal not attacked. Sprayed metal corroded showing thick white rust.	Same as Type 8.	Same as Type 8.	Same as Type 9.	Same as Type 9.

* *Type of base metal preparation*
2. Coarse silica sand and steel flash

** *Types of seal coat*
CR — Chlorinated rubber

–1 — One coat of specified seal coat
–2 — Two coats of specified seal coat

TABLE 5.29: ZIRCONIUM ALLOYS–TELEDYNE WAH CHANG ALBANY

Zirconium is used in a wide variety of industrial and chemical processing applications. This wide use is due to zirconium's excellent resistance to many chemical solutions, even at elevated temperatures and pressures. Zirconium is very resistant to corrosive attack in most organic and mineral acids, strong alkalis, and some molten salts. Because of zirconium's unique corrosion properties, it is an excellent material for use in chemical processes which require alternate contact with strong acids and alkalis. Zirconium alloys are not readily attacked by oxidizing media unless halides are present. It has excellent oxidation resistant properties to 400°C in air, steam, carbon dioxide, nitrogen and oxygen. Zirconium alloys have little need for anodic protection systems. Zirconium alloys have high resistance to localized forms of corrosion, pitting, crevice corrosion, and stress corrosion cracking. The combination of these factors make zirconium alloys suitable for use in a wide variety of corrosive environments.

Chemical Compositions of Zircadyne Alloys

Grade (ASTM Designation)	Zircadyne 702 (R60702)	Zircadyne 704 (R60704)	Zircadyne 705 (R60705)
Chemical Compositions, Percent			
Zr + Hf, min.	99.2	97.5	95.5
Hafnium, max.	4.5	4.5	4.5
Fe + Cr	0.20 max.	0.2-0.4	0.2 max.
Tin	—	1.0-2.0	—
Hydrogen, max.	0.005	0.005	0.005
Nitrogen, max.	0.025	0.025	0.025
Carbon, max.	0.05	0.05	0.05
Niobium	—	—	2.0-3.0
Oxygen, max.	0.16	0.18	0.18

Zirconium Corrosion Data

CORROSIVE MEDIA	CONCENTRATION %	TEMPERATURE °C	CORROSION RATE, mpy			REMARKS
			Zr 702	Zr 704	Zr 705	
Acetaldehyde	100	Boiling	<2	—	—	
Acetic Acid	5-99.5	35-Boiling	<1	—	<1	
Acetic Acid (anhydride)	99	Room-Boiling	<1	—	<1	
Acetic Acid (glacial)	99.7	Boiling	<5	—	—	
Aluminum Chlorate	30	100	<2	—	—	
Aluminum Chloride	5, 10, 25 25 40	35-100 Boiling 100	<1 <1 <2	— — —	— <1 —	
Aluminum Chloride (aerated)	5, 10	60	<2	—	—	
Aluminum Fluoride	20	Room	>50	—	—	pH = 3.2
Aluminum Potassium Sulfate	10	Boiling	nil	—	nil	pH = 3.2
Aluminum Sulfate	25 60	Boiling 100	nil <2	— —	nil —	
Ammonia (wet)	+ water	38	<5	—	—	
Ammonium Carbamate	—	193	<1	—	—	58.4% Urea, 16.8% Ammonia, 14.8% CO_2, 9.9% H_2O at 3,200-3,500 psi

(continued)

TABLE 5.29: ZIRCONIUM ALLOYS—TELEDYNE WAH CHANG ALBANY (continued)

CORROSIVE MEDIA	CONCENTRATION %	TEMPERATURE °C	CORROSION RATE, mpy Zr 702	Zr 704	Zr 705	REMARKS
Ammonium Chloride	1,10, saturated	35-100	<1	—	—	
Ammonium Hydroxide	28	Room-100	<1	—	—	
Ammonium Fluoride	20 20	28 98	>50 >50	— —	— —	pH = 8 pH = 8
Ammonium Oxalate	100	100	<2	—	—	
Ammonium Sulfate	5, 10	100	<5	—	—	
Aniline Hydrochloride	5, 20 5, 20	35-100 100	<1 <2	— —	— —	
Aqua Regia	3:1	Room	>50	—	—	3 parts HCl/1 part HNO_3
Barium Chloride	5, 20 25	35-100 Boiling	< 1 5-10	— —	— —	
Bromine	100-Liquid Vapor	20 20	<10 —	— —	20-50 >50	Pitting Pitting
Bromochloromethane	100	100	< 2	—	—	
Cadmium Chloride	100	Room	< 2	—	—	
Calcium Bromide	100	100	< 2	—	—	
Calcium Chloride	5, 10, 25 70 75 Mixture	35-100 Boiling Boiling 79	< 1 < 1 < 5 < 1	— — — —	— < 1 — —	 B.P. = 162°C 14% CaCl, 8% NaCl 0.2% $Ca(OH)_2$
Calcium Fluoride	Saturated Saturated	28 90	nil nil	— —	— —	pH = 5 pH = 5
Calcium Hypochlorite	2, 6, 20	100	< 5	—	—	
Carbonic Acid	Saturated	100	< 5	—	—	
Carbon Tetrachloride	0-100	Room-100	< 2	—	—	
Chlorine (water saturated)	—	Room 75	>50 >50	— —	— —	
Chlorine Gas (more than 0.13% H_2O)	100	94	>50	—	—	
Chlorine Gas (dry)	100	Room	< 5	—	—	
Chlorinated Water	—	100	< 2	—	—	
Chloroacetic Acid	100	Boiling	< 1	—	—	
Chromic Acid	10-50	Boiling	< 1	—	—	
Citric Acid	10-50 10, 25, 50 50	35-100 100 Boiling	< 1 < 1 < 5	— — —	— — —	
Chrome Plating Solution	—	66	>50	—	>50	M + T Chemicals CR-100
Cupric Chloride	5, 10, 20 20, 40, 50	35-100 Boiling	>50 >50	>50 >50	>50 >50	
Cupric Cyanide	Saturated	Room	>50	—	—	
Cupric Nitrate	40	Boiling	W.G.	—	W.G.	B.P. = 115°C
Dichloroacetic Acid	100	Boiling	<20	—	—	
Ethylene Dichloride	100	Boiling	< 5	—	—	

(continued)

TABLE 5.29: ZIRCONIUM ALLOYS—TELEDYNE WAH CHANG ALBANY (continued)

CORROSIVE MEDIA	CONCENTRATION %	TEMPERATURE °C	CORROSION RATE, mpy			REMARKS
			Zr 702	Zr 704	Zr 705	
Ferric Chloride	0-50 0-50	Room-100 Boiling	>50 >50	>50 >50	>50 >50	
Ferric Sulfate	10	0-100	< 2	—	—	
Formaldehyde	6-37 0-70	Boiling Room-100	< 1 < 2	— —	< 1 —	
Fluoboric Acid	5-20	Elevated	>50	—	—	
Fluosilicic Acid	10	Room	>50	—	—	
Formic Acid	10-90	35-Boiling	< 5	—	—	
Formic Acid (aerated)	10-90	Room-100	< 5	—	—	
Hydrazine	Mixture Mixture	109 130	< 1 nil	— —	— —	2% Hydrazine + saturated NaCl - 6% NaOH 2% Hydrazine + saturated NaCl - 6% NaOH
Hydrobromic Acid	48 Mixture	Boiling Boiling	< 5 < 1	— —	< 5 <1	B.P. = 125°C (shallow pits) 24% HBr + 50% Acetic Acid (glacial)
Hydrochloric Acid	2 5 10 20 32 32	225 Room 35 35 30 82	< 1 < 1 < 1 < 1 < 1 < 1	— — — — — —	< 1 — — — — —	
20% HCl + Cl_2 gas	—	58	5-10*	—	—	*Pitting
37% HCl - Cl_2 gas	—	58	< 5	—	—	
10% HCl + 100 ppm $FeCl_3$	—	30	< 1	< 2	< 1	SCC observed
10% HCl + 100 ppm $FeCl_3$	—	105	5-10*	—	—	*Pitting Rate
20% HCl + 100 ppm $FeCl_3$	—	105	< 5	—	—	
37% HCl + 100 ppm $FeCl_3$	—	53	< 5	—	—	SCC Observed
Hydrochloric Acid	Mixture Mixture	Room Room	Dissolved Dissolved	— —	— —	20% HCl + 20% HNO_3 10% HCl + 10% HNO_3
Hydrofluoric Acid	0-100	Room	>50	—	—	
Hydrogen Peroxide	50	100	< 2	—	—	
Hydroxyacetic Acid	—	40	< 5	—	—	
Lactic Acid	10-100 10-85	148 35-Boiling	< 1 < 1	— —	— —	
Magnesium Chloride	5-40 47	Room-100 Boiling	< 2 nil	— —	— nil	
Manganese Chloride	5, 20	Room-100	< 1	—	—	
Mercuric Chloride	1-Saturated Saturated	35-100 Boiling	< 1 < 1	— —	— < 1	
Nickel Chloride	5, 20 5-20 30	35-100 100 Boiling	< 1 < 1 nil	— — —	— — nil	
Nitric Acid	20 70 10-70 70-98	103 121 Room-260 Room-Boiling	< 1 < 1 < 1 < 1*	< 1 < 1 — —	< 1 < 1 — —	 *SCC Observed

(continued)

TABLE 5.29: ZIRCONIUM ALLOYS–TELEDYNE WAH CHANG ALBANY (continued)

CORROSIVE MEDIA	CONCENTRATION %	TEMPERATURE °C	CORROSION RATE, mpy Zr 702	Zr 704	Zr 705	REMARKS
Nitric Acid + 1% Fe	65	120	< 1	—	—	
Nitric Acid + 1% Fe	65	204	< 1	—	—	
Nitric Acid + 1.45% 304 S.S.	65	204	nil	—	—	
Nitric Acid + 1% Cl^- (as NaCl)	70	120	nil	—	—	
Nitric Acid + 1% Seawater	70	120	nil	—	—	
Nitric Acid + 1% $FeCl_3$	70	120	nil	—	—	
Oxalic Acid	0-100	100	< 1	—	—	
Perchloric Acid	70	100	< 2	—	—	
Phenol	Saturated	Room	< 5	—	—	
Phosphoric Acid	5-30	Room	< 5	—	—	
	5-35	60	< 5	—	—	
	5-50	100	< 5	—	—	
	35-50	Room	< 5	—	—	
	45	Boiling	< 5	—	—	
	50	Boiling	< 5	5-10	10-15	B.P. = 108°C
	65	100	5-10	—	<20	
	70	Boiling	>50	—	>50	B.P. = 123-126°C
	85	38	5-20	—	—	
	85	80	20-50	—	20-50	
	85	Boiling	>50	—	>50	B.P. = 156°C
	Mixture	Room	nil	—	—	88% H_3PO_4 + 0.5% HNO_3
	Mixture	Room	W.G.	—	—	88% H_3PO_4 + 5% HNO_3
	Mixture	89	>50	—	>50	85% H_3PO_4 + 4% HNO_3
Potassium Chloride	Saturated	60	< 1	—	—	
	Saturated	Room	< 1	—	—	
Potassium Fluoride	20	28	nil	—	—	pH = 8.9
	20	90	>50	—	—	pH = 8.9
	0.3	Boiling	< 1	—	—	
Potassium Hydroxide	50	27	< 1	—	—	
	10	Boiling	< 1	—	—	
	25	Boiling	< 1	—	—	
	50	Boiling	< 5	—	—	
	50-anhydrous	241-377	>50	—	—	
	Mixture	29	< 1	—	—	13% KOH, 13% KCl
Potassium Iodide	0-70	Room-100	< 2	—	—	
Potassium Nitrite	0-100	Room-100	< 2	—	—	
Silver Nitrate	50	Room	< 5	—	—	
Sodium Bi-Sulfate	40	Boiling	< 1	—	< 1	B.P. = 107°C
Sodium Chloride	3-Saturated	35-Boiling	< 1	—	< 1	
	29	Boiling	< 1	—	—	
	Saturated	Room	< 1	—	—	
	Saturated	Boiling	< 1	—	< 1	Adjusted to pH = 1
	Saturated	107	nil	—	—	Adjusted to pH = 0
Sodium Chloride + Saturated SO_2	3.5	80	nil	—	—	
Sodium Chloride + Saturated SO_2	25	80	nil	—	—	
Sodium Chloride + Saturated SO_2	Saturated	80	nil	—	—	

(continued)

TABLE 5.29: ZIRCONIUM ALLOYS—TELEDYNE WAH CHANG ALBANY (continued)

CORROSIVE MEDIA	CONCENTRATION %	TEMPERATURE °C	CORROSION RATE, mpy Zr 702	Zr 704	Zr 705	REMARKS
Sodium Chloride	Mixture	215	nil	nil	nil	25% NaCl + 0.5% Acetic Acid + 1% S + saturated H_2S
Sodium Fluoride	Saturated	28	nil	—	—	
	Saturated	90	>50	—	—	
Sodium Formate	0-80	100	< 2	—	—	
Sodium Hydrogen Sulfite	40	Boiling	< 1	—	< 1	
Sodium Hydroxide	5-10	21	< 1	—	—	
	28	Room	< 1	—	—	
	10-25	Boiling	< 1	—	—	
	40	100	< 1	—	—	
	50	38-57	< 1	—	—	
	50-73	188	20-50	—	—	
	73	110-129	< 2	—	—	
	73 to anhydrous	212-538	20-50	—	—	
	Mixture	82	< 1	—	—	9-11% NaOH, 15% NaCl
	Mixture	10-32	< 1	—	—	10% NaOH, 10% NaCl & wet $CoCl_2$
	Mixture	129	< 1	—	—	0.6% NaOH, 2% $NaClO_3$ + trace of NH_3
	Mixture	191	< 1	—	—	7% NaOH, 53% NaCl, 7% $NaClO_3$, 80-100 ppm NH_3
	Mixture	138	< 5	—	—	52% NaOH + 16% NH_3
Sodium Hydroxide (Suspended salt-violent boiling)	20	60	10-20	—	—	
Sodium Hydroxide + 750 ppm Free Cl_2	50	38	< 1	—	—	
	50	38-57	< 1	—	—	
Sodium Hypochlorite	6	100	< 5	—	—	as received super chlor.
	6	50	nil	—	nil	
Sodium Iodide	0-60	100	< 2	—	—	
Sodium Peroxide	0-100	Room-100	< 2	—	—	
Sodium Silicate	0-100	Room-100	< 2	—	—	
Sodium Sulfate	0-20	Room-100	<2	—	—	
Sodium Sulfide	33	Boiling	nil	—	nil	
Stannic Chloride	5	100	<1	—	—	
	24	Boiling	<1	—	—	
Succinic Acid	0-50	100	<2	—	—	
	100	150	<2	—	—	
Sulfuric Acid	0-75	20	<1	<1	<1	
	80	20	<5	>50	- -	
	80	30	20-50	>50	>50	
	77.5	60	10-20	—	<10	
	75	50	<1	—	—	
	77	50	5-10	>50	—	
	80	50	>50	>50	>50	
	75	80	<5	—	<5	
	65	100	—	<1	<5	
	70	100	<2	—	<5	
	75	100	<5	—	<5	
	76	100	<10	—	—	
	77	100	<20	—	—	
	77.5	100	>50	>50	>50	
	60	130	—	—	<5	
	65	130	<1	—	—	
	70	140	<5	—	<10	

(continued)

TABLE 5.29: ZIRCONIUM ALLOYS—TELEDYNE WAH CHANG ALBANY (continued)

CORROSIVE MEDIA	CONCENTRATION %	TEMPERATURE °C	CORROSION RATE, mpy Zr 702	Zr 704	Zr 705	REMARKS
Sulfuric Acid	58	Boiling	—	<1	<5	
	62	Boiling	<5	—	10-20	
	64	Boiling	<5	—	20-50	
	68	Boiling	<5	—	—	
	69	Boiling	<5	—	—	
	71	Boiling	<5	—	—	
	72-74	Boiling	5-10	>50	—	
	75	Boiling	10-20	>50	—	
Sulfuric Acid						
+ 1000 ppm Fe^{3+}	60	Boiling	<1	—	—	B.P. = 152-155°C
+ 10,000 ppm Fe^{3+}	60	Boiling	<5	—	—	Added as $Fe_2(SO_4)_3$
Sulfuric Acid						
+ 200-1000 ppm Fe^{3+}	65	Boiling	<5	—	—	B.P. = 152-155°C
+ 10,000 ppm Fe^{3+}	65	Boiling	5-10	—	—	Added as $Fe_2(SO_4)_3$
Sulfuric Acid						
+ 14 ppm - 141 ppm Fe^{3+}	70	Boiling	5-10	—	—	B.P. = 167-171°C
+ 200 ppm	70	Boiling	10-20	—	—	Added as $Fe_2(SO_4)_3$
+ 1410 ppm-10,000 ppm Fe^{3+}	70	Boiling	>50	—	—	
Sulfuric Acid						
+ 1000 ppm $FeCl_3$	60	Boiling	<5	<5	<20	
+ 10,000 ppm $FeCl_3$	60	Boiling	<5	<20	20-50	
+ 20,000 ppm $FeCl_3$	60	Boiling	20-50	20-50	>50	
Sulfuric Acid						
+ 200 ppm $FeCl_3$	65	Boiling	< 5	< 5	<20	
+ 1000 ppm $FeCl_3$	65	Boiling	< 5	< 5	<20	
+ 10,000 ppm $FeCl_3$	65	Boiling	< 5	< 5	<20	
Sulfuric Acid						
+ 10 ppm $FeCl_3$	70	Boiling	<20	<20	>50	
+ 100 ppm $FeCl_3$	70	Boiling	<20	<20	>50	
+ 200 ppm $FeCl_3$	70	Boiling	<20	<20	>50	
+ 1000 ppm $FeCl_3$	70	Boiling	<20	<20	>50	
+ 10,000 ppm $FeCl_3$	70	Boiling	20-50	>50	>50	
Sulfuric Acid						
+ 200 ppm Cu^{2+}	60	Boiling	< 5	—	—	Added as $CuSO_4$
+ 1000-10,000 ppm Cu^{2+}	60	Boiling	< 1	—	—	
Sulfuric Acid						
+ 200-10,000 ppm Cu^{2+}	65	Boiling	< 5	—	—	Added as $CuSO_4$
Sulfuric Acid						
+ 3 ppm Cu^{2+}	70	Boiling	5-10	—	—	Added as $CuSO_4$
+ 27-226 ppm Cu^{2+}	70	Boiling	>50	—	—	
Sulfuric Acid						
+ 1000-10,000 ppm NO_3^-	60	Boiling	< 5	—	—	Added as $NaNO_3$
+ 50,000 ppm NO_3^-	60	Boiling	>50	—	—	
Sulfuric Acid						
+ 200-1000 ppm NO_3^-	65	Boiling	< 5	—	—	Added as $NaNO_3$
+ 10,000 ppm NO_3^-	65	Boiling	10-20	—	—	
+ 50,000 ppm NO_3^-	65	Boiling	>50	—	—	
Sulfuric Acid						
+ 200 ppm NO_3^-	70	Boiling	5-10	—	—	Added as $NaNO_3$
+ 6000 ppm NO_3^-	70	Boiling	20-50	—	—	
Sulfuric Acid						
+ 1000 ppm NO_3^-	60	Boiling	< 5	—	—	Added as HNO_3
+ 10,000 ppm NO_3^-	60	Boiling	10-20	—	—	
+ 50,000 ppm NO_3^-	60	Boiling	>50	—	—	
Sulfuric Acid						
+ 1000 ppm NO_3^-	65	Boiling	< 5	—	—	Added as HNO_3
+ 10,000-50,000 ppm NO_3^-	65	Boiling	>50	—	—	
Sulfuric Acid	Mixture	Room-100	< 1	—	—	1% H_2SO_4, 99% HNO_3
	Mixture	Room-100	nil	—	—	10% H_2SO_4, 90% HNO_3
	Mixture	Boiling	< 1	—	—	14% H_2SO_4, 14% HNO_3
	Mixture	100	>50	>50	>50	25% H_2SO_4, 75% HNO_3
	Mixture	Room	< 1	—	—	50% H_2SO_4, 50% HNO_3
	Mixture	Boiling	>50	>50	>50	68% H_2SO_4, 5% HNO_3

(continued)

TABLE 5.29: ZIRCONIUM ALLOYS–TELEDYNE WAH CHANG ALBANY (continued)

CORROSIVE MEDIA	CONCENTRATION %	TEMPERATURE °C	CORROSION RATE, mpy Zr 702	Zr 704	Zr 705	REMARKS
Sulfuric Acid (Cont.)	Mixture	Boiling-135	10-20	10-20	>50	68% H_2SO_4, 1% HNO_3
	Mixture	Room	>50	>50	>50	75% H_2SO_4, 25% HNO_3
	Mixture	Boiling	< 1	—	—	7.5% H_2SO_4, 19% HCl
	Mixture	Boiling	< 1	—	—	34% H_2SO_4, 17% HCl
	Mixture	Boiling	< 1	—	—	40% H_2SO_4, 14% HCl
	Mixture	Boiling	1-5	—	—	56% H_2SO_4, 10% HCl
	Mixture	Boiling	< 1	—	—	60% H_2SO_4, 1.5% HCl
	Mixture	Boiling	< 5	—	—	69% H_2SO_4, 1.5% HCl
	Mixture	Boiling	10-20	—	—	69% H_2SO_4, 4% HCl
	Mixture	Boiling	<20	—	—	72% H_2SO_4, 1.5% HCl
	Mixture	Boiling	>50	—	>50	20% H_2SO_4, 7% HCl with 50 ppm F impurities
Sulfurous Acid	6	Room	< 5	—	—	
	Saturated	192	5-50	—	—	
Sulfamic Acid	10	Boiling	nil	—	nil	B.P. = 101°C
Tannic Acid	25	35-100	< 1	—	—	
Tartaric Acid	10-50	35-100	< 1	—	—	
Trichloroacetic Acid	10-40	Room	< 2	—	—	
	100	Boiling	>50	—	—	
	100	100	>50	—	—	
Tetrachloroethane	100	Boiling	< 5	—	—	
Trichloroethylene	99	Boiling	< 5	—	—	
Trisodium Phosphate	5-20	100	< 5	—	—	
Urea Reactor Mixture	Mixture	193	< 1	—	—	58 Urea 17 NH_3 15 CO_2 10 H_2O
Water - Sea (Pacific)	—	Boiling	nil	—	nil	
		200	nil	—	—	pH = 7.6
Zinc Chloride	70	Boiling	nil	—	nil	
	5-20	35-Boiling	< 1	—	—	
	40	180	< 1	—	< 1	

TABLE 5.30: TUNGSTEN AND MOLYBDENUM—SCHWARZKOPF DEVELOPMENT

Corrosion Behavior in Acids, Alkalis and Corrosive Solutions

Media	Tungsten	Molybdenum
At 20°C (68°F)		
Hydrochloric acid, 10%	resistant	resistant
Sulfuric acid, 10%	resistant	resistant
Nitric acid, 10%	resistant	resistant
Hydrofluoric acid, 3%	resistant	resistant
Acetic acid, 10%	resistant	resistant
Potassium hydroxide, 10%	1.0*	1.0*
Sodium chloride solution, 3%	resistant	resistant
At 100°C (212°F)		
Hydrochloric acid, 10%	resistant	resistant
Sulfuric acid, 10%	resistant	resistant
Nitric acid, 10%	approximately 0.5*	attacks
Hydrofluoric acid, 3%	approximately 5*	approximately 5*
Acetic acid, 10%	resistant	resistant
Potassium hydroxide, 10%	approximately 0.5*	resistant
Sodium chloride solution, 3%	resistant	resistant

*Corrosion rate, grams per square meter per day.

TABLE 5.31: COBALT, NICKEL AND STAINLESS STEEL ALLOYS—CABOT STELLITE

Comparative Corrosion Data*

Media	Concentration and Temperature	TRIBALOY alloy T-400	TRIBALOY alloy T-700	TRIBALOY alloy T-800	STELLITE alloy No. 6	DELORO alloy No. 60	Stainless Steel Type 316
Acetic Acid	50%, Boiling	E	E	E	E	—	E
Ferric Chloride	10%, Room Temp.	U	U	G	S	U	U
Formic Acid	30%, 150 deg. F (66 deg. C)	—	E	—	S	G	E
	45%, Boiling	E	—	E	S	—	U
Hydrochloric Acid	5%, 150 deg. F (66 deg. C)	U	S	E	U	—	U
Nitric Acid	65%, 150 deg. F (66 deg. C)	U	G	S	U	U	E
	65%, Boiling	—	U	—	U	U	G
Phosphoric Acid	85%, 150 deg. F (66 deg. C)	E	E	E	E	U	E
Sodium Chloride	10% + 5% FeCl Room Temp.	U	U	G	S	U	U
Sulfuric Acid	5%, 150 deg. F (66 deg. C)	—	G	—	E	U	G
	5%, Boiling	—	G	—	U	U	U
	10%, Boiling	U	—	S	U	—	U

*Determined in laboratory tests. It is recommended that samples be tested under actual plant conditions.

Code:
E—Less than 2 mpy (<0.05 mm/y)
G—<20 mpy (<0.51 mm/y)
S—Over 20 mpy (>0.51 mm/y) to 50 mpy (1.27 mm/y)
U—More than 50 mpy (>1.27 mm/y)

Nominal Chemical Composition, Weight Percent

	TRIBALOY alloy T-400	TRIBALOY alloy T-700	TRIBALOY alloy T-800
Co	Bal.	—	Bal.
Co + Fe	—	3.0*	—
Ni	—	Bal.	—
Ni + Fe	3.0*	—	3.0*
Mo	28.5	32.5	28.5
Cr	8.5	15.5	17.5
Si	2.6	3.4	3.4
C	.08*	.08*	.08*

*Maximum

STELLITE Alloy No. 6: cobalt-base alloy
DELORO Alloy No. 60: nickel-base alloy

TABLE 5.32: STAINLESS STEEL, NICKEL AND COPPER ALLOYS—CARPENTER TECHNOLOGY

Corrosion Resistance Table

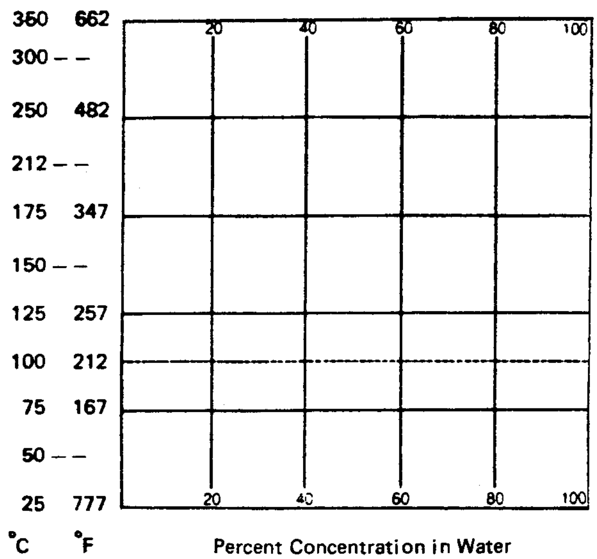
This table shows the resistance of a number of materials to the more common chemicals. Many factors influence the resistance of materials to various solutions. Factors which must be given consideration for service in corrosive environments are: temperature, concentration, aeration, influence of inhibiting or accelerating contaminants, influence of re-circulation, solids in suspension, velocity, frequency of use, and equipment design.

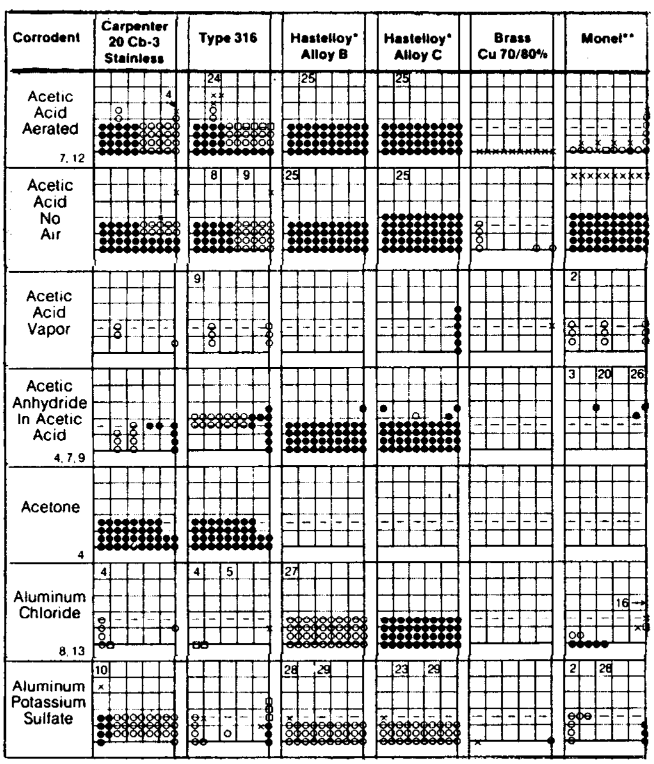
The influence of contaminants is probably the most important from a commercial standpoint. Few corrosive solutions will be free of all contaminants. The majority of these contaminants have no influence on corrosion, but those that do generally affect the conditions greatly.

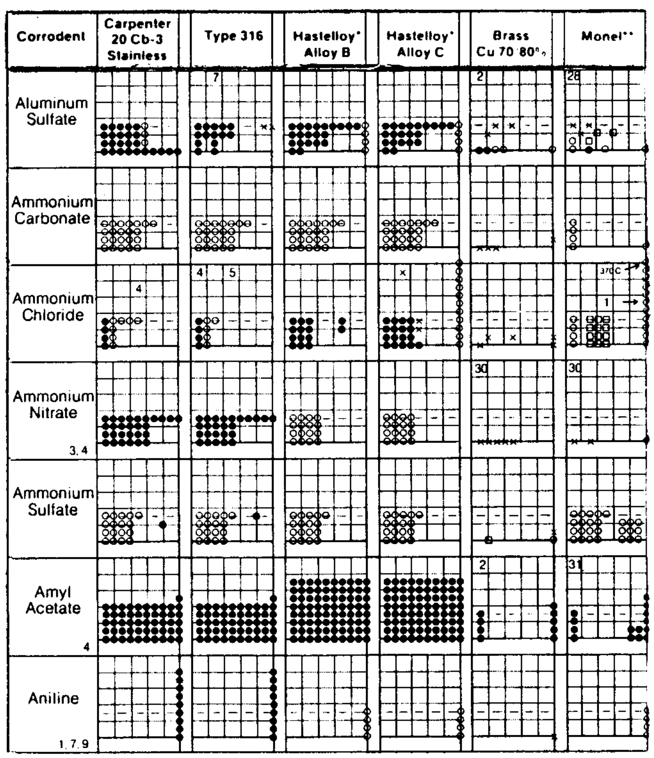
The corrosion data for all grades except Carpenter 20Cb-3 stainless is reprinted from Corrosion Data Survey, 1974 Edition, published by the National Association of Corrosion Engineers. The corrosion rates for Carpenter 20Cb-3 stainless represent a composite of the NACE Corrosion Data Survey and more current data developed in Carpenter's Corrosion Laboratory.

Code:

- ● Corrosion Rate less than 0.002" per year
- ○ Corrosion Rate less than 0.020" per year
- ☐ Corrosion Rate from 0.020" to 0.050" per year
- × Corrosion Rate greater than 0.050" per year







(continued)

TABLE 5.32: STAINLESS STEEL, NICKEL AND COPPER ALLOYS—CARPENTER TECHNOLOGY (continued)

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70/80%	Monel**
Aniline Sulfite						
Arsenic Acid 1						
Barium Carbonate 1			815C	815C		
Barium Chloride 1	13	4 5	86	86		
Barium Hydroxide 1			815C	815C		
Barium Nitrate 1, 4	4	4	815C			
Barium Sulfate			815C		2	
Benzene 1, 2, 3, 4, 14	16				33 34 35	4→
Benzene Sulfonic Acid	2				2	2
Benzoic Acid					2 32	
Boric Acid		4	800C	800C	2	2
Butyl Acetate 4, 7, 9					2	
Butyric Acid					2	2
Cadmium Sulfate					2 21	
Calcium Bisulfite		36 37				
Calcium Carbonate			815C	815C		

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70 80%	Monel**
Calcium Chlorate 4	10	10			2	
Calcium Chloride		4 5	39 815C	4 815C 39	2	4 815C 38
Calcium Sulfate						
Camphor						
Carbonic Acid 6, 9	20	815C			4 2→	40 41
Carbon Disulfide 1, 4, 9, 15						
Carbon Monoxide 1, 4	600C	500C	80 1100C	600C	500C 17	42 600C 33→
Carbon Tetrachloride 1, 9	1	5 1→			1→	
Chlorine 1, 16		4 1→ 5		87	1→ 2→	43
Chloroform 1, 9		4 5 1→			1	
Chlorosulfonic Acid 1, 7, 11		4				
Chromic Acid 7, 10	44	8 44				5
Chromic Sulfates					2	
Citric Acid		4 ←45			2	2 46
Copper Nitrate 1, 10						
Copper Sulfate 1		9 10			2 47	2

(continued)

TABLE 5.32: STAINLESS STEEL, NICKEL AND COPPER ALLOYS—CARPENTER TECHNOLOGY (continued)

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70/80%	Monel**
Cupric Cyanide 1						
Ethanol			31	31		31
Ethyl Acetate 4					2	
Ethyl-Chloride 4		1→ 5→			1→	
Ethylene Dibromide 1,8,9	4	4			1→	
Ethylene Dichloride 4,9	48	21 1→	22			
Ferric Nitrate 4						
Ferric Sulfate						
Ferrous Sulfate		8			2	49
Fluorine Gas 1,4,17						450C 32
Fluosilicic Acid 1	4	4 8	5	5	2	5 50
Formaldehyde 2,4,6,8		20			7	7
Formic Acid 3,7,9		4 51	52		2	2
Furfural 4						
Gallic Acid						
Glutamic Acid		4 5 8	54	54	4 7	

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70 80%	Monel**
Glycerol	4 53 8					
Hexamethylene Tetramine 4,7					7	
Hydrochloric (Aerated) 1,6,7,9	4		55			10
Hydrochloric Acid (No Air)	4		55			
Hydrocyanic Acid + Hydrogen Cyanide 3,4,7,9	14	6	56 57		7, 17	56 57
Hydrofluoric Acid (Aerated) 1,7,9						5
Hydrogen 4	[illegible] 58 59 60 61	[illegible] 58 59 60 61	1100C	1100C	800C	62
Hydrogen Chloride (Anhydrous) 7,9	500C	500C		370C		
Hydrogen Fluoride (Anhydrous)		[illegible]				63 64
Hydrogen Peroxide 3,7		23				23 22
Hydrogen Sulfide - Dry 1,4	[illegible]	[illegible]				
Lactic Acid		4 16 8 9			2	2
Lead Acetate 1,6						
Lead Nitrate 1,10						
Lithium Chloride 1		4 5				2
Lithium Hydroxide					2	

(continued)

TABLE 5.32: STAINLESS STEEL, NICKEL AND COPPER ALLOYS—CARPENTER TECHNOLOGY (continued)

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70/80%	Monel**
Magnesium Chloride	5	5			2 5	2 5
Magnesium Chloride + Calcium Chloride	17 20	4 6			3	17
Magnesium Hydroxide Or Magnesium Oxide						
Magnesium Sulfate	10		5	5	65	
Maleic Acid 1, 7					2	2
Malic Acid						2
Manganese Chloride		5				
Mercuric Nitrate 1						5
Mercury 1					5	5 400F 66
Methane 3, 4						
Methanol 1, 4, 9						
Methyl Chloride 1, 4, 9		1			67	
Methylene Chloride 6, 7		4 5	4	4		23
Mixed Acids H_2SO_4 + HNO_3		68				
Mono-ethanol-amine						16
Naphthalene 4						

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70/80%	Monel**
Naphthenic Acid						2 33
Nickel Chloride						2
Nickel Nitrate 4						1→
Nickel Sulfate					2	2
Nitric Acid 1, 6, 7, 18	70	9 69 37				
Nitric Acid - Red Fuming 7, 9, 18						
Nitric + Hydrofluoric Acids						
Nitriding Gases						
Nitro-Benzene 1, 7, 9	22					
Nitro-glycerin 3						
Nitrous Acids						
Nitrous Oxide						
Oleic Acid	20				4 7 32 1→ 2→	
Oxalic Acid 1, 7		9			2	3
Perchloric Acid 7, 18, 19		1→				
Perchloroethylene 9		4				

(continued)

TABLE 5.32: STAINLESS STEEL, NICKEL AND COPPER ALLOYS—CARPENTER TECHNOLOGY (continued)

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70/80%	Monel**
Phenol 1, 7		385C			7 - 17	385C
Phosphoric Acid (Aerated) 7		9				
Phosphorus 1, 4, 7, 20						
Phthalic Anhydride 7		16→	400C			
Phthalic Anhydride (Pure) + Maleic Anhydride						
Picric Acid 1, 3, 4						
Potassium Bromide	13	4			2	2
Potassium Carbonate			900C	900C	7-17	
Potassium Chlorate 1, 10					2 355C	
Potassium Chloride	4	4 5 22			5	
Potassium Chromate						
Potassium Cyanide 1, 6, 7			23		2 4	2 23
Potassium Dichromate 1, 7			810C	810C		
Potassium Ferri-cyanide 1		71				
Potassium Ferro-cyanide 1						
Potassium Hydroxide 1, 5, 7, 8, 21	2 360C 19	5			2 7	2 5

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70 80%	Monel**
Potassium Nitrate 4, 10						
Potassium Oxalate						
Potassium Perman-ganate 4, 10						
Potassium Peroxide 3, 4, 10						
Potassium Sulfate						
Propionic Acid					2	2
Pyridine 4, 9					2 7	
Pyrogallic Acid						
Pyro-ligneous Acid						2
Rosin 4						
Salicylic Acid 22						
Silver Nitrate 1, 7						
Sodium Acetate						340C
Sodium Aluminum Sulfate						2
Sodium Bicar-bonate					2	
Sodium Bichromate 5, 6						

(continued)

TABLE 5.32: STAINLESS STEEL, NICKEL AND COPPER ALLOYS—CARPENTER TECHNOLOGY (continued)

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70/80%	Monel**
Sodium Bisulfate		5 9			2	2
Sodium Bisulfite		5				4 - 16
Sodium Bromide						
Sodium Carbonate	900C	5-72 900C	900C	900C		33
Sodium Chlorate (4)	10	10				33
Sodium Chloride	2 4 8	5 8 4-22	10	10	17	10 73
Sodium Chromate						
Sodium Citrate						
Sodium Cyanide (1)	700C	4 700C				562C
Sodium Ferri-cyanide (1)						
Sodium Formal-dehyde Sulfoxylate						
Sodium Hydro-sulfide (1, 7, 9)						
Sodium Hydroxide (1, 6)	5a 300C	4 5	5		4	5 74
Sodium Meta-silicates						
Sodium Nitrate (10)		4 34 510C		21 - 23		34 420C
Sodium Perborate	10	10				

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70 80%	Monel**
Sodium Perchlorate (3, 4)	75		76			
Sodium Phosphate		10 14			2 77	
Sodium Phosphate (Tribasic)		5 - 17				
Sodium Silicates	800 1100C	800 1100C			77	
Sodium Sulfate (3)		840C			78	
Sodium Sulfide (9)						
Sodium Sulfite						
Stannous Chloride			4			
Stearic Acid					1→ 2→	
Sulfate Black Liquor						
Sulfate Green Liquor						
Sulfite Liquor with 10% Sulfur Dioxide		4 79				
Sulfur (4, 23)	454C	13 446C		440C		446C
Sulfur Chloride (9)	1→	4 1→				
Sulfur Containing Oils						
Sulfur Dioxide (6)	81	4 80			1→ 4	1→

(continued)

TABLE 5.32: STAINLESS STEEL, NICKEL AND COPPER ALLOYS—CARPENTER TECHNOLOGY (continued)

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70/80%	Monel**
Sulfuric Acid Aerated 1, 7, 24			82			82
Sulfuric Acid Fuming 1, 6						
Sulfuric Acid No Air- Static		9	82			
Sulfurous Acid 6, 9	83	5, 83				
Sulfur Trioxide 3, 6, 7, 9, 21	370C	370C		370C	1→	
Tall Oil						
Tannic Acid					2	84
Tetra-phosphoric Acid						
Titanium Tetra-chloride 9, 21						
Toluene 4, 9					5, 85	

Corrodent	Carpenter 20 Cb-3 Stainless	Type 316	Hastelloy* Alloy B	Hastelloy* Alloy C	Brass Cu 70/80%	Monel**
Trichloro-ethylene 9		4			1→	4
Trichloro-monofluoro-ethane						
Trichloro-propane						
Trichloro-trifluoro-ethane						
Triphenyl Phosphite						
Uric Acid 1						
Vinyl Chloride 4	500C	475C				450C
Zinc Carbonate						
Zinc Chloride		4, 5, 8				1, 2
Zinc Sulfate	4, 8-16	4, 8-16			2	2

*Registered Trademark of Cabot Corporation.
**Registered Trademark of INCO.

Footnotes for Corrosives:

1 Poison
2 Toxic
3 Explosive
4 Flammable
5 Ingestion poison
6 Inhalant poison
7 Attacks skin
8 Irritant
9 Vapor harmful
10 Ignites organics
11 Fuming liquid
12 Hygroscopic
13 Liberates HCl in water
14 Narcotic
15 Volatile
16 Hazardous under pressure
17 Ignites combustibles
18 Fire hazard
19 Explosive over 70%
20 Ignites in moist air at 30°C
21 Exothermic in water
22 Dust explodes
23 Explosive dust
24 Exothermic with water

Footnotes for Data Squares:

1 No water
2 No air, oxygen
3 Low air, oxygen
4 Pits
5 Stress cracks
6 Stress corrosion
7 Discolors
8 Crevice attack
9 Intergranular attack
10 No chlorides
11 May discolor
12 May catalyze
13 May pit
14 May stress crack
15 Transgranular attack
16 Vapor
17 Aerated
18 Catalyzes
19 Static
20 Agitated
21 ~7 pH
22 <7 pH
23 >7 pH
24 No HCl, H_2SO_4, NaCl
25 No ferric chloride
26 ~0.1% acetic acid
27 Also sludge
28 No iron salts
29 No sulfuric acid
30 Explosive
31 With H_2SO_4
32 With steam
33 No sulfur
34 No stress
35 No ammonia
36 300 psi
37 Stress relieved
38 No HCl, Cu, Ni ions
39 No Cu, Fe ions
40 Over 70% air
41 20-70% air, 530 psi
42 With sulfur, <340°C=x
43 <10 mg/1
44 No H_2SO_4
45 <60 psi
46 No sulfides
47 <20% zinc
48 Trace HCl
49 pH 2 to 3.5
50 Annealed, immersed
51 >2.25% Mo
52 Erratic
53 With NaCl
54 With NaCl, HCl, H_2O_2
55 No Fe, Cl
56 With +~0.05–1% H_3PO_4 or H_2SO_4
57 +SO_2 or HCOOH
58 <RC 22, 60,000
59 Annealed
60 No cold work
61 No H_2S
62 Permeable to H_2
63 Unsulfated
64 With or without steam
65 240 psi
66 Cold worked
67 >80% copper
68 >20% sulfuric, bal. nitric acid
69 No Mo; low C
70 Red fuming
71 Pits in chlorides
72 Over 400°C
73 Steam and air
74 75-100% concentration
75 Low NaCl
76 With HCl
77 <17% zinc
78 <0.23%, 200 psi
79 300 psi
80 No SO_3
81 No NaCl
82 High pressure
83 75-120 psi
84 No sodium sulfite
85 + ammonia
86 Avoid hydroxides
87 Saturated

TABLE 5.33: TITANIUM, ZIRCONIUM AND TANTALUM—ASTRO METALLURGICAL

CORROSION RESISTANCE CHART FOR TITANIUM, ZIRCONIUM, TANTALUM

The reactive metals, titanium, zirconium and tantalum offer unusual resistance to most materials encountered in the Chemical Processing, Metal Finishing and Waste Treatment industries. In many instances they are the only metals that meet the service life requirements of the application.

RATING	CORROSION RATE
A	Less than 5 mpy
B	5 to 50 mpy
C	Greater than 50 mpy

THE IMPORTANCE OF TEMPERATURE IN MATERIALS SELECTION

Corrosion data is developed by exposing the material to environments at specific temperatures. However, when applied to process equipment, the fluid temperatures *may not always represent the actual material exposure temperature.*

In evaluating corrosion data, special attention should always be given to *actual* metal temperature in the particular environment. This is especially important in selecting material for heat exchanger services.

Often solutions at higher temperatures than those recommended can be handled in a heat exchanger that is designed as a cooler. This is due to the fact that the tube wall temperature will be below the temperature of the incoming solution. On the other hand, in heating applications, tube wall temperatures can exceed otherwise safe temperature limits even though the solution leaving the heater is within prescribed temperatures for the metal used.

Consequently, in selecting material for heat transfer equipment, it is often important that the *actual* tube wall temperature should be computed before evaluating material selection for the planned process conditions.

MEDIA	CONCENTRATION %	TEMPERATURE °F	TITANIUM	ZIRCONIUM	TI-PD	TANTALUM
Acetaldehyde	100	150	–	A	–	
Acetic Acid	5, 25, 50, 75, 99.5	Boiling	A	A	–	A
Acetic Acid	Vapor–33	Boiling	A	A	–	A
Acetic–Glacial Acid	99.7	Boiling	A	A	–	A
Acetic Anhydride	99	Room	A	A	–	A
Acetone	100	150	A	A	–	
Adipic Acid (plus 15/20% Glutaric Acid, 2% Acetic Acid)	25	390	B	–		
Adiponitrile Solution (NH_3)	Vapor	700	A	–	–	
Alum	100	212	–	A	–	
Aluminum Chloride (Aerated)	5, 10	140	A	A	–	A
Aluminum Chloride	25	212	C	A	A	A
Aluminum Chloride	25	Room	A	A	A	A
Aluminum Fluoride	Saturated	Room	A	C	–	C
Aluminum Hydroxide	100	212	–	A		–
Aluminum Nitrate	Saturated	Room	A	–	–	–
Aluminum Sulfate	Saturated	Room	A	A	–	A
Aluminum Sulfate (1% H_2SO_4)	Saturated	Room	A	–	–	–
Aluminum Sulfate (1% Sodium Carbonate)	Saturated	Room	A	–	–	–
Amidation Reaction	–	212	A	–	–	
Ammonium Acid Phosphate	10	Room	A	–	–	A
Ammonia, Anhydrous (200 PSI)	100	104	A	–	–	–

(continued)

TABLE 5.33: TITANIUM, ZIRCONIUM AND TANTALUM—ASTRO METALLURGICAL (continued)

MEDIA	CONCENTRATION %	TEMPERATURE °F	TITANIUM	ZIRCONIUM	TI-PD	TANTALUM
Ammonia	50	190	A	A		
Ammonia	Plus Water	–	A	A	–	–
Ammonium Bicarbonate	50	212	A	–	–	A
Ammonium Carbonate (Aqueous)	50	212	A	–	–	A
Ammonium Carbonate	50	Boiling	A	–	–	A
Ammonium Chloride	1, 10, Saturated	212	A	A	–	A
Ammonium Fluoride	10	Room	A	–	–	C
Ammonium Hydroxide	28	80	A	A*	–	–
Ammonium Perchlorate	15-20	80-190	A	–	–	–
Ammonium Sulfate	50	212	–	A	–	A
Ammonium Sulfate	5, 10, Saturated	Room	A	A	–	A
Ammonium Sulfate	5, 10	212	A	–	–	A
Ammonium Sulfate (Aqueous)	10	Boiling	A	–	–	A
Aniline, plus 2% $AlCl_2$	98	316	B	–	–	
Aniline Hydrochloride	5, 20	99	A	A	–	A
Aqua Regia	3HCL: 1HNO_3	Room	A	–	–	A
Aqua Regia	3:1	170	B	C	–	A
Barium Carbonate	15	212	–	A	–	
Barium Carbonate	Saturated	Room	A	–	–	A
Barium Chloride	5, 20	212	A	A	–	
Barium Chloride	20	212	–	A	–	
Barium Chloride	25	Boiling	A		–	A
Barium Chloride	Saturated	Room	A	-	–	A
Barium Hydroxide	Saturated	Room	A			A
Barium Hydroxide	50	212	–	A	–	
Barium Hydroxide – $8H_2O$	Saturated	Room	A	–		A
Barium Nitrate	10	Room	A	–	·	A
Benzaldehyde	100	212	–	A		
Benzene	100	212	–	A	–	
Benzene	Liquid	Room	A	–	–	
Benzene	Vapor & Liquid	176	A		–	
Benzoic Acid	75	212	–	A	–	
Benzoic Acid	Saturated	Room	A	–	·	A
Benzyl Sulfonic Acid	100	212	–	A	–	
Boric Acid	10	Boiling	A	-	-	A
Boric Acid	50	212	–	A	-	
Boric Acid	Saturated	Room	A	–	–	A
Bromine	Liquid	86	C	–	–	A
Bromine	Vapor	86	A	–	-	A
Bromine	Water	Room	A	C	-	A
Bromine – Methyl Alcohol	1	Room	B	-	-	-
Butyric Acid	Undiluted	Room	A	–	–	A
Butyric Acid	Undiluted	212	–	A	–	
Calcium Bicarbonate	100	212	–	A	–	A
Calcium Bisulfite	–	80	A	–	–	
Calcium Carbonate	Saturated	Boiling	A	–	–	A
Calcium Chloride	5, 10, 20	212	A	A	–	A
Calcium Chloride	28	Boiling	A	A	–	A
Calcium Hydroxide	Saturated	Room	A	–	–	A
Calcium Hydroxide	Saturated	Boiling	A	–		A
Calcium Hypochlorite	2, 6	212	A	A	–	A
Calcium Hypochlorite	Saturated	Room	A	B	-	A
Carbolic Acid	Saturated	Room	A	A	–	A
Carbon Tetrachloride	99	Boiling	A	-	–	A
Carbon Tetrachloride	Liquid	Boiling	A	A		A
Carbon Tetrachloride	Vapor	Boiling	A	–	-	

(continued)

TABLE 5.33: TITANIUM, ZIRCONIUM AND TANTALUM—ASTRO METALLURGICAL (continued)

MEDIA	CONCENTRATION %	TEMPERATURE °F	TITANIUM	ZIRCONIUM	TI-PD	TANTALUM
Chlorine Dioxide	–	180	A	–	–	A
Chlorine (Water Saturated)	–	Room	B		A	A
Chlorine (Water Saturated)	–	167	A		A	A
Chlorine Gas (Dry)	100	Room	C	B	–	A
Chlorine Gas (more than 0.13% H_2O)	100	200	A	C	A	A
Chloroacetic Acid	30	180	A	B	–	A
Chloroacetic Acid	100	Boiling	A	A	–	A
Chloroform	100	Boiling	A	A	–	
Chromic Acid	10	Boiling	A	A	A	A
Chromic Acid	20	Room	A	A	–	A
Chromic Acid	365	195	B	A	–	A
Citric Acid	10, 25	212	A	A	–	A
Citric Acid	50	140	A	A	–	A
Citric Acid (Aerated)	50	212	A	A	–	A
Citric Acid (Non-Aerated)	50	212	B	A	–	A
Copper Cyanide (Electroplating Solution)	–	Room	A	–	–	A
Copper Nitrate	Saturated	Room	A	–	–	A
Copper Sulfate	5	Room	A	–	–	A
Copper Sulfate	Saturated	Boiling	A	–	–	A
Cupric Carbonate – Cupric Hydroxide	Saturated	Room	A	–	–	A
Cupric Chloride	20, 40, 50	Boiling	A	C	–	A
Cupric Cyanide	Saturated	Room	A		–	A
Cupric Sulfate	50	212	–	A	–	
Cuprous Chloride	50	195	B	–	–	A
Cyano Acetic Acid	100	212	–	A	–	
Cyclohexane	–	302	A	–	–	
Cyclohexane	100	100	A	A	–	
Cyclohexane	100	212	–	A	–	
Dichloroacetic Acid	100	212	A	B	–	A
Dichloroacetic Acid	100	Boiling	A	B	–	A
Dimethyl Ether	100	212	–	A	–	
Dioxane	100	212	–	A	–	
Esters	–	250	A	–	–	
Ethyl Acetate	2-100	212	–	A	–	
Ethyl Alcohol	95	Boiling	A	–	–	
Ethyl Alcohol	Liquid	Room	A	A	–	
Ethyl Alcohol	Partial Immersion	Room	A	A	–	
Ethylene Dichloride	100	Boiling	A	A	–	A
Ferric Chloride	5, 10, 20, 30	Room	A	C	–	A
Ferric Chloride	5, 10, 20, 30	212	A	C	A	A
Ferric Chloride	5, 10, 20, 30, 40, 50	Boiling	A	C	–	A
Ferric Sulfate	10	Room	A	–	–	A
Ferric Sulfate	10	212	A	A	–	
Ferric Sulfate	Saturated	Room	A	–	–	A
Ferric Sulfate	49	212	–	A	–	
Fluoboric Acid	5-20	Elevated	C		–	C
Fluorine	Gas	Room	B	–	–	C
Fluorine	½ liq.-½ gas	310	A	–	–	
Fluorine	Liquid	310	A	–	–	
Fluorine	Gas	310	A	–	–	
Fluorine, liquid	(4 hr. exposure)	320	B	–	–	
Fluorine, gaseous	(8 hr. exposure)	Room	B	–	–	
Fluorine, gaseous	(288 hrs. exposure)	220	A	–	–	
Fluorosilicic Acid	10	Room	C	C	–	C
Formaldehyde	37	Boiling	A	A*	–	A
Formaldehyde, plus 2½% H_2SO_4	50	158	B	–	–	A

(continued)

TABLE 5.33: TITANIUM, ZIRCONIUM AND TANTALUM–ASTRO METALLURGICAL (continued)

MEDIA	CONCENTRATION %	TEMPERATURE F	TITANIUM	ZIRCONIUM	TI-PD	TANTALUM
Formamide Vapor		572	A		-	
Formic Acid	10, 25, 50, 90	212	A	A		A
Formic Acid (Non-Aerated)	10	Boiling	A	A	–	A
Formic Acid (Non-Aerated)	25, 50	Boiling	C	A	A	A
Formic Acid (Non-Aerated)	25	212	C	A	–	A
Formic Acid (Non-Aerated)	80	Boiling	C	A	–	
Formic Acid (Aerated)	10-90	212	A	A	–	A
Formic Acid (H_2O Solution)	9	125	B	A	–	A
Furfural Alcohol	-	337	-	A	–	
Glue, Polyvinyl Resin	-	Room	A	–	–	
Glycerine	-	Room	A	–	–	A
Hydriodic Acid	57	Room	B	–	–	A
Hydrobromic Acid	40	Room	A	C	A	A
Hydrochloric Acid	5	Room	A	A	A	A
Hydrochloric Acid	10	95	B	A	–	A
Hydrochloric Acid	20	95	C	A	–	A
Hydrochloric Acid	35	212	C	A	A	
Hydrochloric Acid (Aerated)	5	95	A	A	A	A
Hydrochloric Acid (Aerated)	10	95	B	A		A
Hydrochloric Acid (Aerated)	20	95	C		–	A
Hydrochloric Acid Plus 1% HNO_3	5	100, 200	A	–	–	
Hydrochloric Acid Plus 5% HNO_3	5	100, 200	A	–	–	
Hydrochloric Acid Plus 10% HNO_3	5	100	A	–	–	
Hydrochloric Acid Plus 10% HNO_3	5	200	B	–	–	
Hydrochloric Acid Plus 0.05% $CuSO_4$	5	100, 200	A	–	–	
Hydrochloric Acid Plus .5% $CuSO_4$	5	100, 200	A	–	–	
Hydrochloric Acid Plus 1% $CuSO_4$	5	100, 200	A	–	–	
Hydrochloric Acid Plus 5% $CuSO_4$	5	100, 200	A	–	–	
Hydrochloric Acid Plus .50% CrO_3	5	100, 200	A	–	–	
Hydrochloric Acid Plus 1% CrO_3	5	100, 200	A	–	–	
Hydrochloric Acid Plus .50% $CuSO_4$	10	150	A	–	–	
Hydrochloric Acid Plus .10% $CuSO_4$	10	150	A	–	–	
Hydrochloric Acid Plus .20% $CuSO_4$	10	150	A	–	–	
Hydrochloric Acid Plus .25% $CuSO_4$	10	150	A	–	–	
Hydrochloric Acid Plus .50% $CuSO_4$	10	150	A	–	–	
Hydrochloric Acid Plus 1% $CuSO_4$	10	150	A	–	–	
Hydrochloric Acid (Non-Aerated)	1	100	B	–	–	
Hydrochloric Acid (Non-Aerated)	1	160	B	–	–	
Hydrochloric Acid (Non-Aerated)	1	Boiling	B	–	–	
Hydrochloric Acid (Non-Aerated)	3-5	Room	B	A	–	
Hydrochloric Acid (Non-Aerated)	3-5	160	B	–	–	
Hydrochloric Acid (Non-Aerated)	3-5	Boiling	B	–	–	
Hydrochloric Acid (Non-Aerated)	5	125	B	–	–	
Hydrochloric Acid (Non-Aerated)	10	Room	B	A	–	
Hydrochloric Acid (Non-Aerated)	10	160	B	–	–	
Hydrofluoric Acid	48	Room	C	C	–	C
Hydrofluoric Acid (Andydrous)	100	Room	B	–	–	C
Hydrofluoric – Nitric Acid	(1HF:15HNO_3)	Room	C	–	–	C
Hydrogen Peroxide	3, 6	Room	A	A	–	A
Hydrogen Peroxide	30	Room	B	–	–	A
Hydrogen Peroxide	50	140	–	A	–	
Hydrogen Sulfide	Saturated HOH	Room	A	–	–	A
Hydrogen Sulfide	Saturated HOH	70	A	–	–	
Hydroxyacetic Acid	–	104	A		–	A
Iodine in water Plus Potassium Iodide	–	Room	A	–	–	
Lactic Acid	10-85	212	A	A	–	

(continued)

TABLE 5.33: TITANIUM, ZIRCONIUM AND TANTALUM—ASTRO METALLURGICAL (continued)

MEDIA	CONCENTRATION %	TEMPERATURE °F	TITANIUM	ZIRCONIUM	TI-PD	TANTALUM
Lactic Acid	10-100	Room	A	–	–	A
Lead Acetate	Saturated	Room	A	–	–	A
Linseed Oil, Boiled	–	Room	A	–	–	
Magnesium Chloride	5-40	Room	A	–	–	A
Magnesium Chloride	5-40	212	A	A	–	A
Magnesium Chloride	40	212	–	A	–	
Magnesium Hydroxide	Saturated	Room	A	–		A
Magnesium Sulfate	Saturated	Room	A	–	–	A
Magnesium Sulfate	37	200	–	A	–	
Maleic Acid	–	Room	A	–	–	A
Manganous Chloride	5-20	212	A	A	–	A
Mercuric Chloride	1, 5, 10, 55	212	A	A	–	A
Mercuric Chloride	Saturated	Room	A	A	–	A
Mercuric Chloride	Saturated	200	A	A	–	A
Mercuric Cyanide	Saturated	Room	A	–	–	A
Mercury	–	Room	A	–	–	A
Methyl Ethyl Ketone	All	Boiling	–	A	–	
Nickel Chloride	5-20	212	A	–	–	
Nickel Nitrate Plus 6% HOH	50	Room	A	–	–	A
Nickel Sulfate	40	180	–	A	–	
Nitric Acid (Aerated)	98	80	A	A	–	
Nitric Acid (Aerated)	5, 10, 20, 30	95	A	A	–	
Nitric Acid (Aerated)	5-69.5	212	A	A		
Nitric Acid (Aerated)	65	347	A	A	A	
Nitric Acid (Aerated)	40	392	B	A	–	
Nitric Acid (Aerated)	70	518	B	–	–	
Nitric Acid (Aerated)	20	554	B	–	–	
Nitric Acid (Non-Aerated)	65	Boil – 250	A	–	A	
Nitric Acid (Non-Aerated)	98	Room	A	–	–	
Nitric Acid	10, 20, 40, 69.5	95	A	A	A	
Nitric Acid	10, 20, 40, 69.5	212	A	A	A	A
Nitric Acid	65	Boiling	A	A	A	A
Nitric Acid – White Fuming	90	180	B	–	–	A
Nitric Acid – White Fuming	–	252	B	–	–	
Nitric Acid – White Fuming	–	320	B	–	–	
Nitric Acid – White Fuming	Liquid or Vapor	Room	A	–	–	
Nitric Acid + 17% Adipic Acid	38	194-203	A	–	–	–
Nitric Acid – Red Fuming*	–	Room	C	–	–	–
*Less than 1% water = pyrophoric reaction						
Oxalic Acid	1	98.6		A	–	A
Oxalic Acid	0.5	95		A	–	A
Oxalic Acid	5	95	B	A	–	A
Oxalic Acid	10	95	B	A	–	A
Oxalic Acid	0.5-25	140	B	A	–	A
Perchloromethylmercaptan Plus ½ to 1% H_2O		Room	A	–	–	
Perchloromethylmercaptan (Anhydrous)		Room	C	–	–	
Phenol (Carbolic Acid)	Saturated	Room	A	A	–	A
Phosphoric Acid	5-30	Room	A	A	–	A
Phosphoric Acid	35-85	Room	B	B	–	A
Phosphoric Acid	40	212	–	A	–	
Phosphoric Acid	5-3.5	140	B	A	–	A
Phosphoric Acid	85	100	B	B	–	A
Phosphoric Acid	5	212	B	A	–	A
Phosphoric Acid	10	175	B	A	–	A
Phosphoric-Sulfuric + $CuSO_4$	$15H_3PO_4$-$10H_2SO_4$	150	B	–	–	A

(continued)

TABLE 5.33: TITANIUM, ZIRCONIUM AND TANTALUM—ASTRO METALLURGICAL (continued)

MEDIA	CONCENTRATION %	TEMPERATURE °F	TITANIUM	ZIRCONIUM	TI-PD	TANTALUM
Phosphorus Trichloride	Saturated	Room	A	–	–	A
Photographic Emulsions	–	–	A	–	–	
Potassium Bromide	Saturated	Room	A	–	–	A
Potassium Chloride	36	Boiling	A	–	–	A
Potassium Chloride	Saturated	Room	A	A	–	A
Potassium Dichromate	–	–	A	–	–	A
Potassium Ferricyanide	Saturated	Room	A	–	–	A
Potassium Ferricyanide & 5% NaCl	0.5	Room	A	–	–	A
Potassium Iodide	Saturated	Room	A	–	–	A
Potassium Iodide & 0.1% Na_2CO_3	Saturated	Room	A	–	–	A
Potassium Permanganate	Saturated	Room	A	–	–	A
Potassium Hydroxide	10	Boiling	A	A	–	
Potassium Hydroxide	25	Boiling	B	A	–	A
Potassium Hydroxide	50	Boiling	C	A	–	A
Potassium Nitrate	100	212	–	A	–	
Potassium Sulfate	10	Room	A	–	–	A
Potassium Thiosulfate	1	–	A	–	–	A
Propionic Acid	Vapor	374	C	–	–	A
Sea Water	–	Boiling	A	A	–	
Silver Nitrate	50	Room	A		–	A
Silver Nitrate	15	90	–	A	–	
Sodium Acetate	Saturated	Room	A	–	–	A
Sodium Aluminate	25	Boiling	A	–	–	A
Sodiun Bisulfate	Saturated	Boiling	A	–	–	A
Sodium Bisulfate	10, 25	Boiling	A	–	–	A
Sodium Carbonate	10, 25	Boiling	A	–	–	A
Sodium Chlorate	Saturated	Room	A	–	–	A
Sodium Chlorate	10-25	Room	A	–	–	A
Sodium Chloride	29	Boiling	A	A	A	A
Sodium Chloride	Saturated	Room	A	A	A	A
Sodium Chloride	Saturated	Boiling	A	A	A	A
Sodium Citrate	Saturated	Room	A	–	–	A
Sodium Cyanide	Saturated	Room	A	–	–	A
Sodium Dichromate	Saturated	Room	A	–	–	A
Sodium Fluoride	Saturated	Room	A	–	–	C
Sodium Fluoride	20	90	–	A	–	
Sodium Hydroxide	10, 25	Boiling	A	A	–	C
Sodium Hydroxide	28	Room	A	A	–	C
Sodium Hydroxide	40	176	B	A	–	C
Sodium Hydroxide	Saturated	Room	A		–	C
Sodium Hypochlorite	6	Room	A		–	A
Sodium Nitrite	Saturated	Room	A	–	–	A
Sodium Nitrite	50	200	–	A	–	
Sodium Phosphate	Saturated	Room	A	–	–	A
Sodium Phosphate	20	90	–	A	–	
Sodium Silicate	25	Boiling	A	–	–	A
Sodium Sulfate	10-20	Boiling	A	–	–	A
Sodium Sulfate	Saturated	Room	A	–	–	A
Sodium Sulfide	10	Boiling	A	–	–	A
Sodium Sulfide	Saturated	Room	A	–	–	A
Sodium Sulfite	10	Boiling	A	–	–	A
Sodium Sulfite	Saturated	Room	A	–	–	A
Sodium Sulfite	Saturated	Boiling	A	–	–	A
Sodium Thiosulfate	10, 25	Boiling	A	–	–	A
Sodium Thiosulfate – Acetic Acid	20-20	Room	A	–	–	A
Stannic Chloride	5	212	A	A	–	A

(continued)

TABLE 5.33: TITANIUM, ZIRCONIUM AND TANTALUM—ASTRO METALLURGICAL (continued)

MEDIA	CONCENTRATION %	TEMPERATURE °F	TITANIUM	ZIRCONIUM	TI-PD	TANTALUM
Stannic Chloride	24	Boiling	A	A	–	A
Stannic Chloride	24	140	A	A	–	A
Stannic Chloride	100	Molten	A	–	–	A
Stannous Chloride	Saturated	Room	A	–	–	A
Stannous Chloride	68	212	–	A	–	
Stearic Acid	100	360	A	–	–	A
Succinic Acid	–	365	A	–	–	
Sulfur Plus HO_4	–	Room	A	–	–	
Sulfur (Molten)	100	464	A	–	–	–
Sulfur Dioxide (Water saturated)	–	Room	B	–	–	A
Sulfur Dioxide (Dry)	–	275	B	–	–	A
Sulfuric Acid	1, 3	140	A	A	A	A
Sulfuric Acid	5	140	B	A	A	A
Sulfuric Acid	15	Room	A	A	–	A
Sulfuric Acid	To 70%	212	–	A	–	
Sulfuric Acid Plus 0.25% $CuSO_4$	5	200	A	–	–	
Sulfuric Acid Plus 0.25% $CuSO_4$	30	100	A	–		
Sulfuric Acid Plus 0.25% $CuSO_4$	30	200	A	–	–	
Sulfuric Acid Plus 0.5% $CuSO_4$	5	200	A	–	–	
Sulfuric Acid Plus 1.0% $CuSO_4$	30	100	A	–	–	
Sulfuric Acid Plus 1.0% $CuSO_4$	30	200	B	–	–	
Sulfuric Acid Plus 0.5% CrO_3	5	200	A	–	–	
Sulfuric Acid Plus 0.5% CrO_3	30	200	A	–	–	
Sulfuric Acid Plus 1.0% CrO_3	5	200	A	–	–	
Sulfuric Acid Plus 1.0% CrO_3	30	200	A	–	–	
Sulfuric Acid Vapors	96	100-300	A	–	–	A
Sulfuric Acid-Nitric Acid	90-10	Room	B	–	–	A
Sulfuric Acid-Nitric Acid	70-30	Room	B	–	–	A
Sulfuric Acid-Nitric Acid	50-50	Room	B	–	–	A
Sulfuric Acid-Nitric Acid	30-70	Room	A	–	–	A
Sulfuric Acid-Nitric Acid	10-90	Room	A	–	–	A
Sulfuric Acid-Nitric Acid	10-90	140	A	–	–	A
Sulfuric Acid-Nitric Acid	50-50	95	A	–	–	A
Sulfuric Acid-Nitric Acid	50-50	140	B	–	–	A
Sulfurous Acid	6	Room	A	A	–	A
Sulfurous Acid	Saturated	375	–	B	–	A
Sulfurous Acid-Partial Immersion	Saturated	Room	A	–	–	
Sulfurous Acid-Partial Immersion	Saturated	100	A	–	–	
Tannic Acid	25	212	A	A	–	A
Tartaric Acid	10-50	212	A	A	–	A
Tartaric Acid	10, 25, 50	140	A	A	–	A
Tetrachloroethane (water mixture)	100	Boiling	B	A	–	–
Toluene Sulphone Chloride	–	Room	A	–	–	
Trichloroacetic	100	212	C	C	–	–
Trichloroethylene	99	Boiling	B		–	–
Trisodium Phosphate	5, 20	212	–		–	
Urea-Ammonia	–	Elevated Temp. & Pres.	A	A	–	
X-Ray Developer Solution	–	Room	A	–	–	
Zinc Chloride	10	Boiling	A		–	A
Zinc Chloride	20	212	A	A	–	A
Zinc Chloride	Saturated	Room	A	–	–	A
Zinc Sulfate	Saturated	Room	A	–	–	A
Zinc	Molten	–	–	–		A

TABLE 5.34: TUNGSTEN, TANTALUM AND TITANIUM CARBIDE ALLOYS—KENNAMETAL

Kennametal hard carbide alloys

grade K602 is a carbide of tantalum and tungsten with a small amount of binder. It is used successfully for applications in which both corrosion and wear are exceptionally severe. The corrosion resistance of K602 is almost equal to that of platinum, while its resistance to wear is better than most other tungsten carbides. Compressive yield strength at elevated temperatures is exceptionally high.

K602 is used successfully in seal rings, including applications where the material runs against itself. Other applications include nozzles, orifice plates, bushings, valving parts, mortar and pestle sets. It has been found to be an ideal material where corrosion resistance and wear life are critical. It is sufficiently nonmagnetic for wear parts in magnetic tape recorders, particularly video tape applications.

grade K701 is a tungsten carbide with chromium cobalt binder. It provides maximum wear resistance, good to very-good corrosion resistance, and is stronger than K602. K701 is recommended where the higher corrosion resistance of K602 may not be required, or where more strength is needed than that provided by K602.

Used for homogenizing valve parts, K701 is withstanding solid-fluid dispersion materials at almost 1000 feet-per-second in processing such products as food, paint, and tobacco. It is used in nozzle and valve parts for handling slurries in refining petrochemicals, clay, soap, detergents, and other bulk products. Other applications include catalyst compacting dies and wear parts for coal processing.

grade K703 also contains chromium and cobalt. It is not quite as resistant to corrosion and wear as is K701, but it is stronger and more easily fabricated. It has been used extensively for pulverizing coal, minerals and chemicals.

grade K714 has an excellent combination of resistance to wear, corrosion and shock. It is easily fabricated and lower in cost than either K701 or K703. It has been applied with particular success in valving and nozzle applications where the components are used "as sintered" or with very little finishing because of cost considerations.

grade K801 is the strongest of the Kennametal corrosion-wear grade series, but has less wear resistance than the other grades. It is a hard tungsten carbide made with a nickel binder instead of cobalt —the binder usually found in tungsten carbides. K801 was developed for use where other grades are not sufficiently corrosion resistant but where conditions may not require the higher corrosion resistance and correspondingly higher cost of K602 or K701.

K801 has proved to be a better choice than other carbides for seal rings and other parts subjected to moderately corrosive conditions. It provides distinct advantages where electrolytic attack of the binder or etching may occur, such as when immersed in mineralized or boiler feed water.

In sodium hydroxide and hot sulfuric acid tests, K801 has shown better corrosion resistance than K701. K801 can also be used to advantage in radioactive atmospheres because the nickel binder has a much shorter half-life than the cobalt used as a binding element in most other carbides.

grades K3404, K3406, K3047, K3411 are used where high hardness and high resistance to impact are primary requirements. Included in such applications are form crush rolls and hammermills; also inserts and tips for bits used to cut and drill coal, rock and other minerals.

grades K82, K84, K86 are a gall resisting series made under the most rigid quality control to accept the fine surface and polish required. They have fine grain size, cobalt binder and—due to the large $WTiC_2$ content—a high resistance to "pickup" or galling. Compared to other Kennametal grades, they have slightly less abrasion resistance, but good strength, moderate rigidity and medium thermal expansion rates. The softer grades have higher cobalt content.

These grades are applied most extensively to tube and bar drawing operations, sheet metal drawing, cupping, deep drawing applications and sizing mandrels. They are used where the "slippery" quality of the tungsten-titanium carbide, well known in the metal cutting field, provides properties that are not available in straight tungsten carbide grades.

grades K92, K94, K95, K96 are a wear resisting series, essentially tungsten carbide of fine grain size with a cobalt binder. The hardest grades have the highest wear resistance and rigidity. When compared with other Kennametal grades, thermal expansion rates are low to medium.

(continued)

TABLE 5.34: TUNGSTEN, TANTALUM AND TITANIUM CARBIDE ALLOYS–KENNAMETAL (continued)

Kentanium

grade K162B has a nickel-molybdenum binder and is the best general purpose Kentanium grade. It has the greatest resistance to oxidation at temperatures in the 1000° to 1400° F range. It is used in seal rings and bearings (can run against itself), also for valve parts, check valve balls and hot flash trimming tools.

corrosion resistance of Kennametal and Kentanium is largely determined by the corrosion resistance of the binder metal since carbides themselves are nearly inert. At room temperature, cobalt has corrosion resistance about as good as other commonly used wear resistant materials. At elevated temperatures, however, it is attacked more rapidly. Therefore, Kennametal grades with the lowest cobalt content have the highest resistance in hot solutions. For more severe corrosive conditions the corrosion-wear series of Kennametal compositions has been developed. The corrosion resistance of grade K602, the carbide of tantalum and tungsten with a small amount of binder, is almost equal to that of the noble metals while possessing much greater resistance to wear than these more expensive metals.

Use of carbides for their corrosion resistance alone is seldom justified since other materials having this property are more workable and less costly. However, when abrasion is involved, the combined corrosion-wear resistance of Kennametal or Kentanium will give far better results.

corrosion-wear resistance of some carbides and metals

The weight loss in milligrams per square decimeter per day is shown in the table*

	type and binder	grade	50% NaOH		5% HNO_3		5% H_2SO_4		37% HCl		abrasion resistance factor	corrosion-wear factor**
			22°C	100°C	22°C	100°C	22°C	100°C	22°C	100°C		
corrosion-wear series	WC-TaC-Co	K602	0.3	3.1	9.5	35.1	1.7	9.8	0.2	3.4	470	23,500
	WC-Co-Cr	K701	0.8	1.8	390	125	116	1280	67	1713	825	123
		K703	nil	2.3	928	920	114	2007	363	3868	760	21
		K714	nil	31.7	364	498	89.1	1052	53.3	1354	380	71
	WC-Ni	K801	nil	nil	534	2310	128	153	106	2126	110	10
structural-wear-impact series	WC-Co	K3047	nil	nil	2235	decomposed	113	decomposed	706	decomposed	95	1
die and wear parts series	WC-Co	K96	nil	nil	1143	326	123	1661	163	1963	165	10
	complex carbide-Co	K86	nil	3.1	1731	546	273	2327	208	2977	55	2.5
high temp. resistance series (Kentanium) ***	TiC-Ni-Mo	K162B	nil	2.9	1333	....	39	232	1231	decomposed	20	0.2
metals	nickel	....	nil	....	nil	not good	39	poor	3041	very poor	16	0.05
	monel	....	nil	....	65.4	not good	40	poor	2648	very poor	12	0.04
	Co-Cr-Ni-W cast alloy	....	0.3	1.9	0.3	0.8	0.5	551	285	94,500	32	1

*Corrosion resistance tests were performed with ground samples in a Huey Corrosion Tester for seven days. The above values are averages of duplicate runs. Solution strengths were calculated on a weight basis and strengths were maintained by replacing with new solutions each day.

**corrosion-wear factor = abrasion resistance factor × 10 ÷ 22°C HCl loss.

***Kentanium has better corrosion resistance than the cobalt binder tungsten carbides in salt solutions.

TABLE 5.35: VARIOUS METALS AND ALLOYS—DURIRON

Durco Designation	COMPOSITION							
	Chromium	Nickel	Molybdenum	Copper	Silicon	Manganese	Carbon	Iron
Ductile Iron					2.75 max		3.0 min	Bal
Carbon Steel	0.40 max	0.50 max	0.25 max	0.50 max	0.60 max	1.00 max	0.30 max	Bal
Durco CF-8M	18.0-21.0	9.0-12.0	2.0-3.0		1.50 max	1.50 max	0.08 max	Bal
Durcomet 100	24.5-26.5	4.75-6.00	1.75-2.25	2.75-3.25	1.00 max	1.00 max	0.04 max	Bal
Durimet 20	19.0-22.0	27.5-30.5	2.0-3.0	3.0-4.0	1.50 max	1.50 max	0.07 max	Bal
Durco CY-40	14.0-17.0	Bal			3.00 max	1.50 max	0.40 max	11.00 max
Durco M-35		Bal		26.0-33.0	2.00 max	1.50 max	0.35 max	3.50 max
Nickel		95.0 min		1.25 max	2.00 max	1.50 max	1.00 max	3.00 max
Chlorimet 2	1.00 max	Bal	30.0-33.0		1.00 max	1.00 max	0.07 max	3.0 max
Chlorimet 3	17.0-20.0	Bal	17.0-20.0		1.00 max	1.00 max	0.07 max	3.0 max
Duriron					14.20-14.75	1.50 max	0.70-1.10	Bal
Durichlor 51	3.25-5.00				14.20-14.75	1.50 max	0.75-1.15	Bal
Superchlor	3.25-5.00				14.20-14.75	1.50 max	0.75-1.15	Bal
Durco DC-8	Proprietary Cobalt Base Shaft Sleeve Alloy							
Titanium	N,0.05 max; H,0.0100 max; O, 0.35 max.						0.10 max	0.30 max
Titanium-Pd	N, 0.05 max; H, 0.0100 max; O, 0.35 max; Pd, 0.12 min.						0.10 max	0.30 max
Zirconium	N, 0.03 max; H, 0.004 max; 0, 0.20 max; Hf, 4.5 max						0.10 max	0.30 max

	Ductile Iron & Carbon Steel	Durco CF-8M	Durcomet 100	Durimet 20	Durco CY-40	Durco M-35	Nickel	Chlorimet 2	Chlorimet 3	Duriron	Durichlor 51 & Superchlor	Durco DC-8	Titanium	Titanium-Pd	Zirconium
Acetate solvents	S	E	E	E	S	S	S	E	E	E	E	E	E	E	E
Acetic acid, all strengths	P	S	G	G	S	S	S	G	E	E	E	E	E	E	E
Acetic anhydride	P	G	G	G	G	G	G	G	E	E	E	E	E	E	E
Alum	P	S	G	G	P	P	S	G	G	E	E	E	S	S	E
Aluminum chloride	P	P	S	S	P	S	G	E	G	G	E	S	S	G	E
Aluminum sulfate & H_2SO_4	P	S	G	G	P	S	P	G	G	E	E	E	S	S	E
Ammonium chloride	P	P	S	G	G	S	S	E	E	G	E	G	E	E	E
Ammonium fluoride	P	S	G	G	S	S	S	S	G	P	P	E	S	S	P
Ammonium hydroxide	S	E	E	E	E	P	P	E	E	S	S	E	G	G	E
Ammonium nitrate	S	G	G	E	G	P	P	G	E	E	E	E	E	E	E
Ammonium phosphate	P	G	G	G	G	S	S	G	G	E	E	E	G	G	E
Ammonium sulfate	S	S	G	G	G	S	P	G	E	E	E	E	E	E	E
Ammonium sulfate & H_2SO_4	P	S	G	G	P	S	P	G	G	E	E	E	S	S	E
Aniline dyes	S	G	G	G	G	P	S	E	E	E	E	E	E	E	E
Aniline hydrochloride	P	P	S	S	P	S	S	S	G	S	G	S	G	G	E
Anodizing solutions	P	S	G	G	S	P	P	P	G	G	G	G	G	G	G
Antimony trichloride	P	P	S	S	S	S	S	S	G	G	G	G	G	G	E
Arsenic acid	P	G	G	G	G	G	S	E	E	G	G	E	E	E	E
Barium chloride	S	P	G	G	S	G	G	G	E	G	E	E	E	E	E
Barium nitrate	S	G	G	E	G	P	P	G	E	E	E	E	E	E	E
Barium sulfate	S	G	G	G	S	G	S	E	E	E	E	E	E	E	E
Benzoic acid	P	G	E	E	G	G	S	E	E	E	E	E	E	E	E
Black liquor	P	G	G	G	G	S	S	G	G	G	G	E	G	G	E
Boric acid	P	G	G	G	G	S	S	E	E	E	E	E	E	E	E

(continued)

TABLE 5.35: VARIOUS METALS AND ALLOYS—DURIRON (continued)

	Ductile Iron & Carbon Steel	Durco CF-8M	Durcomet 100	Durimet 20	Durco CY-40	Durco M-35	Nickel	Chlorimet 2	Chlorimet 3	Duriron	Durichlor 51 & Superchlor	Durco DC-8	Titanium	Titanium-Pd	Zirconium
Brine, acid	P	P	P	P	P	S	P	E	E	E	E	G	E	E	E
Brine, alkaline	G	G	E	E	E	E	E	E	E	G	G	E	E	E	E
Bromine, dry	P	P	S	S	G	G	G	G	G	P	P	G	P	P	E
Bromine, wet	P	P	P	P	P	P	P	P	G	P	P	S	E	E	P
Cadmium sulfate	S	G	E	E	S	G	S	E	E	E	E	E	E	E	E
Calcium bisulfate	P	G	G	G	P	S	P	S	G	P	P	E	G	G	E
Calcium bisulfite & H_2SO_4	P	S	G	G	P	S	P	P	G	P	P	E	P	S	E
Calcium chloride	S	S	G	G	G	G	G	E	E	E	E	E	E	E	E
Calcium hydroxide (lime)	S	G	G	G	G	G	G	G	G	G	G	G	G	G	E
Calcium hypochlorite	P	P	P	S	P	P	P	P	G	G	E	E	E	E	S
Calcium phosphate	S	G	G	G	G	G	G	G	E	E	E	E	G	G	G
Carbon bisulfide	P	G	G	G	E	S	G	S	E	G	G	E	S	S	E
Carbonic acid	S	G	E	E	G	P	S	E	E	E	E	E	G	G	E
Carbon tetrachloride	S	S	G	G	G	G	E	G	E	G	E	E	G	G	E
Cellulose acetate	S	G	G	G	S	S	S	G	E	E	E	E	E	E	E
Chloroacetic acid	P	P	P	P	P	S	S	P	G	G	E	E	E	E	G
Chlorinated water	P	P	S	S	P	S	S	P	G	G	E	G	E	E	P
Chlorine dioxide	P	P	P	P	P	P	P	P	S	S	E	G	E	E	P
Chlorine gas, wet	P	P	P	P	P	P	P	P	G	S	E	G	E	E	P
Chromic acid	P	P	S	S	P	P	P	P	S	E	E	S	G	G	E
Citric acid	P	G	E	E	G	S	S	G	E	E	E	E	G	G	E
Copper nitrate	P	G	G	E	S	P	P	P	E	E	E	E	E	E	E
Copper silver nitrate	P	G	G	G	S	P	P	P	E	E	E	E	E	E	E
Copper sulfate	P	S	E	E	S	P	P	G	E	E	E	E	E	E	E
Copper sulfate + 10% H_2SO_4	P	S	G	G	P	P	P	G	G	E	E	E	S	G	E
Cupric chloride	P	P	P	P	P	P	P	P	S	P	E	E	G	G	P
Cuprous chloride	P	P	G	G	P	P	P	P	E	E	E	E	G	G	E
Ethylene dichloride	P	S	S	S	S	G	E	G	G	G	E	E	G	G	E
Fatty acids	S	G	E	E	E	G	S	E	E	E	E	E	E	E	E
Ferric chloride	P	P	P	P	P	P	P	P	S	P	E	E	E	E	P
Ferric ferro-cyanide	P	G	G	G	S	P	P	G	E	E	E	E	E	E	E
Ferric nitrate	P	G	G	E	S	P	P	P	E	E	E	E	E	E	E
Ferric sulfate	P	G	E	E	S	P	P	G	E	E	E	E	E	E	E
Ferric sulfate + 10% H_2SO_4	P	S	G	G	P	P	P	P	G	E	E	G	G	E	E
Ferrous sulfate	P	S	E	E	S	S	P	E	E	E	E	E	E	E	E
Ferrous sulfate + 10% H_2SO_4	P	S	G	G	P	S	P	E	G	E	E	G	P	P	E
Formaldehyde	P	G	E	E	G	G	S	E	E	E	E	E	E	E	E
Formic acid	P	S	G	G	S	G	P	G	E	E	E	E	S	S	E
Glycerin, crude	P	G	G	G	G	S	S	S	G	E	E	G	G	G	E
HCl waste pickle liquor	P	P	P	P	P	P	P	S	G	S	G	P	S	E	S
Hydrochloric acid (<150° F)	P	P	P	P	P	S	S	G	S	S	S	S	P	S	E
Hydrochloric acid (>150° F)	P	P	P	P	P	P	P	G	P	P	S	P	P	S	E

(continued)

TABLE 5.35: VARIOUS METALS AND ALLOYS—DURIRON (continued)

	Ductile Iron & Carbon Steel	Durco CF-8M	Durcomet 100	Durimet 20	Durco CY-40	Durco M-35	Nickel	Chlorimet 2	Chlorimet 3	Duriron	Durichlor 51 & Superchlor	Durco DC-8	Titanium	Titanium-Pd	Zirconium
Hydrofluoric acid	P	S	S	G	P	G	P	G	G	P	P	G	P	P	P
Hydrofluosilicic acid	P	S	S	G	P	G	P	G	G	P	P	G	P	P	P
Hydrogen peroxide	S	G	G	G	G	G	G	P	G	G	G	G	G	G	E
Hypochlorite bleach	P	P	P	S	P	P	P	P	G	G	E	G	E	E	S
Iodine, dry	S	S	P	S	S	S	S	S	G	G	G	G	P	P	G
Lactic acid	P	G	G	G	G	S	S	G	E	E	E	E	E	E	E
Lead acetate	P	G	G	G	S	S	P	E	E	E	E	E	E	E	E
Lead nitrate	P	G	G	E	S	P	P	P	E	E	E	E	E	E	E
Lead sulfide	P	G	G	G	S	S	S	G	G	G	G	G	G	G	E
Lithopone	S	G	E	E	G	S	G	G	E	G	G	E	E	E	E
Magnesium chloride	S	P	G	G	G	G	S	G	E	G	E	E	E	E	E
Magnesium sulfate	S	G	G	G	G	G	S	E	G	E	E	E	E	E	E
Maleic acid	S	G	G	G	G	S	S	G	E	G	G	E	E	E	E
Malic acid	P	G	G	E	G	S	S	E	E	E	E	E	E	E	E
Manganese chloride	S	P	G	G	P	S	S	G	E	G	E	E	E	E	E
Mercuric chloride	P	P	P	P	P	P	P	P	S	P	E	E	G	G	G
Mercuric nitrate	P	G	G	E	G	P	P	P	E	E	E	E	E	E	E
Mercuric sulfate	P	S	E	E	S	P	P	G	E	E	E	E	E	E	E
Mercurous sulfate	P	S	G	E	S	P	P	E	E	E	E	E	E	E	E
Metal plating solutions	P	P	S	S	P	P	P	S	S	G	G	G	S	S	G
Mine water	P	G	G	G	E	P	P	G	E	G	G	E	E	E	E
Mixed acid	P	S	G	G	S	P	P	P	S	E	E	G	S	S	P
Nickel chloride	P	P	S	S	P	P	P	E	E	E	E	E	E	E	E
Nickel ammonium sulfate	P	G	E	E	S	P	P	E	E	E	E	E	E	E	E
Nitric acid, all strengths	P	S	G	G	S	P	P	P	S	G	G	G	G	G	P
Nitric acid + 3% – 5% HF	P	P	S	S	P	P	P	P	S	P	P	S	P	P	P
Nitrobenzene	S	E	E	E	G	P	P	E	E	E	E	E	E	E	E
Oleic acid	S	G	E	E	G	S	S	E	E	E	E	E	E	E	E
Oleum	S	G	G	G	S	P	P	G	G	P	P	G	P	P	P
Oxalic acid	P	S	G	G	G	G	S	G	G	E	E	E	P	P	E
Phenol	S	E	E	E	G	S	E	E	E	E	E	E	E	E	E
Phosphoric acid+2%H_2SO_4 1%HF	P	P	E	G	P	P	P	G	G	P	P	G	P	P	P
Phosphoric acid, all strengths	P	G	E	G	S	P	P	E	G	E	E	E	P	P	G
Picric acid	P	G	E	E	G	G	G	E	E	E	E	E	E	E	E
Phthalic acid	S	G	G	G	G	S	S	G	G	E	E	G	G	G	E
Potassium bisulfate	P	G	E	E	S	G	S	G	E	E	E	E	S	S	E
Potassium chloride	S	P	G	G	S	G	S	G	E	G	E	E	E	E	E
Potassium hydroxide	S	S	G	G	E	G	E	E	E	S	S	E	G	G	E
Potassium iodide	S	G	G	G	G	S	S	S	G	G	G	G	G	G	E
Potassium nitrate	S	E	E	E	E	G	E	G	E	E	E	E	E	E	E
Potassium sulfate	S	G	E	E	S	G	S	E	E	E	E	E	E	E	E
Pyridine sulfate	S	G	G	G	S	G	S	E	E	E	E	E	E	E	E

(continued)

TABLE 5.35: VARIOUS METALS AND ALLOYS—DURIRON (continued)

	Ductile Iron & Carbon Steel	Durco CF-8M	Durcomet 100	Durimet 20	Durco CY-40	Durco M-35	Nickel	Chlorimet 2	Chlorimet 3	Duriron	Durichlor 51 & Superchlor	Durco DC-8	Titanium	Titanium-Pd	Zirconium
Sea water	S	S	G	G	S	S	S	G	E	G	G	E	E	E	E
Sodium bicarbonate	S	E	E	E	E	E	E	E	E	E	E	E	E	E	E
Sodium bichromate	G	G	G	G	G	G	S	S	G	G	G	E	G	G	E
Sodium bisulfate	P	G	E	E	G	G	S	G	E	E	E	E	G	G	E
Sodium bisulfite	S	G	E	E	P	S	P	S	E	P	P	E	E	E	E
Sodium chlorate	P	G	G	G	G	G	G	P	G	G	E	E	G	G	E
Sodium chloride	S	S	G	G	S	E	G	G	E	G	E	E	E	E	E
Sodium ferricyanide	S	G	G	G	G	G	G	G	E	E	E	E	E	E	E
Sodium hydroxide	S	S	G	G	E	G	E	E	E	S	S	E	G	G	E
Sodium hydroxide, fused	P	P	P	P	E	P	E	S	S	P	P	S	P	P	E
Sodium hypochlorite	P	P	P	P	P	P	P	P	S	G	E	G	E	E	S
Sodium nitrate	S	E	E	E	E	S	G	S	E	E	E	E	E	E	E
Sodium perchlorate	P	S	G	G	P	S	S	G	G	G	E	E	E	E	G
Sodium phosphate	G	G	G	G	G	G	G	G	G	G	G	E	G	G	E
Sodium sulfate	S	G	E	E	G	G	S	E	E	E	E	E	E	E	E
Sodium sulfide	S	G	G	G	E	S	E	G	G	G	G	G	G	G	E
Sodium sulfite	S	G	E	E	S	S	S	S	E	P	P	E	E	E	E
Sodium thiosulfate	P	G	E	E	S	S	S	E	E	E	E	E	E	E	E
Stannic chloride	P	P	P	P	P	P	P	P	S	S	E	E	G	G	P
Stannous chloride	P	P	S	G	S	S	G	G	G	G	G	E	G	G	E
Stearic acid	S	G	E	E	G	S	S	E	E	E	E	E	E	E	E
Sulfite liquors	S	G	G	G	P	P	P	P	E	P	P	G	E	E	E
Sulfite liquors + H_2SO_4	P	P	S	G	P	P	P	S	G	P	P	G	S	S	E
Sulfur	S	G	G	G	G	S	G	G	G	G	G	G	G	G	E
Sulfur chloride	P	P	G	G	G	S	E	E	G	S	E	G	G	G	E
Sulfur dioxide	S	G	E	E	S	S	S	S	E	P	P	E	S	S	E
Sulfuric acid, sat. with SO_2	P	P	S	S	P	P	P	G	G	P	G	G	P	P	E
Sulfuric acid, up to 100° F	P	P	G	G	P	S	P	E	G	E	E	E	P	P	E
Sulfuric acid, 5% to boiling	P	P	G	G	P	G	P	S	G	G	G	G	P	G	E
Sulfuric acid 60-100%176° F	P	P	P	G	P	P	P	E	G	E	E	G	P	P	P
Sulfurous acid	P	S	S	G	P	P	P	P	E	P	P	G	P	P	E
Sugar solutions	S	E	E	E	E	G	E	E	E	E	E	E	G	E	E
Tannic acid	P	G	G	G	G	G	S	E	E	E	E	E	E	E	E
Tar and ammonia	S	S	G	G	G	P	P	G	G	S	S	G	G	G	E
Tartaric acid	P	G	G	G	G	G	S	G	G	E	E	G	E	E	E
Titanic sulfate	P	G	G	G	P	P	P	G	G	E	E	G	G	G	E
Toluene	S	E	E	E	E	G	E	E	E	E	E	E	E	E	E
Zinc chloride	P	P	S	G	P	G	P	G	E	G	E	E	E	E	E
Zinc sulfate	P	S	E	E	S	G	S	G	E	E	E	E	E	E	E

E = Excellent—Virtually unattacked under all conditions. G = Good—Generally acceptable with a few limitations. S = Satisfactory—Suitable under many conditions; not recommended for remainder. P = Poor—Unsuitable under all conditions.

TABLE 5.36: VARIOUS METALS AND ALLOYS—GENERAL METALS TECHNOLOGIES

CORROSION DATA—SALTS

MEDIA	Concentration	Temperature °F	Tantalum	Aluminum	Carpenter No. 20Cb 3	Copper	Cupro-Nickel	Hastelloy "B"	Hastelloy "C"	Incoloy 800	Incoloy 825	Inconel 600	Monel 400	Nickel 200	Silicon Bronze	Stainless Steel 304	Stainless Steel 316	Stainless Steel 430	Titanium Comm'l Grade	Zirconium
Acetyl Chloride		Cold & Boiling		B	B	C	C			B	B		AB		C	B	B			
Aluminum Acetate	Saturated		A	B	A	A	A	A	A	A	A	AB	AB		A	A	A			
Aluminum Chloride	5%	Room	A	AB	A	B	B	A	A		A		AB	B	B	C	C	C	A	A
Aluminum Fluoride	5%	Room	C	AB	A	A	A	A	A	B	A		AB	B	A	B	B	C		
Aluminum Hydroxide	Saturated		A	A	A	A	A			A	A		AB	AB	A	A	A	A	A	
Aluminum Oxalate				AB	A	A	A	A	A		A		AB		A					
Aluminum Potassium Sulphate	2%	Room	A	AB	A	A	A			•A	A		AB		A	•A	A	•A	A	
Aluminum Potassium Sulphate	10%	Room	A	AB	A	A	A		A	•A	A		AB		A	•A	A	•B	A	
Aluminum Potassium Sulphate	10%	Boiling	A	C	A	AB	AB				A		C		AB	•B	A	•C	A	
Aluminum Potassium Sulphate	Saturated	Boiling	A	C	A	AB	AB				A		C		AB	•B	B	•C	A	
Aluminum Sulphate	10%	Room	A	BC	A	B	B	A	A	A	A		AB	A	B	•A	A	•B	A	A
Aluminum Sulphate	10%	Boiling	A		A	AB	AB	A	A	AB	A		B	C	AB	•B	A	•C	A	A
Aluminum Sulphate	Saturated	Room	A	B	A	A	A	A	A	B	A	BC	AB	BC	A	•A	A	•C	A	
Aluminum Sulphate	Saturated	Boiling	A		A	AB	AB			B	A	C	B	C	AB	•B	A	•C	A	
Ammonia (Anhydrous—Dry)				A	A	A	A	A	A	A	A	A	AB	AB	A	A	A	A	B	
Ammonium Alum			A	B	A	C	B	A	A	A	A	AB			C	A	A	AB		
Ammonium Alum (Slightly Ammoniacal)			A	AB	A	C	C	A	A	A	A	AB	BC	BC	C	A	A	B		
Ammonium Bicarbonate		Hot	A	A	A	C	C			A	A	B	B	B	C	A	A			
Ammonium Bromide	5%	Room	A	AB	A	BC	BC	A	A	A	A		AB	AB	BC	A	A	B		
Ammonium Carbonate	All Conc.	Hot & Cold	A	A	A	B	B	A	A	A	A	A	A	A	B	A	A	A		
Ammonium Chloride	1%	Room	A	AB	A	B	BC	A	A	•A	A	A	A	A	C	•A	A	•A	A	A
Ammonium Chloride	10%	Boiling	A	C	A	C	C	A	A	•A	A	•A	AB	AB	C	•A	•A	•A	A	A
Ammonium Chloride	28%	Boiling	A	C	A	C	C	A	A	•B	A	•A	B	B	C	•B	•A		A	A
Ammonium Chloride	50%	Boiling	A	C	A	C	C		A	•B	A		AB	AB	C	•B	•A		A	A
Ammonium Hydroxide				AB	A	C	C	A	A	A	A	A	C	A	C	A	A	A	A	A
Ammonium Monosulphate			A	C	A	B	B	A	A	A	A		AB		B	A	A			
Ammonium Oxalate	5%	Room	A	A	A	C	B	A	A	A	A	AB	AB		C	A	A	B		
Ammonium Persulphate	5%	Room	A	B	A	B	B	C	A	A	A	AB	C	C	B	A	A	A		
Ammonium Phosphate	5%	Room	A	BC	A	B	B	A	A	A	A	AB	AB	AB	B	A	A	A	A	A
Ammonium Sulphate	1% to 5% Agitated, Aerated	Room	A	BC	A	B	B	A	A	A	A	AB	AB	AB	B	A	A	A	A	A
Ammonium Sulphate	10%	Boiling	A	C	A	B	B	A	B		A	B	AB	B	B	•B	•A		B	
Ammonium Sulphate	Saturated	Boiling	A	C	A	B	B	A	B		B	B	AB	B	B	•B	•A			
Ammonium Sulphite	Saturated	Cold & Boiling	A		A	C	C				B	C	C	C	C	A	A			
Amyl Acetate			A	A	A	A	A	A	A		A	A	A	A	A					
Amyl Chloride			A	BC	A	A	A	A	A	A	A	AB	AB	AB	A					
Aniline Hydrochloride	5%	Room	A	C		B	B	A	A					AB	B	C	C	C	A	A
Antimony Trichloride		Room	A	B		A	A			B	AB		AB	AB	A	C	C	C	A	
Barium Carbonate		Room	A	AB	A	A	A	A	A	A	A		AB		A	A	A	A	A	
Barium Chloride	5% to Sat.	Room	A	C	A	B	B	A	A	A	A		AB	AB	B	A	A	•A	A	A
Barium Chloride	Aqueous Sol.	Hot	A	C	A	BC	BC			B	A	AB	AB	AB	BC	•B	•A		A	A
Barium Hydrate				C	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A		
Barium Nitrate	Aqueous Sol.	Hot	A	A	A	B	B			A	A	AB			B	A	A		A	
Barium Sulphate		Room	A	A	A	A	A			A	A		AB	AB	A	A	A	A	A	
Butyl Acetate			A	A	A	A	A	A	A		A		AB		A					
Calcium Carbonate		Room	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Calcium Chlorate	Dilute	Hot or Cold	A		A	AB	B		A	A	A	AB	AB	AB	AB	A	A			
Calcium Chloride	Dil. or Conc.	Room	A	AB	•A	A	A	A	A		•A	A	AB	AB	A	••B	•A	C	A	A
Calcium Hydroxide	10% to 20%	Boiling	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A		
Calcium Hydroxide	50%	Boiling		C	A	A	A	A	A	C	A	AB	AB	AB	A	C	B		A	
Calcium Hypochlorite	2%	Room		C	C	C	B	C	A	•B	•A	C	C	C	C	•B	•A	•B	A	B
Calcium Sulphate	Saturated	Room	A	AB	A	A	A			A	A		AB		A	A	A	A		
Carbon Bisulphide		Room	A	A	A	A	A			A	A	A	AB	A	A	A	A	A		
Carbon Tetrachloride	Pure	Room	A	AB	A	AB	A	A	A	A	A	A	A	A	AB	•A	A	•A	A	A
Carbon Tetrachloride	5% to 10% Aqueous Sol.	Room		B	A	AB	A	A	A	A	A	A	A	A	AB	C	B	C	A	A
Chlorobenzene (Pure)	Concentrated	Room		AB	B	AB	A			AB	AB	AB	AB	AB	AB	A	A	A		
Copper Acetate	Saturated	Room	A	C	A	B	B	A	A	A	A	AB			B	A	A	A		
Copper Carbonate	Sat. Sol.		A	C	A	A	A	A	A	A	A	AB			A	A	A	A	A	
Copper Chloride	1% Agitated & Aerated	Room	A	C		C	B	Z	Z	•B	•A	B	B	B	C	•B	•A	•B	A	
Copper Chloride	5% Agitated	Room	A	C		C	C	A	A			C	C	C	C	•C	•B	•B	A	
Copper Chloride	5% Aerated	Room	A	C		C	C	A	A			C	C	C	C	•C	•C	•C	A	
Copper Cyanide	Saturated	Boiling	A	C	B	C	C	A	A			C	C	C	C	A	A	A	A	
Copper Nitrate	1% to 5%	Room	A	C	A	C	C	C	A	A	A	BC	C	C	C	A	A	A	A	
Copper Nitrate	50% Aqueous	Room	A	C	A	C	C	C	A	A	A	C	C	C	C	A	A		A	
Copper Sulphate	5%	Room	A	C	A	BC	B	A	A	A	A	B	B	B	BC	A	A	A	A	
Copper Sulphate	Saturated	Boiling	A	C	A	BC	BC			A	A	C	C	C	BC	A	A		A	
Cupric Nitrate		105°	A	C	C	C	BC	C	A	C	C	C	C	C	C	C	C	C	A	C
Cupric Nitrate			A	C	A	C	C	C	A	A	A	C	C	C	C	A	A			
Ethyl Acetate			A	A	A	A	A	A	A	AB	A	A	A	A	A					
Ethyl Chloride	5%	Room	A	AB	A	A	AB	A	A	A	A		AB	AB	A	A	A	A		
Ethylene Chloride		Room	A	AB	A	B	B			A	A	B	A	A	B	A	A		A	AB
Ferric Chloride	1% Still	Room	A	C	C	C	C	C	A	C	C	C	C	C	C	†•B	•A	•B	A	C
Ferric Chloride	1% Still	Boiling	A	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	A	C
Ferric Chloride	5% Still	Room	A	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	A	C
Ferric Chloride	5% Agitated	Room	A	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	A	C
Ferric Chloride	5% Aerated	Room	A	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	A	C
Ferric Hydroxide		Room	A		A	B	B	C	A	A	A	A	AB	AB	B	A	A			
Ferric Nitrate	1% to 5%	Room	A	C	A	C	C	C	A	A	A	C	C	C	C	A	A	A		
Ferric Sulphate	1% to 5%	Room	A	C	A	C	C	C	A	AB	A	C	B	C	C	•A	A	A		
Ferrous Chloride		Room	A	C	C	B	B	A	A		•B	C	C	C	B				A	
Ferrous Sulphate	Dilute	Room	A	AB	A	B	B	A	A	A	A	C	C	C	B	A	A	A		
Ferrous Ammonium Citrate			A	B		B	B	A	A			AB			B					
Hydrogen Peroxide		Room	A	A	A	BC	BC	B	A	AB	A	AB	AB	AB	BC	††A	††A	††A	A	A
Hydrogen Peroxide		Boiling	A	A	A	C	C	B	A		A				C	††B	††A	††B	A	
Hydrogen Sulphide	Dry	Room	A	A	A	A	A	B	A	A	A	AB	AB	B	A	A	A	††A	A	
Hyposulphite Soda (Hypo)			A	A		B	B					AB	AB	AB	B	A	A	B		
Lactic Acid Salts			A	AB	A	A	A	A	A	A	A	AB	B	B	A	A	A			
Lead Acetate			A	BC	A	B	B	A	A	A	A	B	AB	AB	B	A	A	A	A	

(continued)

TABLE 5.36: VARIOUS METALS AND ALLOYS—GENERAL METALS TECHNOLOGIES (continued)

CORROSION DATA—SALTS

MEDIA	Concentration	Temperature °F	Tantalum	Aluminum	Carpenter No. 20Cb 3	Copper	Cupro-Nickel	Hastelloy "B"	Hastelloy "C"	Incoloy 800	Incoloy 825	Inconel 600	Monel 400	Nickel 200	Silicon-Bronze	Stainless Steel 304	Stainless Steel 316	Stainless Steel 430	Titanium Comm'l Grade	Zirconium
Manganese Carbonate			A	A	A	A	A			A	A	AB	AB	AB	A	A	A	A	A	
Manganese Chloride	10% to 50% Aqueous Sol.	Boiling	A		B	BC	BC			A	A	AB	AB	AB	BC	A	A		A	
Magnesium Carbonate			A	AB	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Magnesium Chloride	1% to 5% Still	Room	A	B	A	B	B	A	A	A	A	A	A	A	B	•A	A	C	A	A
Magnesium Chloride	1% to 5% Still	Hot	A	C	A	B	B	A	A	A	A	A	A	A	B	B	•B	C	A	A
Magnesium Hydroxide	Thick Suspension	Room	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A		A	
Magnesium Nitrate			A	A	A	B	B	C	A	A	A	AB			B	A	A	A	A	
Magnesium Sulphate	5%	Hot	A	A	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	
Methylene Chloride	40%	Room to Boiling		BC	A	A	A	A	A	A	A		AB	AB	A	A	A	A		
Mercuric Bichloride	0.07%	Room	A	C		C	C	C	C	•A	•A				C	•A	•A			
Mercuric Chloride	Dilute	Room	A	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	A	A
Mercuric Cyanide			A	C	A	C	C	C	A	C	B	C	C	C	C	A	A		A	
Mercurous Nitrate			A	C	A	C	C	C	A	B	A	B	C	C	C	A	A	A		
Nickel Chloride		Room	A	C	A	BC	B	C	A	AB	A		AB		B	B	•A	C	A	AB
Nickel Nitrate	10%	Room	A	BC	A	B	B	AB	A	A	A	C	C	C	B	A	A	A		
Nickel Sulphate	10%	Room	A	BC	A	A	A	A	A	A	A	B	B	B	A	A	A	B		
Nitrous Oxide	Dry		A	A	A	A	A	C	A		A	C	C	C	A					
Phosphoric Anhydride	Dry	Room	A	A	A	A	A			A	A				A	A	A			
Phosphorous Trichloride			A	BC	A	BC	BC	C	A	A	A			AB	BC	A	A			
Potassium Bichromate	Neutral	Room	A	A	A	A	A	C	A	A	A	AB	AB	AB	A	A	A	A	A	
Potassium Bromide	5%	Room	A	B	A	A	A	A	A	A	A	AB	AB	AB	A	•B	•A		A	
Potassium Carbonate	1%	Room	A	BC	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	
Potassium Chlorate			A	AB	A	AB	B	C	A	C	AB	C	C	C	AB	A	A	A	A	
Potassium Chloride	1% to 5%	Room	A	AB	A	A	A	A	A	•A	A	•B	A	A	A	•A	•A	•A	A	
Potassium Chloride	1% to 5%	Boiling	A	B	A	BC	BC	C	A	•A	A	•B	AB	AB	BC	•A	•A	•A	A	
Potassium Cyanide			A	C	A	C	C	A	A	A	A	B	AB	B	C	A	A	A		
Potassium Dichromate	Neutral		A	A	A	A	A	C	A	A	A	AB	B	B	A	A	A	A		
Potassium Ferricyanide	5%	Room	A	A	A	A	A	A	A	A	A	B	B	B	A	A	A	A	A	
Potassium Ferrocyanide	5%	Room	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A		
Potassium Hydrate				C	A	A	A	A	A	A	A	A	A	A	A	A	A	A		
Potassium Hydroxide	5%	Room	A	C	A	B	A	A	A	A	A	B	A	A	B	A	A	A	A	A
Potassium Hydroxide	27%	Boiling	C	C	A	BC	BC	A	A	A	A	B	A	A	BC	A	A		A	A
Potassium Hydroxide	50%	Boiling	C	C	A	B	B	A	A	A	A	B	A	A	B	B	A		A	
Potassium Hypochlorite				C	A	C	B	C	A	C	BC	C	C	C	C	C	C	C	A	
Potassium Iodide			A	B	A	A	A	A	A	AB	A	AB	B	B	A	A	A		A	
Potassium Nitrate	5%	Room	A	A	A	A	A	C	A	A	A	AB	AB	AB	A	A	A	A	A	
Potassium Oxalate			A	B	A	A	A	A	A	A	A			AB	A	A	A	A		
Potassium Permanganate	Neutral		A	A	A	A	A	C	A	A	A	AB	AB		A	A	A	A	A	
Potassium Sulphate	1% to 5%	Room	A	A	A	A	A	A	A	A	A	B	AB	B	A	A	A	A	A	
Potassium Sulphate	1% to 5%	Hot	A	B	A	B	B			A	A	AB	A3	AB	B	A	A		A	
Potassium Sulphide (Salt)			A		A	C	C			A	A				C	A	A		A	
Quinine Bisulphate (Dry)			A		A	A^{o}	A^{o}	A	A	B	A		AB		A^{o}	B	A	B		
Quinine Sulphate (Dry)			A		A	A^{o}	A^{o}	A	A	A	A		AB		A^{o}	A	A	B		
Silver Bromide			A	C	A	C	C	A	A	•B	A		AB		C	•B	•A	C		
Silver Chloride			A	C	A	C	C	C	A		A				C	C	C	C	A	
Silver Cyanide			A	C	A	C	C	A	A	A	A		AB		C	A	A	A	A	
Silver Nitrate			A	C	A	C	C	AB	AB	A	A	AB	C	C	C	A	A	A	A	
Sodium Acetate (Moist)	5%	Room	A	A	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A		
Sodium Benzoate			A	A		A	A	A	A				AB		A					
Sodium Bicarbonate	All Conc.	150°	A	AB	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Sodium Bichromate	Neutral		A	A	A	A	A	C	A	A	A	AB			A	A	A	A	A	
Sodium Bisulphate			A	AB	A	B	B	A	A	A	A	AB	AB	AB	B	A	A		A	
Sodium Borate			A	AB	A	A	A	A	A	A	A		AB		A	A	A	A	A	
Sodium Bromide	5%	Room	A	B	A	A	A	A	A	A	A	B	AB	B	A	A	A		A	
Sodium Carbonate	All Conc.	Room	A	AC	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	
Sodium Chlorate	25%		A	AB	A	AB	AB	C	A	A	A	AB			AB	A	A	A	A	
Sodium Chloride	5% Still	Room to 105°	A	AB	A	A	A	A	A	•A	A	A	A	A	A	•A	•A	•B	A	A
Sodium Chloride	20% Aerated	Room	A	B	A	A	A	A	A	•A	A	A	A	A	A	•A	•A		A	
Sodium Chloride	Saturated	Room	A	B	A	A	A	A	A	•A	A	A	A	A	A	•A	•A		A	
Sodium Chloride	Saturated	Boiling	A	B	A	A	A	A	A	•A	A	A	A	A	A	•B	•A		A	
Sodium Citrate			A	C	A	A	A	A	A	A	A	AB		AB	A	A	A	A	A	
Sodium Ferricyanide			A	A	A	A	A	A	A	•A	A	AB	AB		A	•A	•A	•A		
Sodium Ferrocyanide			A	A		A	A								A					
Sodium Fluoride	5%	Room	C	B		BC	A	A	A			A	AB		A	•B	B	C	A	
Sodium Hydrosulphite			A	A	A	B	B	B	A		A	A	A	A	B					
Sodium Hydroxide	10%	Room	C	C	A	B	A	A	A	A	A	A	A	A	B	A	A	A	A	A
Sodium Hypochlorite	5%	Room		BC	B	C	C	C	A	•B	•A	C	C	C	C	•B	•A	C	B	B
Sodium Hyposulphite	Dilute	Room	A		A	B	B	A	A	AB	A	AB	AB	AB	B	††A	A	††B		
Sodium Lactate			A	C	A	A	A	A	A	A	A		AB		A	A	A			
Sodium Nitrate	All Conc.	Room	A	A	A	A	A	C	A	A	A	A	AB	AB	A	A	A	A	A	
Sodium Nitrite			A	A		A	A			B	AB	B	B	B	A	A	A		A	
Sodium Peroxide		212°	C	AB	A	B	B	C	A	A	A	AB	AB	AB	B	A	A			
Sodium Phosphate	5%	Room	A	AB	A	A	A	A	A	A	A	AB	AB	AB	A	A	A		A	
Sodium Silicate			A	AB	A	A	A	A	A	A	A		AB		A	A	A	A	A	
Sodium Sulphate	5% Still	Room	A	A	A	A	A	A	A	A	A	AB	AB	B	A	A	A	A	A	
Sodium Sulphate	Concentrated	Room	A	A	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	
Sodium Sulphide	Saturated	Room	A	BC	A	C	B	A	/	AB	A	AB		AB	C	•B	A	•B	A	
Sodium Sulphite	5%	Room	A	A	A	B	B	C	A	A	A		B		B	A	A	B	A	
Stannic Chloride	5%	Room	A	C	A	C	C	A	A	C	B	B	AB	AB	C	C	C	C	A	A
Stannous Chloride	5%	Room	A	C	A	B	B	A	A	AB	A	AB	AB	AB	B	C	B	C	A	
Sulphur Chloride	Dry		A	C	A	A	A	A	A		A		AB	AB	A	C	C	C		
Sulphur Dioxide	Dry	Room	A	A	A	A	A	C	A	A	A	A	A	A	A	A	A		A	
Sulphur Dioxide	Moist	Room	A	B	A	B	B	C	A	B	A	A	A	A	B	B	A	C	A	
Titanium Tetrachloride			A	C	A	B	B	C	A		A		AB		B	A			A	
Zinc Chloride	5% Still	Room	A	C	A	B	B	A	A	B	A	AB	AB	AB	B	C	B	C	A	A
Zinc Chloride	5% Still	Boiling	A	C	A	B	B	AB	AB	C	A	B	B	AB	B	C	•B	C	A	A
Zinc Sulphate	5%	Room	A	AB	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	
Zinc Sulphate	Saturated	Room	A	AB	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	
Zinc Sulphate	25%	Boiling	A	AB	A	B	B	A	A	A	A	AB	AB	AB	B	A	A		A	

A—Fully resistant
B—Slightly attacked
C—Unsatisfactory

•—Subject to pitting at air line or when allowed to dry
••—Keep solution alkaline
††—May attack when sulphuric acid is present

†—May attack when hydrochloric acid is present
°—Tin-coated
*—Not recommended for use with beverages

(continued)

TABLE 5.36: VARIOUS METALS AND ALLOYS–GENERAL METALS TECHNOLOGIES (continued)

CORROSION DATA–ACIDS

MEDIA	Concentration	Temperature °F	Tantalum	Aluminum	Carpenter No. 20Cb-3	Copper	Cupro-Nickel	Hastelloy "B"	Hastelloy "C"	Incoloy 800	Incoloy 825	Inconel 600	Monel 400	Nickel 200	Silicon-Bronze	Stainless Steel 304	Stainless Steel 316	Stainless Steel 430	Titanium Comm'l Grade	Zirconium
Acetic Acid	5% Unaerated	Room	A	A	A	A	AB	A	A	A	A	AB	A	AB	A	A	A	A	A	A
Acetic Acid	20% Unaerated	Room	A	A	A	A	A	A	A	A	A	AB	AB	B	A	A	A	A	A	A
Acetic Acid	50% Unaerated	Room	A	A	A	AB	A	A	A	A	A	AB	AB	AB	A	A	A	...	A	A
Acetic Acid	50% Unaerated	Boiling	A	B	A	C	BC	A	A	B	A	...	AB	AB	BC	C	B		A	A
Acetic Acid	100% Unaerated	Room	A	A	A	A	A	A	A	B	A	...	AB	AB	A	A	A	A	A	A
Acetic Acid	100% Unaerated	Boiling	A	C	A	C	C	A	A	C	A	C	AB	B	C	C	B	...	A	A
Acetic Anhydride	Unaerated	Room	...	A	A	A	AB	A	A	A	A	AB	AB	A	A	A	A	A	A	A
Acetic Anhydride	Unaerated	Boiling	...	B	A	C	C	A	A	A	A	B	B	A	C	A	A	C	A	A
Acetic Vapors	100% Unaerated	Hot	...	AB	A	B	B	A	A	...	A	AB	AB	B	B	C	C	C	A	...
Arsenic Acid	90%	225°	...	B	...	B	B	...	...	B	...	B	...	...	B	B	B	B	...	...
Benzoic Acid	5%	Room	A	A	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	...	...
Boric Acid	5%	Boiling	A	A	A	A	A	A	A	A	A	B	AB	B	A	A	A	A	...	...
Butyric Acid	5%	Room	A	A	A	A	A	A	A	A	A	AB	B	AB	A	A	A	A	...	...
Carbonic Acid			A	A	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	...
Carbolic Acid, C. P.		Room	A	A	A	A°	A°	A	A	A	A	AB	AB	AB	A°	•A	•A	C	...	A
Chloroacetic Acid		Room	A	C	C	BC	BC	A	A	C	C	AB	AB	AB	BC	C	C	C	A	B
Chloric Acid		Room	...	C	A	...	...	...	...	...	A	...	...	...	...	C	C	C	...	...
Chlorosulphonic Acid	10%		A	BC	C	...	...	A	A	C	C	C	C	C	...	C	C	...	...	...
Chromic Acid	5%	Room	A	AB	A	C	C	C	A	A	A	AB	C	C	C	A	A	B	A	...
Chromic Acid, C. P.	10%	Boiling	A	AB	C	C	C	C	A	C	BC	C	C	C	C	C	B	C	A	...
Chromic Acid	50%	Boiling	A	AB	C	C	C	C	B	C	C	C	C	C	C	C	C	C	B	...
Citric Acid	5% Still	150°	A	A	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	A
Citric Acid	15%	Room	A	A	A	A	A	A	A	AB	A	AB	AB	AB	A	A	A	A	A	A
Citric Acid	15%	Boiling	A	BC	A	B	B	A	A	AB	A	AB	AB	AB	B	B	A	AB	A	A
Citric Acid	Concentrated	Boiling	A	BC	A	B	B	A	A	BC	AB	B	B	B	B	C	B	...	A	AB
Fatty Acids			A	A	A	A	A	A	A	A	A	A	AB	AB	A	...	...	...	...	...
Formic Acid	5% Still	Room to 150°	A	C	A	A	A	A	A	B	A	B	B	AB	A	•B	•A	C	B	A
Gallic Acid	5%	Room to Boiling	...	A	A	A	A	A	A	B	A	B	B	B	A	A	A	A		
Hydrobromic Acid		Boiling	A	C	C	C	C	A	B	C	C	C	C	C	C	C	C	C	...	...
Hydrochloric Acid	5% Unaerated	Room	A	C	C	C	BC	B	A	C	B	B	AB	B	BC	C	C	C	B	A
Hydrochloric Acid	10% Unaerated	Room	A	C	C	C	BC	A	A	C	B	C	B	B	C	C	C	C	B	A
Hydrochloric Acid	20% Unaerated	Room	A	C	C	C	BC	A	A	C	B	C	C	C	C	C	C	C	C	A
Hydrochloric Acid	All	100°	A	C	C	C	C	A	A	C	BC	C	C	C	C	C	C	C	C	A
Hydrochloric Acid	All	122°	A	C	C	C	C	B	B	C	BC	C	C	C	C	C	C	C	C	A
Hydrochloric Acid	All	160°	A	C	C	C	C	A	B	C	C	C	C	C	C	C	C	C	C	C
Hydrochloric Acid Fumes	Concentrated	100°	A	C	C	C	BC	...	...	C	BC	C	C	C	C	C	C	C	C	C
Hydrocyanic Acid			A	A	A	C	C	A	A	A	A	...	AB	...	C	A	A	C	A	...
Hydrofluoric Acid	All	All	C	C	C	C	BC	A	A	C	C	A	A	A	C	C	C	C	C	C
Hydrofluoric Acid, Vapors		212°	C	C	C	C	BC	A	A	C	C	A	A	A	C	C	C	C	...	C
Hydrofluosilicic Acid	5%	70°	C	...	A	C	BC	A	A	B	A	B	AB	B	C	C	C	...	C	...
Hydrofluosilicic Acid Vapors		212°	C	...	C	...	...	...	...	...	...	...	AB	...	...	C	C	...	...	...
Lactic Acid	5%	Room	A	AB	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	A
Lactic Acid	5%	150°	A	BC	A	A	A	A	A	B	A	B	C	C	A	B	A	B	A	A
Lactic Acid	10%	150° to Boiling	A	...	A	AB	AB	A	A	C	A	B	C	C	AB	C	B		A	AB
Malic Acid		Cold & Hot	A	A	A	C	BC	A	A	A	A	AB	AB	AB	C	A	A	B	A	...
Molybdic Acid	5%	Room	A	...	A	...	...	A	A	A	A	...	...	...	...	A	A		...	...
Muriatic Acid		Room	A	C	C	C	BC	A	A	...	B	C	C	C	C	C	C	C	...	...
Nitric Acid	5%	Room	A	BC	A	C	C	C	A	A	A	C	C	C	C	A	A	A	A	A
Nitric Acid	20%	Room	A	C	A	C	C	C	A	AB	A	C	C	C	C	A	A	A	A	A
Nitric Acid	50%	Room	A	C	A	C	C	C	A	AB	A	AB	C	C	C	A	A	A	A	A
Nitric Acid	50%	Boiling	A	C	A	C	C	C	C	AB	A	C	C	C	C	A	A	A	A	A
Nitric Acid	65%	Boiling	A	C	A	C	C	C	C	B	A	C	C	C	C	B	B	C	B	A
Nitric Acid	95%	Room	A	A	A	C	C	C	A	C	A	C	C	C	C	...	...	...	A	A
Nitric Acid	Concentrated	Room	A	A	A	C	C	C	A	C	A	C	C	C	C	A	A	A	A	A
Nitric Acid	Concentrated	Boiling	A	C	A	C	C	C	C	C	A	C	C	C	C	B	B	C	B	A
Nitric Acid	Fuming	Room	...	A	A	C	C	C	A	C	A	C	C	C	C	A	A	A	C	A
Nitrous Acid	5%	Room	A	AB	A	B	B	...	...	A	A	AB	...	...	B	A	A	A	A	...
Oleic Acid		Room	A	A	A	A	AB	A	A	B	B	A	AB	AB	A	•A	A	•B	A	...
Oxalic Acid	5%	Cold & Hot	A	B	A	A	A	A	A	A	A	...	AB	...	A	A	A	A	C	...
Oxalic Acid	10%	Room	A	B	A	A	A	A	A	A	A	AB	AB	B	A	A	A	...	A	AB
Oxalic Acid	10%	Boiling	A	C	A	AB	AB	B	A	...	A	AB	AB	B	AB	C	C	...	C	AB
Phosphoric Acid	1%	Room	A	C	A	B	BC	A	A	A	A	A	AB	A	B	††A	††A	††A	A	A
Phosphoric Acid	5%	Room	A	C	A	B	BC	A	A	A	A	AB	AB	A	B	A	A	A	A	A
Phosphoric Acid	10% Still	Room	A	C	A	B	BC	A	A	B	A	AB	AB	AB	B	A	A	B	A	A
Phosphoric Acid	10% Agitated	Room	A	C	A	B	BC	A	A	B	A	B	B	AB	B	A	A	B	A	A
Phosphoric Acid	10% Aerated	Room	A	C	A	B	BC	A	A	B	A	B	AB	B	B	A	A	B	A	A
Picric Acid	Concentrated	Room	...	A	A	C	C	A	A	B	B	C	C	C	C	A	A	A	...	...
Pyrogallic Acid			...	A	A	A	A	A	A	A	A	...	...	AB	A	A	A	A	A	...
Salicylic Acid			A	A	A	A	A	A	A	...	A	AB	AB	AB	A	...	...	...	A	...
Stearic Acid	Concentrated	200°	A	A	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	...
Succinic Acid		Molten	...	A	...	A	A	B	B	...	A	AB		...	A	C				...
Sulphuric Acid	5%	Room	A	BC	A	BC	BC	A	A	B	A	AB	A	AB	BC	C	B	C	B	A
Sulphuric Acid	5%	Boiling	A	C	A	BC	BC	A	B	...	AB	C	AB	BC	BC	C	C	C	C	A
Sulphuric Acid	10%	Room	A	B	A	BC	BC	A	A	...	AB	C	AB	C	BC	C	B	C	B	A
Sulphuric Acid	10%	Boiling	A	C	B	C	C	A	B	C	AB	C	B	C	C	C	C	C	C	A
Sulphuric Acid	50%	Room	A	C	A	BC	BC	A	A	C	AB	C	B	C	BC	C	C	...	B	A
Sulphuric Acid	50%	Boiling	A	C	BC	C	C	A	C	C	BC	C	C	C	C	C	C	C	C	A
Sulphuric Acid	Concentrated	Room	A	A	A	C	C	A	A	A	A	...	AB	...	C	A	A	A	C	C
Sulphuric Acid	Concentrated	Boiling	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sulphuric Acid	Concentrated	300°	A	C	BC	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sulphuric Acid	Fuming	Room	C	A	A	C	C	A	B	C	C	C	C	C	C	C	B	...	C	...
Sulphuric Anyhdride	Dry	Room	C	A	...	B	B	A	A	C	B	C	C	D	B	...	...	...	...	...
Sulphurous Acid	Saturated	375°	A	B	A	C	C	C	A	C	A	C	C	C	C	C	B	C	A	B
Sulphurous Spray		Room	A	B	A	B	B	C	A	C	A	C	C	C	B	C	C	...	A	...
Tannic Acid	10%	Room	A	A	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	A
Tannic Acid		150°	A	AB	A	A	A	A	A	B	A	B	B	B	A	B	A	B	A	A
Tartaric Acid	10%	Room	A	BC	A	A	A	A	A	A	A	AB	AB	AB	A	A	A	A	A	B
Tartaric Acid		150°	A	BC	A	A	A	A	A	B	A	B	B	B	A	B	A	C	A	...
Trichloroacetic Acid		Room	...	C	...	BC	B	...		C	C	...	B	...	BC	C	C	C	C	...
Uric Acid	Concentrated		...	C	A	A	A	A	A	A	A	AB	...	...	A	A	A	A	A	...

A–Fully resistant
B–Slightly attacked
C–Unsatisfactory

•–Subject to pitting at air line or when allowed to dry
••–Keep solution alkaline
††–May attack when sulphuric acid is present

†–May attack when hydrochloric acid is present
°–Tin-coated
*–Not recommended for use with beverages

(continued)

TABLE 5.36: VARIOUS METALS AND ALLOYS—GENERAL METALS TECHNOLOGIES (continued)

CORROSION DATA—MISCELLANEOUS

MEDIA	Concentration	Temperature °F	Tantalum	Aluminum	Carpenter No. 20Cb 3	Copper	Cupro Nickel	Hastelloy "B"	Hastelloy "C"	Incoloy 800	Incoloy 825	Inconel 600	Monel 400	Nickel 200	Silicon Bronze	Stainless Steel 304	Stainless Steel 316	Stainless Steel 430	Titanium Comm'l Grade	Zirconium
Aniline	Conc.	Room	A	AB	A	A	C	A	A	A	A	B	B	B	A	A	A	A	A	
Bleaching Powder	Solution	Hot	C	C	AB	B	B	C	A		B	C	C	C	B	BC	AB			
Bromine	Dry		A	A	A	A	A	C	A	C	A	A	A	A	A	C	C	C	AC	
Bromine Water		Room	A	C	AB	C	BC	C	A	C	B	C	C	C	C	C	C	C		C
Camphor			A	A	A	A	A	A	A		A			AB	A	A	A	A		
Cadmium		Molten	A	C		C	C	C	C	C	C	C	C	C	C	C	C		AC	
Caustic Lime			A	AC		A	A	A	A	A		A	A	A	A	A	A			
Chlorinated Water	Saturated	Room	A	AC	A	C	C	C	A	C	A	C	C	C	C	C	•B	C	A	C
Chlorine Gas—Dry		Room	A	A	A	A	A	A	A	C	A	A	A	A	A	C	C	C	C	B
Chlorine Gas—Moist		Room	A	C	C	C	C	C	A	C	C		AB	AB	C	C	C	C	A	C
Chlorine Gas—Moist		212°	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	A	C
Chloroform		Room	A	AB	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Chromium Plating Bath		Room	A		AB	C	C				AB	C	C	C	C	AB	AB		AB	
Developing Solutions		Room	A		A	A°	A°	A	A	A	A	A			A°	A	A	B		
Dyewood, Liquor		Room	A													††A	A			
Flue Gases			A	B	AB	BC	BC	B	A	A		AB			BC		AB		A	
Fluorine		Room	C	A	BC	BC	C			C	C	A	A	A	C	C	C	C	A	
Formaldehyde		Room	A	AB	A	A	A	A	A	A	A	A	A	A	A	•A	•A	•A	A	
Fuel Oil (Containing H_2SO_4)		Hot	A	BC	A	AB	AB	A	A	B	A	C	B	C	AB	C	B			
Furfural			A	A	A	A	A	A	A	A	A	B	B	B	A	A	A		A	A
Glauber's Salt	Solution	Hot	A	A	A	A	A	A	A	A	A		AB		A	A	A			
Glue—Solution Acid		Hot	A	B	A	AB	AB	A	A	A	A	AB	A	A	AB	•B	A			
Iodine			A	AB	C	C	AC	C	A	C	C	C	A	A	C	C	C	C		
Iodoform			A	A												C	A			
Lead		Molten	A	A		C	C	A	A	C	C	C	C	C	C	C	C	C	AC	
Lye (Caustic)	34%	230°	C	C	A	AB	A	A	A	A	A	A	A	A	AB	A	A	B		
Lysol		212°	A	AC	A	AB	A	A	A	AB	A	A	A	A	AB	•A	•A	C		
Mercury			A	C	A	C	C	A	A	A	A	A	AB	AB	C	A	A	A	A	
Mine Water—Acid			A	B	A	B	B	A	A	•A	A	A	C	C	B	•A	•A			
Mustard		Room	A	AB		A°	A°	A	A				AB		A°	•A	•A	C		
Sal Ammoniac	20%	Boiling	A	C	A	C	C	A	A	B	A		AB		C	B	B		B	
Salt	Saturated	Room	A	AB	•A	A	A	A	A	•A	A	A	A	A	A	••B	•A	C	A	A
Salt Brine	Saturated	Hot	A	B	•A	AC	A	A	A	AB	A	AB	AB	AB	AB	•A	•A		A	
Sea Water			A	AB	A	AC	A	A	A	•A	A	AB	AB	AB	AB	•A	•A	C	A	A
Sewage			A	AB		B	AB			A	A				B	††A	††A			
Soaps		Room	A	BC	A	AB	AB	A	A	A	A	A	A	A	AB	A	A	A		
Sulphur—Dry		Molten	A	A	A	C	C	A	A	A	A	C	C	C	C	A	A	A		
Sulphur—Wet			A	B	A	B	B				A	C	C	C	B	•B	•A	•B	AC	
Tin		Molten	A	C		C	C	A	A	C	C	C	C	C	C	C	C	C		
Vinegar and Salt			A	C	A	B	B	A	A		A	AB			B					
Water—Salt			A	B	A	AC	A	A	A	•A	A	AB	AB	AB	AB	•A	•A	C	A	A
Water—Sea			A	A	A	AC	A	A	A	•A	A	AB	AB	AB	AB	•A	•A	C	A	A
Zinc		Molten	A	C		C	C	C	C	C	C	C	C	C	C	C	C	C	AC	

A—Fully resistant
B—Slightly attacked
C—Unsatisfactory

•—Subject to pitting at air line or when allowed to dry
••—Keep solution alkaline
††—May attack when sulphuric acid is present

†—May attack when hydrochloric acid is present
°—Tin-coated
*—Not recommended for use with beverages

(This information has been extracted from the *Nooter Technical Service* Bulletin No. 101.)

TABLE 5.37: VARIOUS METALS AND ALLOYS—WALWORTH

In an effort to be specific, first and alternate choices are designated in the following table for each solution listed. In making the first choice, consideration was given to such factors as corrosion resistance, material availability and economy. An alternate choice material is listed for most solutions. The alternate choice in most cases is equal in corrosion resistance to the first choice material, but is usually more costly.

Corrosive Medium	Temp °F	First Choice	Alternate
Acetic Acid			
In conc. to 100%	150	18-8S	18-8SMo
In conc. to 100%	200	18-8SMo	A-20
In conc. to 60%	Boiling	18-8SMo	A-20
60% to 100%	Boiling	A-20	
Acetic Anhydride			
100%	175	18-8SMo	A-20
100%	244	N-3	
Acetone	Boiling	18-8S	18-8SMo
Acetyl Chloride	Boiling	A-20	
Acid Mixtures			
50% HNO_3—50% H_2SO_4	140	18-8S	18-8SMo
50% HNO_3—50% H_2SO_4	200	18-8SMo	A-20
50% HNO_3—50% H_2SO_4	250	A-20	
25% HNO_3—75% H_2SO_4	200	18-8SMo	A-20
25% HNO_3—75% H_2SO_4	250	A-20	
10% HNO_3—70% H_2SO_4	140	18-8S	18-8SMo
10% HNO_3—70% H_2SO_4	Boiling	A-20	
5% HNO_3—30% H_2SO_4	140	18-8SMo	A-20
5% HNO_3—30% H_2SO_4	230	A-20	
5% HNO_3—15% H_2SO_4	200	18-8SMo	A-20
5% HNO_3—15% H_2SO_4	220	A-20	
90% Acetic—2% H_2SO_4	70	18-8SMo	A-20
Acid & Salt Mixtures			
Fuming HNO_3—10% KNO_3	Boiling	18-8S	18-8SMo
Fuming HNO_3—10% $Al(NO_3)_3$	Boiling	18-8S	18-8SMo
10% H_2SO_4—10% $CuSO_4$	Boiling	18-8SMo	A-20
10% H_2SO_4—2% $Fe_2(SO_4)_3$	Boiling	A-20	
Acid Mine Water	70	18-8SMo	A-20
Aerozine—50	100	18-8S	
Alcohol			
Ethyl	212	18-8SMo	A-20
Methanol	212	18-8SMo	A-20
Alkylation—Sulfuric Acid	100	A-20	
Aluminum Acetate			
All Concentrations	160	18-8S	18-8SMo
All Concentrations	212	18-8SMo	A-20
Aluminum Chloride			
All Concentrations	75	A-20	
10%	125	A-20	
All Concentrations	300	N-2	
Aluminum Fluoride—20%	160	Monel	Nickel
Aluminum Hydroxide			
Saturated	70	18-8SMo	A-20
10%	200	18-8SMo	A-20
Aluminum Sulfate			
In conc. to 50%	212	18-8SMo	A-20
Saturated	212	A-20	
Aluminum Chrome Sulfate—5%	70	18-8SMo	A-20
Alum			
(Potassium Aluminum Sulfate)			
10%	212	18-8SMo	A-20
All Concentrations	212	A-20	
Digestion of Bauxite in H_2SO_4 to make Alum	300	A-20	
Ammonium Bicarbonate			
In conc. to 90%	212	18-8S	18-8SMo
Ammonium Carbonate			
All Concentrations	212	18-8S	18-8SMo
Ammonium Chloride			
(Sal Ammoniac)			
In conc. to 50%	70	18-8SMo	A-20
In conc. to 50%	150	A-20	Monel
In conc. to 100%	212	Monel	Nickel
Ammonium Chlorostannate			
(Saturated)	70	18-8SMo	A-20
Ammonium Hydroxide	212	18-8S	18-8SMo
Ammonium Nitrate—Neutral			
83% & 95%	212	18-8S	18-8SMo
Ammoniated Ammonium Nitrate	160	18-8SMo	A-20
Ammonium Oxalate			
In conc. to 30%	200	18-8S	18-8SMo
Ammonium Perchlorate			
In conc. to 10%	200	18-8S	18-8SMo
In conc. to 40%	200	N-3	
Ammonium Persulfate			
In conc. to 30%	200	18-8SMo	A-20
Ammonium Phosphate			
In conc. to 30%	200	18-8S	18-8SMo
Ammonium Sulfate			
In conc. to 10%	212	18-8SMo	A-20
In conc. to 50%	160	18-8SMo	A-20
Saturated	212	A-20	
Plus free H_2SO_4	150	A-20	Monel
Ammonium Sulfite			
In conc. to 50%	212	18-8SMo	A-20
Ammonium Bisulfite			
(Sulfite Cooking Liquor)	280	18-8SMo	A-20
Ammonium Thiocyanate			
In conc. to 50%	175	18-8S	18-8SMo
Amyl Alcohol—50%	350	A-20	
Amyl Mercaptan	300	A-20	
Aniline—Conc.	200	18-8SMo	A-20
Aniline & Ferric Chloride	650	N-3	N-2
Arsenic Acid			
In conc. to 30%	200	18-8SMo	A-20
In conc. to 100%	200	A-20	

(continued)

TABLE 5.37: VARIOUS METALS AND ALLOYS—WALWORTH (continued)

Corrosive Medium	Temp °F	First Choice	Alternate
Barium Carbonate			
All Concentrations	70	18-8S	18-8SMo
10%	212	18-8S	18-8SMo
Barium Chloride			
All Concentrations	70	18-8SMo	A-20
40%	212	A-20	
Barium Nitrate—All Concentrations	212	18-8S	18-8SMo
Barium Sulfate			
10%	212	18-8S	18-8SMo
Concentrated	212	A-20	
Benzene (Benzol)	212	18-8S	18-8SMo
Benzene Sulfonic Acid—90%	375	A-20	
Benzoic Acid			
In conc. to 100%	212	18-8S	18-8SMo
100%	400	18-8S	18-8SMo
Black Liquor (Sulfate Pulping)			
In conc. to 75% Solids	340	18-8SMo	A-20
Borax—5%	212	18-8S	18-8SMo
Boric Acid			
In conc. to 50%	300	18-8S	18-8SMo
In conc. to 100%	125	18-8S	18-8SMo
Boron Trifluoride—100%	350	18-8S	18-8SMo
Bromine			
Wet Gas	212	N-3	
Dry (Gas or Liquid)	125	Monel	Nickel
Butyric Acid			
In conc. to 5%	150	18-8S	18-8SMo
In conc. to 25%	100	A-20	
In conc. to 100%	265	N-3	
Carbonic Acid—In conc. to 100%	212	18-8S	18-8SMo
Calcium Bisulfite (Sulfite Cooking Liquor)	300	18-8SMo	A-20
Cadmium Sulfate—30%	212	18-8S	18-8SMo
Calcium Chlorate			
In conc. to 10%	212	18-8SMo	A-20
In conc. to 30%	212	A-20	
In conc. to 100%	212	N-3	
Calcium Chloride			
In conc. to 80%	125	18-8SMo	A-20
In conc. to 100%	180	A-20	
Calcium Hydroxide			
In conc. to 50%	212	18-8SMo	A-20
Calcium Hypochlorite			
3 g.p.l. Available Chlorine	70	18-8SMo	A-20
In conc. to 40 g.p.l. available Chlorine	125	N-3	
Carbon Tetrachloride			
C.P.	200	18-8SMo	A-20
Plus H_2O	200	A-20	
Cellulose Acetate	150	18-8SMo	A-20
Chloroacetic Acid— In conc. to 100%	212	N-3	
Chlorobenzene—Concentrated	175	18-8SMo	A-20
Chloroform—Concentrated	212	18-8S	18-8SMo
Chlorine Dioxide			
Solution from absorbers to bleach		317	A-20
Solution from neutralizer		A-20	
Chlorine Trifluoride	100	Monel	Nickel
Chlorine Gas-moist, saturated	70	N-3	
Chlorosulfonic Acid—99.5%	100	18-8S	18-8SMo

Corrosive Medium	Temp °F	First Choice	Alternate
Chromic Acid			
5%	70	18-8S	18-8SMo
In conc. to 50%	125	A-20	
Citric Acid			
In conc. to 50%	212	18-8SMo	A-20
All concentrations	212	A-20	
Coca Cola Syrup	70	18-8S	18-8SMo
Coffee	300	18-8S	18-8SMo
Copper Chloride— In conc. to 100%	70	N-3	
Copper Cyanide—In conc. to Saturated	212	18-8S	18-8SMo
Copper Nitrate—In conc. to Saturated	212	18-8S	18-8SMo
Copper Sulfate			
In conc. to saturated	212	18-8SMo	A-20
Plus 10% H_2SO_4	150	A-20	
Creosote	200	18-8S	18-8SMo
Cresylic Acid	350	A-20	
Cyanogen Gas	70	18-8S	18-8SMo
Dichloroethane	212	18-8S	18-8SMo
Diethanolamine	212	18-8SMo	18-8S
Dinitrochlorobenzene Melted and Solidified	70	18-8S	18-8SMo
Distilling Wort	212	18-8S	18-8SMo
Dyewood Liquor		18-8S	18-8SMo
Epsom Salt ($MgSO_4$)—In conc. to saturated	212	18-8S	18-8SMo
Ether	70	18-8S	18-8SMo
Ethylene Chloride, dry	70	18-8S	18-8SMo
Ethyl Acetate, conc.	200	18-8S	18-8SMo
Ethyl Chloride			
Dry	600	18-8S	18-8SMo
10%	175	A-20	
Fatty Acids (Tall Oil Distillation)			
High Rosin Acids—over 50%	525	18-8SMo	A-20
High Fatty Acids—over 60%	525	317	N-3
Ferric Chloride— 18% (HCl-24.7%)	700	N-3	N-2
Ferric Nitrate			
In conc. to 100%	125	18-8S	18-8SMo
In conc. to 100%	212	A-20	
Ferric Sulfate			
10%	212	18-8SMo	A-20
In conc. to 100%	70	18-8SMo	A-20
In conc. to 100%	150	A-20	
Fluorine—Dry	800	Nickel	Monel
Formaldehyde			
In conc. to 100%	125	18-8SMo	
In conc. to 100%	212	A-20	
Formic Acid			
In conc. to 100%	125	18-8SMo	A-20
In conc. to 100%	212	A-20	
Fruit Juices	212	18-8S	18-8SMo
Furfural—In conc. to 100%	212	18-8S	18-8SMo
Gallic Acid—In conc. to 100%	212	18-8S	18-8SMo
Glue (Acid Solutions)	140	18-8SMo	A-20

(continued)

TABLE 5.37: VARIOUS METALS AND ALLOYS—WALWORTH (continued)

Corrosive Medium	Temp °F	First Choice	Alternate
Hydrazine	125	18-8S	
Hydrobromic Acid—			
In conc. to 50%	200	N-2	
Hydrochloric Acid—			
In conc. to 37%	212	N-2	
Hydrocyanic Acid	125	18-8SMo	A-20
Hydrofluoric Acid			
In conc. to anhydrous (Air free)	212	Monel	
In conc. 90% to Anhydrous	100	A-20	
Hydrogen Fluoride—Gas	500	Monel	Nickel
Hydrogen Peroxide			
In conc. to 90%	150	18-8S	18-8SMo
Hydrogen Sulfide			
Dry	900	18-8S	18-8SMo
Wet	125	18-8SMo	A-20
Iodoform	70	18-8SMo	A-20
Ink		18-8SMo	A-20
Isomerization—			
Butane (HCl & $AlCl^3$)	100	N-2	
Kraft Mill Solutions			
Black Liquor			
In conc. to 75% solids	340	18-8SMo	A-20
White Liquor	300	18-8SMo	A-20
Green Liquor	260	18-8SMo	A-20
Lactic Acid			
In conc. to 100%	160	18-8SMo	A-20
In conc. to 100%	212	A-20	
Lard	Hot	18-8S	18-8SMo
Lead Nitrate			
In conc. to 100%	70	18-8S	18-8SMo
In conc. to 60%	212	18-8SMo	A-20
Linseed Oil	70	18-8S	18-8SMo
Plus H^2SO^4	392	A-20	
Magnesium Chloride			
In conc. to 5%	70	18-8SMo	A-20
In conc. to 50%	175	A-20	
In conc. to 40%	300	Nickel	N-2
Magnesium Nitrate			
In conc. to 10%	212	18-8S	18-8SMo
In conc. to 100%	70	18-8S	18-8SMo
Magnesium Sulfate			
In conc. to 100%	212	18-8SMo	A-20
Maleic Acid	212	18-8SMo	A-20
Maleic Anhydride	350	18-8SMo	A-20
Methyl Chloride—Dry	212	18-8S	18-8SMo
Mayonnaise	70	18-8S	18-8SMo
Methylene Chloride—Dry	212	18-8S	18-8SMo
Milk	212	18-8S	18-8SMo
Mineral Oil	300	18-8S	18-8SMo
Monochloroacetic Acid—70%	120	N-3	A-20
Monoethanolamine			
In conc. to 100%	212	18-8S	18-8SMo
Mustard	70	18-8SMo	A-20
Nickel Sulfate—In conc. to 100%	212	18-8SMo	A-20
Nicotine Sulfate—8% to 15%	200	18-8SMo	A-20
Nitric Acid			
In conc. to 80%	125	18-8S	18-8SMo
In conc. to 65%	212	18-8S	18-8SMo
50 to 85%	150	A-20	
Fuming—86% and Higher	110	A-20	
Nitro Cellulose	70	18-8S	18-8SMo
Nitrogen Tetroxide	100	18-8S	18-8SMo
Nitrous Acid—All conc.	70	18-8S	18-8SMo
Oleic Acid	70	18-8S	18-8SMo
	400	18-8SMo	A-20
	600	A-20	
Oxalic Acid			
In conc. to 90%	70	18-8S	18-8SMo
All Conc.	212	A-20	
Paraffin	Hot	18-8S	18-8SMo
Pentaborane	70	18-8S	
Petroleum Ether		18-8S	18-8SMo
Phenol (Carbolic Acid)			
C.P. or crude	360	18-8S	18-8SMo
Vapors	700	A-20	N-2
Phosphoric Acid			
In conc. to 60%	200	18-8SMo	A-20
60 to 85%—Aerated	200	18-8SMo	A-20
In conc. to 85%—Air Free	200	A-20	N-2
85% to 100% Air Free	275	N-2	
Photographic Developer	70	18-8SMo	A-20
Phthalic Acid	360	18-8SMo	A-20
Phthalic Anhydride	285	18-8SMo	A-20
Picric Acid—In conc. to 100%	212	18-8S	18-8SMo
Propionic Acid—66%	300	A-20	N-3
Propyl Acetate	192	18-8S	18-8SMo
Polyvinyl Acetate, 2% H^2SO^4	150	18-8SMo	A-20
Potassium Bicarbonate			
In conc. to 100%	70	18-8S	18-8SMo
In conc. to 40%	212	18-8SMo	A-20
Potassium Carbonate			
In conc. to 100%	70	18-8S	18-8SMo
In conc. to 60%	212	18-8S	18-8SMo
Potassium Chlorate			
In conc. to 100%	70	18-8SMo	A-20
In conc. to 30%	200	18-8SMo	A-20
Potassium Chloride			
Quiescent—5%	160	A-20	Monel
Aerated—20%	150	A-20	Monel
Saturated *	212	Monel	
Potassium Dichromate			
In conc. to 60%	212	18-8S	18-8SMo
In conc. to 100%	70	18-8S	18-8SMo
Potassium Ferricyanide			
In conc. to 100%	70	18-8S	18-8SMo
In conc. to 60%	200	18-8SMo	A-20
Potassium Ferrocyanide			
In conc. to 30%	200	18-8S	18-8SMo
In conc. to 90%	200	A-20	
Potassium Hydroxide			
(Caustic Potash)			
20%	200	18-8S	18-8SMo
50%	250	A-20	Nickel
75%	275	Nickel	
100%	750	Nickel	Inconel
Potassium Nitrate—			
In conc. to 100%	212	18-8S	18-8SMo

(continued)

TABLE 5.37: VARIOUS METALS AND ALLOYS–WALWORTH (continued)

Corrosive Medium	Temp °F	First Choice	Alternate
Potassium Oxalate			
In conc. to 100%	70	18-8S	18-8SMo
In conc. to 40%	212	18-8S	18-8SMo
Potassium Sulfate			
In conc. to 100%	70	18-8S	18-8SMo
In conc. to 20%	200	18-8SMo	A-20
Pyrogallic Acid			
In conc. to 100%	70	18-8S	18-8SMo
In conc. to 60%	200	A-20	
Rayon Spin Bath			
5 to 15% H_2SO_4	150	A-20	
17% H_2SO_4	190	N-3	
Sea Water	160	A-20	Monel
Selenious Acid—In conc. to 30%	212	18-8S	18-8SMo
Silver Nitrate			
In conc. to 100%	160	18-8S	18-8SMo
In conc. to 70%	212	A-20	
Sodium Bicarbonate			
In conc. to 100%	70	18-8S	18-8SMo
In conc. to 40%	212	18-8S	18-8SMo
Sodium Carbonate			
All concentrations	70	18-8S	18-8SMo
In conc. to 50%	212	18-8SMo	A-20
All concentrations	212	A-20	
Sodium Chlorate			
In conc. to 100%	70	18-8SMo	A-20
In conc. to 70%	212	18-8SMo	A-20
Sodium Chloride			
Quiescent—5%	160	A-20	Monel
Aerated—20%	175	A-20	Monel
Saturated	212	Monel	
Sodium Hydrosulfide—65 to 68%	176	18-8S	18-8SMo
Sodium Hydroxide			
(Caustic Soda)			
20%	200	18-8S	18-8SMo
50%	250	A-20	Nickel
75%	275	Nickel	
100%	750	Nickel	Inconel
Sodium Hypochlorite			
3 g.p.l. Available Chlorine	70	18-8SMo	A-20
In conc. to 40 g.p.l. available Chlorine	125	N-3	
Sodium Nitrate			
70%	212	18-8S	18-8SMo
100% Molten	900	18-8S	18-8SMo
Sodium Sulfate			
In conc. to 30%	212	18-8SMo	A-20
Concentrated	212	18-8SMo	A-20
Sodium Sulfide			
In conc. to 100%	70	18-8SMo	A-20
In conc. to 50%	200	A-20	
Sodium Sulfite			
10%	175	18-8S	18-8SMo
30%	200	A-20	
Spirits of Wine		18-8S	18-8SMo
Starch Solution	100	18-8S	18-8SMo

Corrosive Medium	Temp °F	First Choice	Alternate
Stearic Acid—Conc.	400	18-8SMo	A-20
Sugar & Sugar Solutions		18-8S	18-8SMo
Sulfonic Acid	130	18-8S	18-8SMo
Sulfur Dioxide			
Gas, Moist	200	18-8SMo	A-20
Gas, Dry	575	18-8S	18-8SMo
Sulfur, Molten			
Dry	300	18-8SMo	A-20
Plus Moisture	300	A-20	
Sulfur Monochloride (plus CCl_4)	200	Nickel	Monel
Sulfuric Acid			
All Concentrations	125	A-20	
5%	200	A-20	
10%	175	A-20	
20-40%	150	A-20	
50-60%	140	A-20	
70-80%	130	A-20	
90%	145	A-20	
93-100%	175	A-20	
10-25%	180	N-3	
25-50%	175	N-2	
60%	180	N-2	
80%	210	N-2	
90%	220	N-2	
Oleum	175	A-20	
Sulfurous Acid			
All Concentrations	300	A-20	
All Concentrations	150	18-8SMo	A-20
Tall Oil	525	18-8SMo	
Tannic Acid	150	18-8SMo	A-20
Tanning Liquor		18-8S	18-8SMo
Tartaric Acid			
10%	212	18-8S	18-8SMo
50%	212	18-8SMo	A-20
Trisodium Phosphate—20%	175	18-8S	18-8SMo
Turpentine		18-8S	18-8SMo
Unsymmetrical Dimethyl Hydrazine	140	18-8S	
Urea	260	18-8SMo	
Vegetable Juices	212	18-8SMo	A-20
Vinegar	150	18-8S	18-8SMo
Water, High Purity	750	18-8S	18-8SMo
Zinc Ammonium Chloride—12° Be	180	N-3	A-20
Zinc Chloride			
In conc. to 70%	70	18-8SMo	A-20
In conc. to 90%	150	A-20	
In conc. to 50%	212	Monel	N-2
All conc. to 100%	212	N-2	
Zinc Cyanide—Moist	70	18-8S	18-8SMo
Zinc Nitrate, 10%	175	18-8S	18-8SMo
Zinc Sulfate			
40%	212	18-8SMo	A-20
Saturated	70	18-8SMo	A-20

Aloyco 18-8S Stainless Steel
ASTM A351 Grade CF8

Chemical Requirements	percent
Carbon	0.08 Max.
Manganese	1.50 Max.
Phosphorus	0.04 Max.
Sulfur	0.04 Max.
Silicon	2.00 Max.
Chromium	18.00 to 21.00
Nickel	8.00 to 11.00

Aloyco 18-8S ELC Stainless Steel
ASTM A351 Grade CF3

Chemical Requirements	percent
Carbon	0.03 Max.
Manganese	1.50 Max.
Phosphorus	0.04 Max.
Sulfur	0.04 Max.
Silicon	2.00 Max.
Chromium	17.00 to 21.00
Nickel	8.00 to 12.00

(continued)

TABLE 5.37: VARIOUS METALS AND ALLOYS—WALWORTH (continued)

Aloyco 18-8SMo Stainless Steel ASTM A351 Grade CF8M

Chemical Requirements	percent
Carbon	0.08 Max.
Manganese	1.50 Max.
Phosphorus	0.040 Max.
Sulfur	0.040 Max.
Silicon	1.50 Max.
Chromium	18.00 to 21.00
Nickel	9.00 to 12.00
Molybdenum	2.00 to 3.00

Aloyco 18-8SMo ELC Stainless Steel ASTM A351 Grade CF3M

Chemical Requirements	percent
Carbon	0.03 Max.
Manganese	1.50 Max.
Phosphorus	0.04 Max.
Sulfur	0.04 Max.
Silicon	1.50 Max.
Chromium	17.00 to 21.00
Nickel	9.00 to 13.00
Molybdenum	2.00 to 3.00

Aloyco 18-8 SCb Stainless Steel ASTM A351 Grade CF8C

Chemical Requirements	percent
Carbon	0.08 Max.
Manganese	1.50 Max.
Phosphorus	0.04 Max.
Sulfur	0.04 Max.
Silicon	2.00 Max.
Chromium	18.00 to 21.0
Nickel	9.0 to 12.0
Columbium	.8 Carbon Min. — 1.0 Max.

Aloyco 20 ASTM A351 Grade CN-7M

Chemical Requirements	percent
Carbon	0.07 Max.
Manganese	1.50 Max.
Phosphorus	0.04 Max.
Sulfur	0.04 Max.
Silicon	1.50 Max.
Chromium	19.0 to 22.0
Nickel	27.5 to 30.5
Molybdenum	2.0 to 3.0
Copper	3.0 to 4.0

Aloyco CD-4 ASTM A351 Grade CD4MCu

Chemical Requirements	percent
Carbon	0.04 Max.
Manganese	1.00 Max.
Silicon	1.00 Max.
Sulfur	0.04 Max.
Phosphorus	0.04 Max.
Chromium	24.5 to 26.5
Nickel	4.75 to 6.00
Molybdenum	1.75 to 2.25
Copper	2.75 to 3.25

Nickel ASTM A744/A494 Grade CZ-100

Chemical Requirements	percent
Silicon	2.00 Max.
Carbon	1.00 Max.
Manganese	1.50 Max.
Iron	3.00 Max.
Copper	1.25 Max.
Nickel	95.0 Min.

Cast Nickel-Molybdenum Alloy
Aloyco N-2
ASTM A744 Grade N-12M
ASTM A494 Grade N-12M-1

Chemical Requirements	percent
Nickel	Remainder
Molybdenum	26.0 to 30.0
Manganese	1.0 Max.
Silicon	1.0 Max.
Iron	4.0 to 6.0
Carbon	0.12 Max.
Vanadium	0.20 to 0.60
Chromium	1.00 Max.

Cast Nickel-Molybdenum-Chromium Alloy
Aloyco N-3
ASTM A944 Grade CW-12M
ASTM A494 Grade CW-12M-1

Chemical Requirements	percent
Nickel	Remainder
Chromium	15.5 to 17.5
Molybdenum	16.0 to 18.0
Tungsten	3.75 to 5.25
Iron	4.5 to 7.5
Manganese	1.0 Max.
Silicon	1.0 Max.
Vanadium	0.20 to 0.40
Carbon	0.12 Max.

Nickel-Chromium-Iron Alloy
Aloyco Inconel
ASTM A744/A494 Grade CY-40

Chemical Requirements	percent
Nickel	Remainder
Chromium	14.0 to 17.0
Carbon	0.40 Max.
Iron	11.0 Max.
Manganese	1.50 Max.
Silicon	3.00 Max.
Tensile Requirements	
Tensile Strength, psi	70000 Min.
Yield Strength, psi	28000 Min.
Elongation, percent in 2"	30 Min.

Nickel-Copper Alloy
Aloyco Monel
ASTM A744/A494 Grade M-35

Chemical Requirements	percent
Nickel	Remainder
Copper	26.0 to 33.0
Silicon	2.00 Max.
Iron	3.50 Max.
Manganese	.50 Max.
Carbon	0.35 Max.
Tensile Requirements	
Tensile Strength, psi	65000 Min.
Yield Strength, psi	30000 Min.
Elongation, percent in 2"	25 Min.

Glass, Ceramics, and Carbon-Graphite

TABLE 6.1: CARBON-GRAPHITE—U.S. GRAPHITE

GRAPHITAR is the U.S. Graphite, Inc. trade name for a family of carbon-graphite (mechanical carbon) products. These materials are made by blending carbon and/or graphite powders with a hydrocarbon binder, pressing the mass into the desired shape and furnacing the molded forms at temperatures approximating 2000°F. The result is a material which is highly resistant to wear, chemically inert and thermally stable. . .ideal characteristics for many engineering requirements.

GRAPHITAR GRADE LIST

Grade	Scleroscope Hardness	Compressive Strength psi	Transverse Breaking Strength psi	Tensile Strength psi	Modulus of Elasticity x 10^6 psi	Coefficient of Thermal Expansion x 10^{-6} in/in/°F*	Thermal Conductivity Btu/sq ft/°F/hr	Maximum Recommended Operating Temperature °F in Air	Apparent Density g/cc	Available Porosity % Volume	Maximum Size** sq in	Composition***
3	70	12,500	3,500	2,500	1.6	1.9	3.6	700	1.68	14	60	CG
14	90	38,000	11,000	8,500	2.8	3.0	4.6	500	1.85	0.5	60	CGR
18	75	20,000	5,500	3,500	2.1	2.2	4.7	700	1.70	12	75	CG
30-A	85	25,000	7,000	5,500	1.8	2.5	3.7	700	1.68	13	45	CG
34	88	18,000	6,000	3,500	1.2	2.5	4.8	700	1.65	14	45	CG
35	98	38,000	11,000	7,000	2.1	3.9	5.9	500	1.76	0.7	45	CGR
38	100	35,000	10,500	8,500	2.5	3.6	3.8	500	1.80	2	45	CGR
39	100	38,000	11,500	9,000	2.5	3.4	3.8	500	1.82	1	45	CGR
40	85	28,000	9,000	6,500	2.5	3.0	4.1	500	1.82	3.4	60	CGR
47	95	36,000	11,000	9,500	3.0	2.7	6.4	500	1.88	0.5	60	CGR
48	45	4,500	2,500	1,000	0.5	1.2	27.0	750	1.72	17	45	G
64	35	5,000	3,000	2,500	1.8	1.0	27.0	700	1.80	9	75	CG
67	75	18,000	6,500	4,000	1.6	2.1	5.3	700	1.72	11	45	CG
70	85	28,000	8,000	6,500	2.2	3.2	5.5	500	1.80	3	45	CGR
77	60	12,000	6,000	3,500	1.5	2.8	28.0	500	1.88	3	60	GR
80	75	25,000	10,000	5,500	2.4	2.3	7.0	700	1.80	7	45	CG
84	80	30,000	11,000	6,500	2.8	2.3	7.0	700	1.65	6	45	CG
86	90	36,000	12,500	9,500	3.0	2.3	7.6	500	1.90	0.5	45	CGR
88	95	28,000	8,000	6,000	1.8	2.9	3.9	350	1.80	0.5	45	CGR
92	95	32,000	8,800	7,000	2.8	3.2	5.1	500	1.82	3	75	CGR
94	90	30,000	8,500	6,000	2.2	3.5	5.5	500	1.82	1	45	CGR
95	40	6,000	3,500	3,000	2.0	1.5	27.5	350	1.85	1	45	GR
101	85	38,000	10,500	8,500	2.9	2.9	7.0	350	2.75	1	75	CGB
102	88	38,000	9,500	7,500	2.6	3.1	8.7	700	2.35	4	75	CGCu
103	89	35,000	10,500	7,500	2.8	3.1	9.3	700	2.70	3	75	CGAg
105	84	35,000	11,400	8,500	2.8	3.4	8.5	700	2.35	2	45	CGCuPb
107	92	38,000	10,000	7,500	3.5	2.4	7.0	700	2.20	1	75	CGSb
108	77	17,000	4,200	3,000	1.8	2.4	3.8	350	1.80	3	60	CGR
109	85	40,000	11,500	7,500	3.5	3.1	8.5	700	2.70	1	75	CGCuPb
110	92	32,000	10,000	8,500	3.3	2.3	8.0	700	1.9	1	45	CG
113	100	34,000	10,000	8,000	2.5	5.5	3.8	500	1.8	2	75	CGR
114	90	34,000	12,000	9,000	2.9	2.7	8.0	500	1.90	0.5	45	CGR
2413	60	7,000	2,500	1,000	1.0	2.3	4.1	700	1.55	20	50	CG
2690	97	23,000	6,400	5,000	1.4	3.5	20.6	1200	1.82	9	50	CGH
2767	90	25,000	8,000	6,000	2.0	3.4	5.5	500	1.83	0.5	45	CGR
2887	85	38,000	10,500	8,300	3.0	2.3	9.0	350	2.30	0.5	45	CGBR
2980	65	15,000	4,500	4,000	1.8	2.3	30.0	1000	1.85	4.0	50	CGH
3030	97	60,000	14,000	10,500	3.6	2.9	8.5	700	2.35	0.5		CGCrNi
3048	67	16,200	6,500	4,500	1.8	2.3	30.0	1000	1.85	5.0	50	CGH

*Average values at 70° to 500°F.
**Maximum size for optimum properties. Larger parts can usually be produced with some reduction of physicals.
***Composition: C=carbon, G=graphite, B=babbitt, Cu=copper, Sb=antimony, Ag=silver, Pb=lead, R=resin impregnated, H=high-temperature treated.

(continued)

TABLE 6.1: CARBON-GRAPHITE—U.S. GRAPHITE **(continued)**

GRAPHITAR SEAL GRADES

GRAPHITAR GRADE	TYPICAL APPLICATIONS
Grade 30A	For low to medium pressure oil sealing applications. This grade has relatively high porosity, which aids seal face lubrication.
Grade 38	For low to medium pressure applications. Grade 38 is relatively easy to mold and is most economical in many applications.
Grade 39	A universal grade for use in high pressure applications. Can be used to seal almost any medium except very strong oxidizing or alkaline agents. Grade 39 is the hardest of all GRAPHITAR grades, with a scleroscope reading of 105.
Grade 67	Similar to grade 30A in low to medium pressure applications.
Grade 70	Similar in many respects to grade 38, this grade will also perform well in non-lubricated service such as sealing air.
Grade 86	A universal grade for lubricated or non-lubricated service. Grade 86 offers excellent compressive strength, an extremely low porosity and excellent wear resistance.
Grade 114	A very strong, hard grade which is resistant to any chemical in which GRAPHITAR can function at all. Frequently used in sealing gasses.
Grade 2690	A high temperature material for seal applications which exceed 700°F. Grade 2690 is used almost exclusively for sealing high temperature gasses.
Grade 3048	Superior for aircraft engine main shaft seals. Combines excellent lubricity with good oxidation resistance for long service life.

Graphitar Grades by Chemical compatibility category.

A	B	C	D	E	F
2 64	14 77	101 2831	2767	2690	111
3 67	35 86	102 2832	2840	2866	112
18 75	38 88	103 2833	2864	2936	113
30A 80	39 89	105 2835	2865	2980	114
34 84	40 92	107 2837		3048	
48 110	47 94	109 2859			
2413	70 95	2887			
	108	2957			
		3030			

Resistance to chemical attack varies among the GRAPHITAR Grades because of formulation and processing differences. While each Grade was developed to meet specific physical requirements, the differences do produce chemical effects. The following chart provides a guide to the selection of the appropriate GRAPHITAR Grades. They can be grouped into six chemical compatibility categories—see chart at left.

GRAPHITAR COMPATIBILITY CHART

Chemical	Graphitar Category Suggested
ACIDS	
Abietic	A B C D - F
Acetic	A B - D - F
Acetic Anhydride	A B - D - F
Acetylsalicylic	A B C D - F
Adipic	A B C D - F
Aqua Regia	- - - - -
Arsenic	A B C D - F
Ascorbic	A B C D - F
Battery	A B - D - F
Benzensulfonic	A B C D - F
Benzoic	A B C D - F
Boiler Acid Phosphates	A B C D - F
Boric	A B C D - F
Butyric	A B C D - F
Carbolic	A B - D - F
Carbonic	A B - D - F
Chlorine (Anhydrous Liquid)	A B - - - F
Chloric	- - - - - -
Chlorous	- - - - - -
Chloroacetic	A B - D - F
Chlorosulfonic	A B - D - F
Chromic	- - - - - F
Citric	A B C D - F
Cresylic	A B C D - F
Cyanic	A B - D - F
Fatty Acids	A B C D - F
Fluoboric	- - - - - F
Fluosilicic	A B - - - F
Formic	A B C D - F
Gallic	A B C D - F
Glutamic	A B C D - F
Hydrobromic	A B - D - F
Hydrochloric	A B - D - F
Hydrocyanic	A B - D - F
Hydrofluoric	- - - - - F
Hydrofluosilicic	A B - - - F
Hydrogen Peroxide	- - - - - -
Hypochlorous	- - - - - F
Isophthalic	A B - D - F
Lactic	A B C D - F
Lauric	A B C D - F
Maleic	A B - D - F
Malic	A B - D - F
Muriatic	A B - D - F

(continued)

TABLE 6.1: CARBON-GRAPHITE—U.S. GRAPHITE (continued)

Chemical	Graphitar Category Suggested
Nitrating (To 75%)	· · · · · F
Nitric 0 to 20%	A B · · · F
Nitric 20 to 100%	· · · · · F
Nitrous	A B · · · F
Oleic	A B · D · F
Oleum	· · · · · ·
Orthophosphoric	A B · D · F
Organic Acids	A B · D · F
Oxalic	A B C D · F
Palmitic	A B C D · F
Perchloric	· · · · · ·
Phenolsulfonic	A B · D · F
Phosphoric (Glacial)	A B · D · F
Phthalic	A B · D · F
Picric	A B · D · F
Propionic	A B · D · F
Pyrogallic	A B · D · F
Salicylic	A B · D · F
Sorbic	A B · D · F
Stearic	A B C D · F
Succinic	A B · D · F
Sulphuric (0-75%)	A B · D · F
Sulphuric (75-96%)	A · · · · F
Sulfurous	A B · · · F
Tannic	A B C D · F
Tartaric	A B C D · F
Terephthalic	A B · D · F
Toluenesulfonic	A B · D · F
Toluic	A B · D · F
Trichloroacetic	A B · D · F
Uric	A B · D · F
Valeric	A B · D · F
Vinyl Acetate	A B · D · F

ALKALINE CHEMICALS

Chemical	Graphitar Category Suggested
Ammonium Carbonate	A B · D · F
Ammonium Hydroxide	A B · D · F
Amyl Amines	A B · D · F
Anhydrous Ammonia Liquid	A · · D · F
Barium Hydroxide	A B · D · F
Bleaching Powder	· · · D · F
Butyl Amines	A B · D · F
Calcium Carbonate	A B · D · F
Calcium Hydroxide	A B · D · F
Calcium Hypochlorite	· · · D · F
Calcium Oxide	· · · D · F
Caustic Soda	· · · D · F
Cyclohexylamine	A B · D · F
Detergents	A B · D · F
Diethanol Amine	A B · D · F
Disodium Phosphate	A B · D · F
Hydrazine	· · · · · ·
Hydroxylamine	A B · D · F
Lime Slurries	· · · D · F
Lithium Carbonate	A B · D · F
Lithium Hydroxide	A B · D · F
Lye	· · · D · F
Magnesium Hydroxide	A B · D · F
Monoethanolamine	A B · D · F
Morpholine	A B · D · F
Potassium Bicarbonate	A B · D · F
Potassium Carbonate	A B · D · F
Potassium Chlorate	· · · D · F
Potassium Cyanide	A B · D · F
Potassium Hydroxide	· · · D · F
Potassium Phosphate	A B · D · F
Pyridine	A B · D · F
Soap & Soap Solutions	A B C D · F
Sodium Bicarbonate	A B · D · F
Sodium Carbonate	A B · D · F
Sodium Hydroxide	· · · D · F
Sodium Hypochlorite	· · · D · F
Sodium Peroxide	· · · · · ·
Sodium Phosphate	A B · D · F
Sodium Tetraborate	A B · D · F
"Tetramine" C	A B · D · F
Triethanolamine	A B · D · F
Triethylamine	A B · D · F
Trisodium Phosphate	A B · D · F
Urea	A B · D · F
Water Glass	A B · D · F

SALT SOLUTIONS

Chemical	Graphitar Category Suggested
Alkylaryl Sulfonates	A B C D · F
Allyl Chloride	A B · D · F
Alum (Ammonia)	A B · D · F
Alum (Chrome)	A B · D · F
Alum (Potash)	A B · D · F
Aluminum Chloride	A B · D · F
Aluminum Sulfate	A B · D · F
Ammonium Bicarbonate	A B · D · F
Ammonium Carbonate	A B · D · F
Ammonium Chloride	A B · D · F
Ammonium Nitrate	A B · D · F
Ammonium Phosphate	A B · D · F
Ammonium Sulfate	A B · D · F
Ammonium Thiocyanate	A B · D · F
Arsenic Trichloride	A B · D · F
Baking Soda	A B · D · F
Barium Carbonate	A B · D · F
Barium Chloride	A B · D · F
Barium Sulfate	A B · D · F
Barium Sulfide	A B · D · F
Borax	A B · D · F
Boiler Feed Water Compounds	A B C D · F
Calcium Bisulfite	A B · D · F
Calcium Chloride	A B · D · F
Calcium Sulfate	A B · D · F
Calgon	A B C D · F
Chromium Potassium Sulfate	A B · D · F
Copper Chloride	A B · D · F
Copper Nitrate	A B · D · F
Copper Sulfate	A B · D · F
Ferric Chloride	A B · D · F
Ferric Sulfate	A B · D · F
Ferrous Chloride	A B · D · F
Ferrous Sulfate	A B · D · F
Glauber's Salt	A B · D · F
Ink	A B · D · F
Lead Acetate	A B · D · F
Lead Carbonate	A B · D · F
Lead Nitrate	A B · D · F
Lithium Carbonate	A B · D · F
Magnesium Chloride	A B · D · F
Magnesium Oxide	A B · D · F
Magnesium Sulfate	A B · D · F
Manganous Sulfate	A B · D · F
Mercury Salts	A B · D · F
Nickel Acetate	A B · D · F
Nickel Chloride	A B · D · F
Nickel Nitrate	A B · D · F
Nickel Sulfate	A B · D · F
Nylon Salt	A B · D · F
Phosphorus Trichloride	A · · · · F
Potassium Bisulfide	A B · D · F
Potassium Carbonate	A B · D · F
Potassium Chloride	A B · D · F
Potassium Chromate	A B · D · F
Potassium Cyanide	A B · D · F
Potassium Iodide	A B · D · F
Potassium Permanganate	A · · · · F
Potassium Phosphates	A B · D · F
Potassium Sulfate	A B · D · F
Sal Ammoniac	A B · D · F
Sal Soda	A B · D · F
Sea Water	A B · D · F
Silver Nitrate	· B · · · F
Soda Ash	A B · D · F
Sodium Aluminate	A B · D · F
Sodium Acid Sulfate	A B · D · F
Sodium Bicarbonate	A B · D · F
Sodium Bisulfate	A B · D · F
Sodium Bisulfite	A B · D · F
Sodium Borate	A B · D · F
Sodium Carbonate	A B · D · F
Sodium Chloride	A B · D · F
Sodium Chromate	A B · D · F
Sodium Cyanide	A B · D · F
Sodium Dichromate	A B · D · F
Sodium Fluoride	A B · D · F
Sodium Nitrate	A B · D · F
Sodium Nitrite	A B · D · F
Sodium Phosphates	A B · D · F
Sodium Silicate	A B · D · F
Sodium Sulfate	A B · D · F
Sodium Sulfide	A B · D · F
Sodium Sulfite	A B · D · F
Sodium Thiosulfate	A B · D · F
Stannic Chloride	A B · D · F
Stannous Fluoride	A B · D · F
Sulfate Liquors	A B · D · F
Sulfate Liquors	A B · D · F
Trisodium Phosphate	A B · D · F
Zinc Acetate	A B · D · F
Zinc Ammonium Chloride	A B · D · F
Zinc Chloride	A B · D · F
Zinc Hydrosulfite	A B · D · F
Zinc Sulfate	A B · D · F

FOOD & FOOD PRODUCTS

Chemical	Graphitar Category Suggested
Aspirin	A B C D · F
Alcohol	· B · D · F
Ale	· B · D · F
Beer	· B · D · F
Beet Sugar Liquors	· B · D · F
Butter	· B · D · F
Buttermilk	· B · D · F
Cane Sugar Liquors	· B · D · F
Castor Oil	· B · D · F
Cheeses	· B · D · F
Chocolate	· B · D · F
Cider	· B · D · F
Citrus Juices	· B · D · F
Coconut Oil	· B · D · F
Coffee	· B · D · F
Cola Drinks	· B · D · F
Corn Oil	· B · D · F
Cornstarch Slurry	· B · D · F
Cottonseed Oil	· B · D · F
Dextrin	· B · D · F
Dextrose	· B · D · F
Eggs	· B · D · F
Fish Oil	· B · D · F
Fruit Juices	· B · D · F
Gelatin	· B · D · F
Hydrogenated Fats	· B · D · F
Ice Cream	· B · D · F
Jelly	· B · D · F
Ketchup	· B · D · F
Lard	· B · D · F
Malt	· B · D · F
Monnitol	· B · D · F
Mayonnaise	· B · D · F
Maple Syrup	· B · D · F
Milk	· B · D · F
Mineral Oil	· B · D · F
Molasses	· B · D · F
Monosodium Glutamate	· B · D · F
Oleomargarine	· B · D · F
Olive Oil	· B · D · F
Palm Oil	· B · D · F
Pickle Solutions	· B · D · F
Salad Oil	· · · · · ·
Sorbitol	· B · D · F
Saccharine	· B · D · F
Soybean Oil	· B · D · F
Sugar Solutions	· B · D · F
Soft Drinks	· B · D · F
Starches	· B · D · F
Vegetable Oil	· B · D · F
Vinegar	· B · D · F
Whiskey & Wine	· B · D · F
Water	· B · D · F
Yeast	· B · D · F
Yogurt	· B · D · F

GASES

Chemical	Graphitar Category Suggested
Acetylene	A B C D E F
Air	A B C D E F
Ammonia (Wet)	A B · D · F
Ammonia (Anhydrous)	A · · D · F
Argon (Inert)	A B C D E F

(continued)

TABLE 6.1: CARBON-GRAPHITE—U.S. GRAPHITE (continued)

Chemical	Graphitar Category Suggested
Boron Trifluoride	A B - D - F
Bromine	- - - - - F
Butadiene	A B C D E F
Butane	A B C D E F
Butylene	A B C D E F
Carbon Dioxide	A B - D E F
Carbon Monoxide	A B C D E F
Chlorine	- - - - - F
Cyanogen	A B C D E F
Cyclohexane	A B C D E F
Ethane	A B C D E F
Ether	A B C D E F
Ethylene	A B C D E F
Fluorine	- - - - - -
Freons	A B C D E F
Hydrogen	A B C D E F
Hydrogen Chloride	A B C D E F
Hydrogen Fluoride	- - - - - F
Hydrogen Sulfide	A B - D E F
Iodine	- - - - - F
Methane	A B C D E F
Natural Gas	A B C D E F
Neon	A B C D E F
Nitric Oxide	A B C D E F
Nitrogen	A B C D E F
Nitrous Oxide	A B C D E F
Oxygen	A B C D E F
Phosgene	- - - - E F
Propane	A B C D E F
Propylene	A B C D E F
Steam (to 500°F.)	A B C D - F
Sulfur Dioxide	A B - D - F
Sulfur Trioxide	- - - - - -

SOLVENTS & ORGANIC MATERIALS

Chemical	Graphitar Category Suggested
Acetaldehyde	A B C D - F
Acetone	A B C D - F
Acetophenone	A B C D - F
Acrolein	A B C D - F
Acetate Solvents	A B C D - F
Almond Oil	A B C D - F
Amyl Acetate	A B C D - F
Amyl Alcohol	A B C D - F
Amyl Chloride	A B C D - F
Aniline	A B C D - F
Anthracene	A B C D - F
Asphalt	A B C D - F
Benzaldehyde	A B C D - F
Benzene	A B C D - F
Butyl Acetate	A B C D - F
Butyl Alcohol	A B C D - F
Butyl "Cellosolve"	A B C D - F
Camphor	A B C D - F
Carbitols (Diethylene Glycol Ethers)	A B C D - F
Carbon Disulfide	A B C D - F
Carbon Tetrachloride	A B C D - F
Chloral	A B C D - F
Chlorobenzene	A B C D - F
Chlorothene	A B C D - F
Chloroform	A B C D - F
Coal Tar	A B C D - F
Creosote	A B C D - F
Cresol	A B C D - F
Crotonaldehyde	A B C D - F
Cumene	A B C D - F
Cyclohexane	A B C D - F
Diacetone	A B C D - F
Dibutyl Phosphite	A B C D - F
Dibutyl Phthalate	A B C D - F
Dichloroethane	A B C D - F
Dichloropentane	A B C D - F
Diesel Oil	A B C D - F
Diethylbenzene	A B C D - F
Diethyleneglycol	A B C D - F
Diethyl Sulfate	A B C D - F
Dimethyl Phthalate	A B C D - F
Dioxane	A B C D - F
Dipentene	A B C D - F
Diphenyl	A B C D - F
Dowtherms	A B C D - F
Ether-Diethyl	A B C D - F
Ether-Petroleum	A B C D - F
Ethyl Acetate	A B C D - F
Ethyl Alcohol	A B C D - F
Ethyl Benzene	A B C D - F
Ethyl Chloride	A B C D - F
Ethyl Mercaptan	A B C D - F
Ethyl Sulfate	A B C D - F
Ethylene	A B C D - F
Ethylene Dichloride	A B C D - F
Ethylene Glycol	A B C D - F
Ethylene Oxide	A B C D - F
Formaldehyde	A B C D - F
Freon (Liquefied)	A B C D - F
Fuel Oil	A B C D - F
Furfural	A B C D - F
Furfuryl Alcohol	A B C D - F
Gasoline	A B C D - F
Glycerine	A B C D - F
Glue	A B C D - F
Heptane	A B C D - F
Hydrazine Hydrate	A B C D - F
Isobutyl Acetate	A B C D - F
Isobutyl Alcohol	A B C D - F
Isopropyl Acetate	A B C D - F
Isopropyl Alcohol	A B C D - F
Isopropyl Ether	A B C D - F
Jet Fuel	A B C D - F
Kerosene	A B C D - F
Ketones	A B C D - F
Lubricating Oil	A B C D - F
Lacquers & Lacquer Solvents	A B C D - F
Linseed Oil	A B C D - F
Ligroin (Petroleum Ether)	A B C D - F
Methyl Acetate	A B C D - F
Methyl Acrylate	A B C D - F
Methyl Alcohol	A B C D - F
Methyl "Cellosolve"	A B C D - F
Methyl Chloride	A B C D - F
Methylethyl Ether	A B C D - F
Methyl Ethyl Ketone	A B C D - F
Methyl Formate	A B C D - F
Methyl Isobutyl Ketone	A B C D - F
Methyl Salicylate	A B C D - F
Mineral Oil	A B C D - F
Mineral Spirits	A B C D - F
Monochlorobenzene	A B C D - F
Naphtha	A B C D - F
Naphthalene	A B C D - F
Nitrobenzene	A B C D - F
Octyl Alcohol	A B C D - F
Oleyl Alcohol	A B C D - F
Ortho Dichlorobenzene	A B C D - F
Paint & Paint Vehicles	A B C D - F
Paraffin	A B C D - F
Paraffin Oils	A B C D - F
Para Dichlorobenzene	A B C D - F
Paraformaldehyde	A B C D - F
Paraldehyde	A B C D - F
Perchloroethylene	A B C D - F
Phenol	A B C D - F
Pine Oil	A B C D - F
Polyethylene	A B C D - F
Polystyrene	A B C D - F
Polyurethane	A B C D - F
Prestone	A B C D - F
Propyl Alcohol	A B C D - F
Propylene Dichloride	A B C D - F
Resorcinol	A B C D - F
Stoddard Solvent	A B C D - F
Styrene	A B C D - F
Tar	A B C D - F
Tetrachloroethane	A B C D - F
Tetrachloroethylene	A B C D - F
Toluene	A B C D - F
Trichlorobenzene	A B C D - F
Trichloroethylene	A B C D - F
Tricresyl Phosphate	A B C D - F
Turpentine	A B C D - F
Varnish	A B C D - F
Vinyl Acetate	A B C D - F
Vinyl Chloride	A B C D - F
Water	A B C D - F
Waxes	A B C D - F
Xylene	A B C D - F

- Not recommended for this environment. This does not predict failure for a given Grade . . . only that another Grade would be preferable, all other considerations being equal.

TABLE 6.2: CERAMIC FIBER PRODUCTS—3M

NEXTEL 312 Ceramic Fibers are continuous polycrystalline metal oxide fibers suitable for producing textiles without the aid of other fiber or metal inserts. Nextel fabrics, tapes and sleevings are exceptional, high temperature products designed to meet the toughest thermal and electrical performance requirements and to offer performance far beyond the useful limits of other high temperature textiles.

Individual fibers of NEXTEL 312 are transparent, smooth and continuous. NEXTEL 312 Fibers, in terms of their metal oxides are (by weight) 62% aluminum oxide (Al_2O_3), 14% boron oxide (B_2O_3), and 24% silicon dioxide (SiO_2).

The effects of metals on NEXTEL 312 Fabric heated in air at 2000°F are shown below. The metals which cause attack (molten copper and tin) are extremely reactive at test temperature. Most common metals, however, have no effect on NEXTEL 312 Fibers. The effects of chemicals on NEXTEL 312 Fibers after exposure to 10% chemical baths (room temperature) are also shown.

Effects of Metals on NEXTEL 312 Fabric

Metal	Effect at 1100°C (2012°F)
aluminum, boron,	No attack
platinum, cobalt,	No attack
chromium, gold,	No attack
iron, nickel, silicon,	No attack
soft solder	No attack
copper, tin (molten)	Severe attack

Effects of Chemicals on NEXTEL 312 Fibers

Chemical	Percent Strength Retention*
NH_4OH (ammonium hydroxide)	90
HCl (hydrochloric acid)	90
H_2SO_4 (sulfuric acid)	50
H_3PO_4 (phosphoric acid)	less than 1
NaOH (sodium hydroxide)	less than 1
KOH (potassium hydroxide)	less than 1
CaO (calcium oxide-lime)	40

*After exposure to 10% chemical baths and 10 min. at 815°C (1499°F)

TABLE 6.3: CERAMIC LININGS–ABRESIST

ABRESIST is a mineral material, a silicate with a high compressive strength and a high modulus of elasticity, with extreme resistance to abrasion, whereby a certain sensitivity to impact is also present. In addition to its abrasion resistance, fused cast basalt does not rust and thus always presents a smooth sliding surface. Even after an idle period in a wet transportation system, clogging and plug formation are largely eliminated.

Resistance of ABRESIST® against Bases

Agent	at		Test * Plate test
Potash lye (KOH 25 %) ·353 K, hot, flowing	80° C	100 %*	Operational test; no weight loss after 112 days
Potash lye (KOH 10 %), still	20° C	100 %*	Materials Testing Institute Neuwied; no weight loss after 30 days
Soda lye (NaOH 25 %) 353 K, hot, flowing	80° C	almost 100 %*	Operational test; weight loss of 0.6 % after 9 months
Soda lye (NaOH 10 %)	20° C	almost 100 %*	Materials Testing Institute Neuwied; 0.9 % weight loss after 30 days
Soda solution (Na_2CO_3 5 %)	20° C	almost 100 %*	Materials Testing Institute Neuwied; 0.2 % weight loss after 30 days
Calcium chloride ($CaCl_2$), pasty, still and flowing	20° C	100 %*	Operational test; no weight loss after 25 days

The values cited are average values.

Resistance of ABRESIST® against Acids

Agent	at 293 K	Test * Plate test ** Powder test
Hydrochloric acid (HCl 25 %), flowing	almost 100 %* Protective layer	operational test up to 41 days; weight loss less than 0.2 % weak bleaching of surface
Hydrochloric acid (HCl 38 %), still	almost 100 %*	Materials Testing Institute, Neuwied; 0.6 % weight loss after 30 days
Sulfuric acid (H_2SO_4 40 %), still	100 %*	Operational test; no weight loss after 60 days
Sulfuric acid (H_2SO_4 94 %), still	almost 100 %*	Materials Testing Institute Neuwied; 0.4 % weight loss after 30 days
Sulfuric acid (H_2SO_4), concentrated	almost 100 %**	0.003 % weight loss after 7 days (19 Dec. 1968)
Nitric acid (HNO_3 65 %), still	100 %*	Materials Testing Institute Neuwied; no weight loss after 30 days
Hydrofluoric acid (HF 20 %)	Limited resistance*	Operational test; 0.5 mm was etched away at surface after 20 days
Hydrofluoric acid (HF 40 %)	Limited resistance*	Materials Testing Institute Neuwied; 22.8 % weight loss after 30 days
Probinsäure, still	100 %*	Materials testing Institute Neuwied; no weight loss after 30 days
Lactic acid (8 %), flowing and still	100 %*	Attests by many dairies and the Kiel Testing Institute. No weight loss after 3 years

TABLE 6.4: FOAMED GLASS BLOCK–PENNWALT

A totally inorganic borosilicate foamed glass block containing no binders, PENNGUARD Block offers exceptional resistance to most acids, solvents and weak bases, and over a temperature range up to 960°F (516°C). It is control-manufactured as a 100% closed-celled, foamed glass block, impervious to acidic liquids and gases, is extremely lightweight, and possesses low thermal conductivity values even under completely acidic liquid operating exposures while its low coefficient of thermal expansion provides high resistance to thermal shock. PENNGUARD Block does not support combustion and can be used alone or in combination with refractory or chemically-resistant masonry/monolithic linings at higher temperatures to provide a unique combination of acid corrosion protection and heat conservation. The block is installed in a manner similar to a chemically-resistant masonry lining, utilizing special mortar or an adhesive/membrane to fully bond the block to the substrate and to fully side joint between adjacent block.

Acid Condensate Solutions and Gases	Resistant	Non Resistant
*Sulfuric Acid H_2SO_4	•	
*Nitric Acid, HNO_3	•	
*Hydrochloric Acid, HCl	•	
*Phosphoric Acid, H_3PO_4	•	
*Acetic Acid	•	
*Hydrofluoric Acid, HF		•
Steam Impingement		•
Base and Salt Solutions		
Ammonium Hydroxide, NH_4OH	•	
Magnesium Hydroxide, $Mg(OH)_2$	•	
Calcium Hydroxide, $Ca(OH)_2$		•
Potassium Hydroxide, KOH		•
Sodium Carbonate, Na_2CO_3		•
Sodium Chloride, NaCl	•	

Base and Salt Solutions	Resistant	Non Resistant
Sodium Sulfate, Na_2SO_4	•	
Sodium Sulfite, Na_2SO_3		•
Ammonium Nitrate, NH_4NO	•	
Organics		
Heptane	•	
Kerosene	•	
Benzene	•	
Toluene	•	
Carbon Tetrachloride	•	
Methylene Chloride	•	
Acetone	•	
Methyl Ethyl Ketone	•	
Methanol	•	
Diethyl Ether	•	
Ethyl Acetate	•	

*All concentrations including gaseous forms.

TABLE 6.5: GLASS PIPE–CORNING

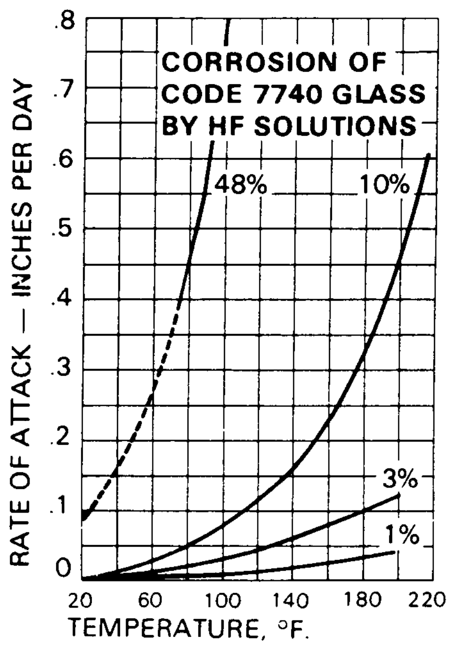
Acids
Sulfuric, hydrochloric, nitric, and acetic are only a few of the most corrosive materials PYREX® pipe can handle with ease.

Halogenated Hydrocarbons
Bromine, chlorine, brominations and chlorinations all are perfect for Corning's corrosion resistant systems.

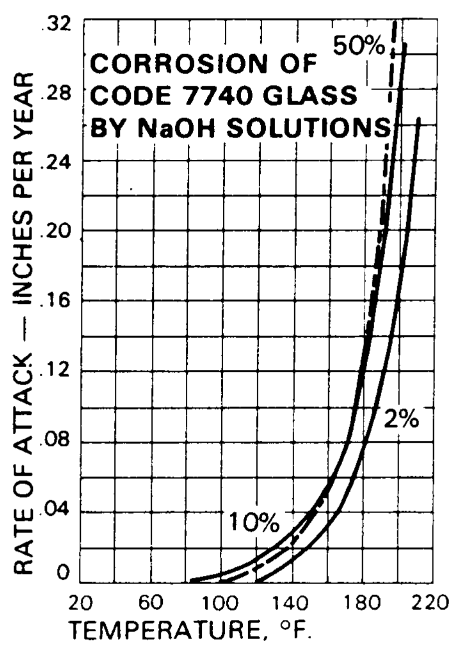
Pharmaceuticals
Solutions are in contact only with PYREX® Brand Pipe and virgin TFE preventing possible contamination of product.

Alkalies & Hydrofluoric Acid.
Low temperature can generally be handled. However, hot alkalies and hydrofluoric acid should be avoided.

Additional Applications
Hydrogen peroxide
Brines
Hot, food grade phosphoric acid
All chemicals in the neutral pH range



Concentrated hydrofluoric acid attacks Code 7740 glass at all temperatures. Mild solutions dumped into drainlines can be tolerated at room temperatures.



Alkaline solutions attack glass very slowly at room temperatures, but as temperature is increased over 100°F, the corrosion rate rises rapidly.

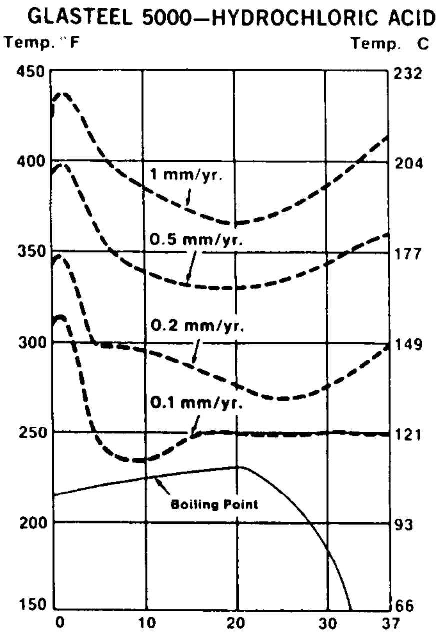
TABLE 6.6: GLASSED STEEL–PFAUDLER

The glass coating of the GLASTEEL composite is a non-conductive mixture of low energy oxides that can corrode only by a self-limiting ion exchange reaction (acids) or by direct chemical solution (alkalis). Consequently, the corrosion rates of GLASTEEL can be accurately measured and valid predictions of service life can be made.

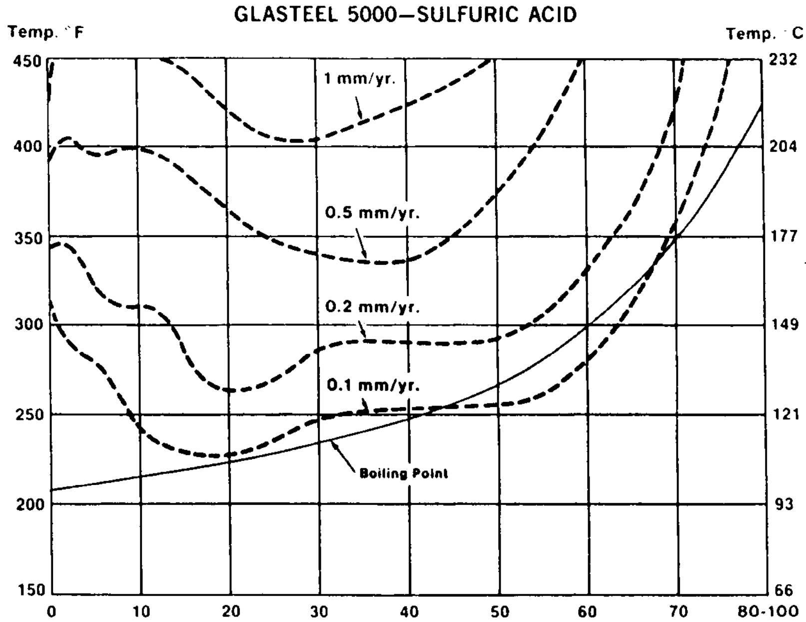
Acid Resistance

Outstanding acid resistance under extreme process conditions is a primary feature of Pfaudler GLASTEEL. The charts which follow can be regarded as reliable quantitative laboratory data on the corrosion resistance of GLASTEEL 5000 in five common reagent-grade acid solutions (liquid phase). Chart data are presented in terms of glass loss expressed in millimeters per year. Average Pfaudler glass thickness is approximately 1 to 2.25 mm (40 to 90 mils) on reactors, high voltage tested. Therefore, approximate years of anticipated service life may be estimated from the charts.

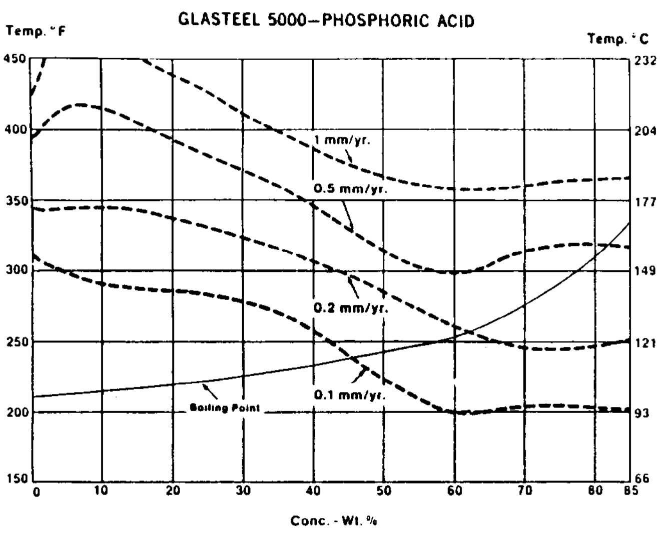
Acid Corrosion Charts



The graph shown here is also typical for hydrobromic, hydriodic and chloroacetic acids.



The graph shown here is also valid for sulphurous acid.



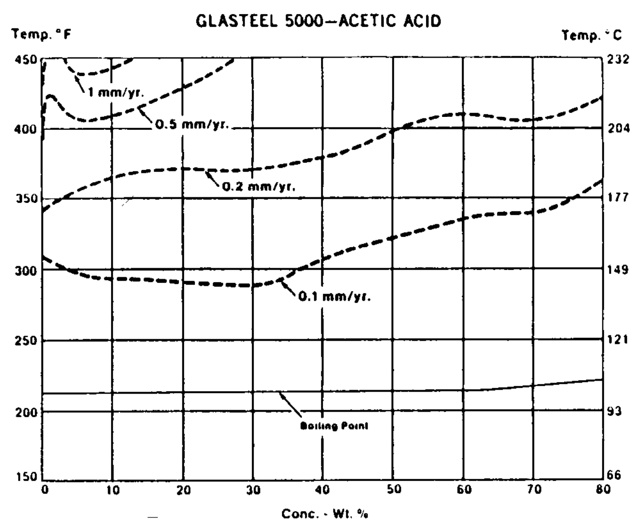


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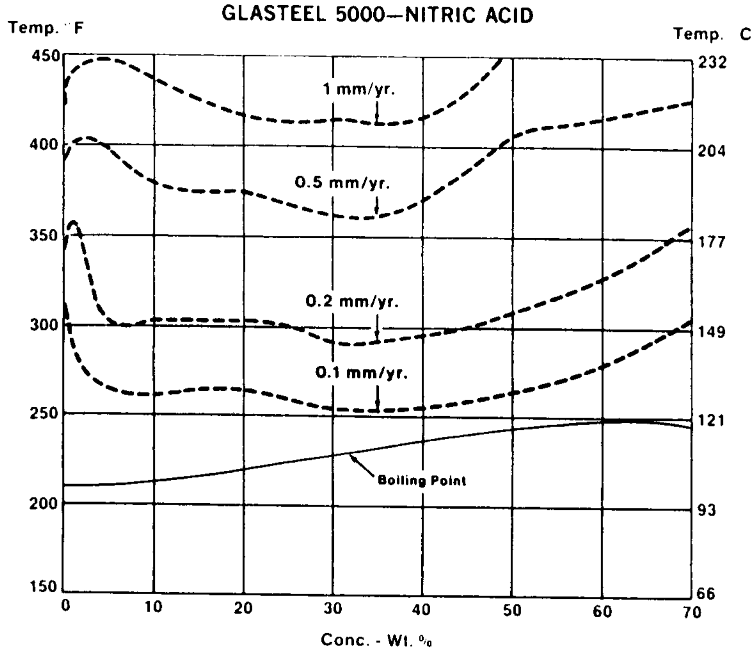
TABLE 6.6: GLASSED STEEL—PFAUDLER (continued)



The graph shown here is also valid for nitrous acid.

Alkali Resistance

Alkali and acid corrosion differ in that alkali attacks the silica network of glass directly and is limited primarily by controlling temperature and concentration. GLASTEEL 5000 exhibits good alkaline corrosion resistance. It can be used at room temperature at any pH value. As temperatures increase, however, the pH value of the environment becomes a more significant factor.

Corrosion charts for specific alkaline solutions are presented below. The charts for sodium hydroxide and sodium carbonate may be used as a general guideline for all hydroxide and carbonate solutions, for example, KOH and K_2CO_3. For hydroxide concentrations greater than 4 wt % (pH 14), the maximum allowable temperatures for a rate of 0.2 mm/yr are: 66°C at 10%, 60°C at 20%, 57°C at 30%.

Alkali Corrosion Charts

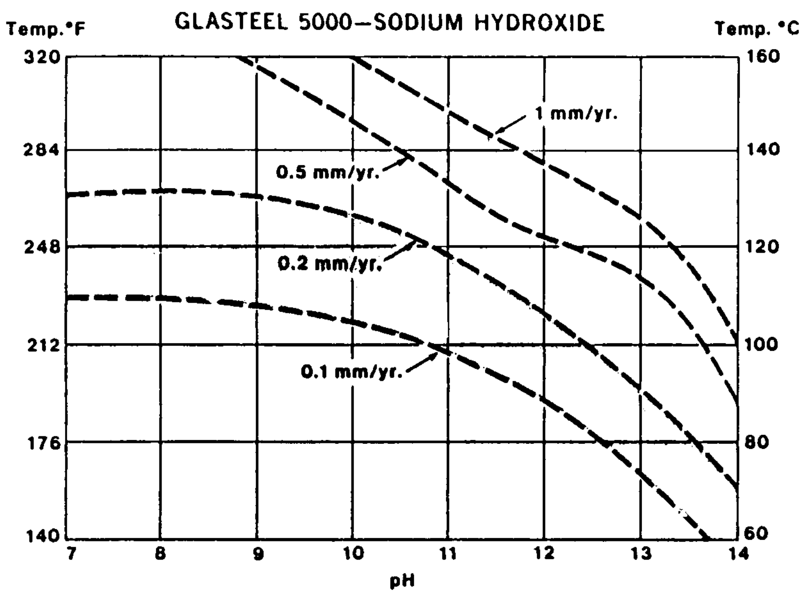


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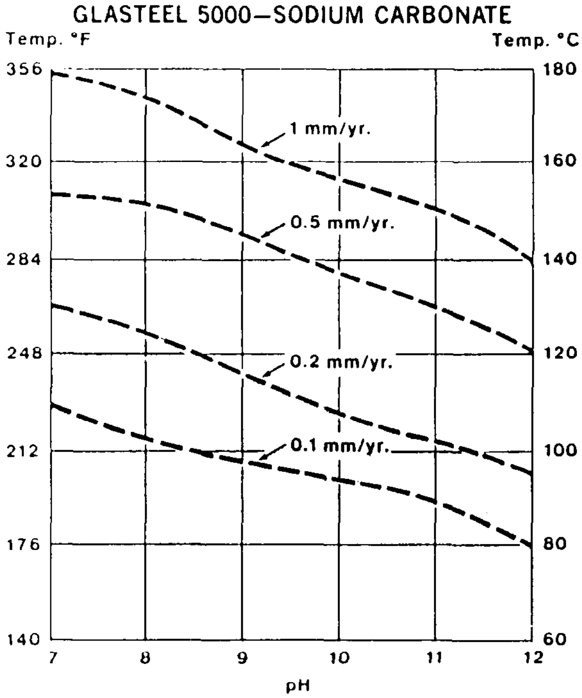
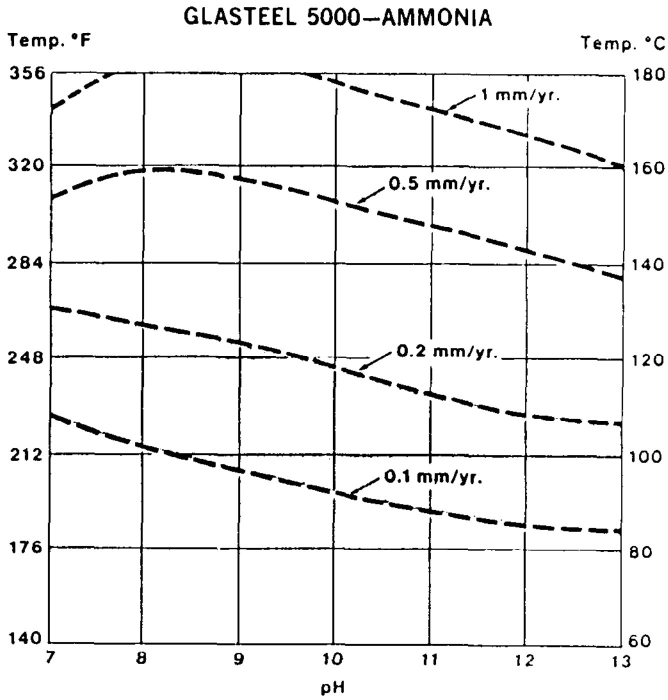
TABLE 6.6: GLASSED STEEL—PFAUDLER (continued)





Corrosion Testing

Testing to the Boiling Point.

Testing up to the boiling point is done using the equipment and procedures specified by the International Oragnization for Standardization (ISO).

Acids

Sample Preparation	according to ISO 2723
Test Unit	according to ISO 2733
Procedure	according to ISO 2743. (This procedure gives quantitative liquid and condensing vapor phase data for most acids.)

Water

Sample Preparation	according to ISO 2723
Test Unit	according to ISO 2733
Procedure	according to ISO 2744. (This procedure gives quantitative liquid and condensing vapor data.)

Alkali

Sample Preparation	according to ISO 2723
Test Unit	according to ISO 2734
Procedure	according to ISO 2745. (This procedure gives quantitative liquid phase data for all alkaline solutions up to 80°C (176°F). For temperature above 80°C, consult Pfaudler.)

Miscellaneous Media

Agent	Temperature (°C) (°F)	Corrosion Rates (mm/yr.) liquid phase	vapor phase
Aqua Regia	150 (302)	<0.5	
Barium Hydroxide sat. sol.	B.P.	<0.1	
Bromine	70 (158)	<0.1	<0.2
Chlorosulfonic Acid	150 (302)	<0.2	
Ferric Chloride, 10%	B.P.	<0.1	<0.1
Hydriodic Acid, 20%	160 (320)	<0.5	
Lithium Chloride, 10%	B.P.	<0.1	<0.1
Lithium Chloride, 30%	B.P.	<0.1	<0.1
Monochloracetic Acid, 20%	B.P.	<0.1	<0.1
Oxalic Acid, 50%	150 (302)	<0.2	
Phosphorous Acid, 70%	110 (230)	<0.1	<0.1
Sodium Fluoride, sat. sol.	B.P.	<0.1	
Sodium Sulfide, 5%	B.P.	<0.1	<0.1
Succinic Acid, sat. sol.	200 (392)	<0.5	<0.1
Tri-sodium Phosphate 5%	B.P.	<0.5	
Water	B.P.	<0.1	
Water	200 (392)	<0.5	

Comparative Resistances of Materials of Construction

TABLE 7.1: STEEL, ALUMINUM AND GLASS FIBER REINFORCED PLASTIC TANK CONSTRUCTION MATERIALS—AMERICAN IRON AND STEEL INSTITUTE

CORROSION RESISTANCE OF TANK-CONSTRUCTION MATERIALS TO AGRICULTURAL CHEMICALS

Chemical	Material and Rating				
	Type 304 Stainless	Type 316 Stainless	Carbon Steel	Aluminum	Glass-Fiber-Reinforced Plastic
FERTILIZERS					
Nitrogen solutions (no free ammonia)	A	A	B	A	A
Nitrogen solutions (free ammonia)	A	A	B	A	C*
Aqua ammonia	A	A	A	A	C*
Mixed liquid fertilizer (1-3-0)	A	A	B	C	ND
Mixed liquid fertilizer (X-X-X)	A	A	B	B	ND
Phosphoric acid (55% P_2O_5) (chloride free)	B	A	C	C	A
Phosphoric acid (55% P_2O_5) (300 ppm chloride)	C	A	C	C	A
INSECTICIDES					
Aldrin (1 oz/gal)	A	A	B	A	A
Aldrin (100%)	A	A	C	C	ND
BHC (1 oz/gal)	A	A	B	B	A
Calcium arsenate	A	A	A	ND	ND
Chlordane (¼ lb/gal)	A	A	B	B	A
DDT (5% in water)	A	A	B	A	ND
DDT (10% in water)	B	B	C	C	ND
DDT (paste)	A	A	B	B	A
Dieldrin (1 oz/gal)	A	A	B	B	A
Dieldrin (10%)	A	A	C	C	ND
Lead arsenate (100%)	A	A	ND	C	ND
Parathion (0.5%)	A	A	B	A	A
Parathion (10%)	A	A	C	C	ND
Toxaphene (10%)	B	B	C	C	ND
FUNGICIDES					
Copper sulfate (10%)	A	A	C	C	A
Pentachlorophenol	ND	ND	A	ND	ND
Carbamates (5%)	A	A	B	A	A
Mercuric chloride (10%)	C	C	C	C	ND
Sulfur (100%)	A	A	A	A	ND
Zinc sulfate (10%)	A	A	C	B	ND
HERBICIDES					
2,4-D (3 oz/gal)	A	A	B	B	A
2,4,5-T (3 oz/gal)	A	A	B	B	A
Sodium TCA (1¼ lb/gal)	A	A	C	C	A
Sodium chlorate (10%)	B	B	ND	B	ND
Sodium arsenite (8 oz/gal)	A	A	A	B	ND
Arsenic acid (10%)	B	B	C	C	ND
DEFOLIANTS					
Magnesium chlorate (10%)	A	A	C	C	A

* Resins used to formulate glass-fiber-reinforced plastics vary in their resistance to alkaline solutions. Solutions containing free ammonia should not be carried in a plastic tank unless the tank is recommended specifically for alkaline solutions.

Key to Symbols:

A. Resistant to corrosion. Should provide long service life with little maintenance. (Corrosion rates at ambient temperature are generally less than 0.002 inch per year.)

B. Moderately resistant. Will corrode to some extent. Maintenance and eventual replacement may be necessary. (Corrosion rates at ambient temperature are generally between 0.002 and 0.020 inch per year.)

C. Not resistant to corrosion and not recommended for continuous use. (Corrosion rates at ambient temperature are generally greater than 0.020 inch per year.)

ND = No data.

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING

MATERIALS
X - Very Good Service
+ - Moderate Service
— - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS
SOLIDS ASSUMED IN SOL'N.
ROOM TEMPERATURES ASSUMED
UNLESS OTHERWISE STATED

	METALS																												CARBONS & CERAMICS								
CHEMICALS	CARBON STEEL, Fe	CAST IRON & DUCTILE IRON Fe	304 STAINLESS STEEL: Fe, 18Cr, 8Ni	316 STAINLESS STEEL: Fe, 16Cr, 10Ni, 2Mo	347 STAINLESS STEEL: Fe, 17Cr, 9Ni, (Cx10)Cb	NI-RESIST IRON: Fe, 14Ni, 2Cr, 2Si	DURIMET 20: CARPENTER 20; Fe; 4Cu, 20Cr, 29Ni, 2Mo, 1Si	WORTHITE 3Mo, 2Cu, Fe, 20Cr, 24Ni, 3Si	DURIRON; Fe, 14Si; Durichlor, Fe, 14Si 3Mo*	COPPER; BRASS; BRONZES; EVERDUR	ALUMINUM: Al (and Alloys)	LEAD, Pb	MONEL: 67Ni, 30Cu, 1.4 Fe	NICKEL Ni	INCONEL: 76Ni, 15Cr, 8Fe	HASTELLOY B: Ni, 26Mo, 4Fe	HASTELLOY C: Ni, 16Mo, 4Fe, 14Cr, 4W	HASTELLOY D: Ni, 8Si, 3Cu	CHLORIMET 3: 3Fe, 1Si, 60Ni, 18Mo, 18Cr	CHLORIMET 2: 63Ni, 32Mo, 3Fe, 1Si	STELLITE; Co, 28Cr, 4W	ZIRCONIUM; Zr	TANTALUM; Ta	SILVER; Ag	PLATINUM; Pt	DOWMETAL (Mg alloys)	TITANIUM; Ti	MOLYBDENUM Mo *NOTE: Duriron is as shown. Durichlor is also satisfactory on Chlorides and HCl	CARBON & GRAPHITE;	GLASS, "PYREX" brand	SILICAWARE	SILICATE CEMENTS	CHEMICAL STONEWARE	TRANSITE (asbestos & cement)	CHEMICAL PORCELAIN	CONCRETE-Unbonded	CONCRETE-Mortar Bonded
ACETIC ACID, 100%, CH_3COOH	o	o	+	x	—	o	x	x	x	o	x	o	—	+	—	x	x	x	x	x	x	x	x	x	x		x		x	x	x	x	x		x		
ACETIC ACID, Dilute	o	o	x	x	—	o	x	x	x	x	—	—	—	o	+	x	x	+	x	x	x	x	x	x	x		x	x	x	x	x		x		x		
ACETIC ANHYDRIDE, $(CH_3CO)_2O$	—	+	x	x	x	—	x	x	x	—	—	o	—	—	+	+	x	+	x	x	x		x	x	x		x		x	x	x	x	x		x		
ACETONE, CH_3COCH_3	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		x			x		x	x	x		x	x	x		
ACETYL CHLORIDE, CH_3COCl	o		—	x			x		x	o			+						x	x										x					x		
ALUMINUM CHLORIDE, $AlCl_3$	o	o	o	o	o	—	x	o	x	—	o	o	o	—	—	x	+	x	x	x	—	x	x	x	x		x		x	x	x	x	x		x		
" HYDROXIDE, $Al(OH)_3$			x	x			x	x	+	x	x		+	+					x	x			x							x					x		
" SULFATE, $Al_2(SO_4)_3$	o		—	—	x	—	x	x	x	—	x	x	—	—	—	x	x	x	x	x	x	x	x	x	x		x		x	x	x		x	x	x		
ALUMS, CONC., $Al_2(SO_4)_3 \cdot K_2SO_4$, etc.	o		o	—	—		+		x	—	—	x							x	x			x		x				x	x					x		
ALUMS, DILUTE	o	o	x	—	—	—	x	x	x	—	x	+	+	+		+	+		x	x		x	x	x	x				x	x	x	x	x	x	x		
AMINES, various	x	x	x	x	x		x	x	x	—	—					x	x	x	x	x	x		—	x	x				x	x			x		x		
AMMONIA (Gas), Moist, NH_3	x		x	x	x	x	x		x	o	o	—	—	—	—	x	x	x	x	x	x		—	x	x	x			x	x	x	o	x	x	x		
AMMONIUM CARBONATE, $(NH_4)_2CO_3$	+	+	+	+	x		x		x	—	—		+	x	+	+	+	+	x	x			x							x		x			x		
" CHLORIDE, NH_4Cl	o	o	o	—	—	x	x	x	x	o	o	—	+	+	—	+	+	x	x	x	—	x	x	x	x		x	+	x	x	x	x	x	x	x	x	
" HYDROXIDE, NH_4OH	x	x	x	x	x	x	x		+	o	—	+	o	o	x	+	+	+	x	x	x	x	—	x	x	x	x	—	x	—			x		x		
" NITRATE, NH_4NO_3	—		x	x	x	—	x	x	x	o	o		x		—	o	x	o	x	x			x						x	x	x		x		x	x	
PERSULFATE, $(NH_4)_2S_2O_8$	o		x	x	x		x	x	x	—	—		o	o	—	o	x	o	x	x			x							x							
PHOSPHATE, $(NH_4)H_2PO_4$	o		x	x		—	x		x	o									x	x										x					x		
" $(NH_4)_2HPO_4$	—		x	x		x	x		x	—	—								x	x										x					x		
" $(NH_4)_3PO_4$	x	—	x	x	x	x	x	x	x	o	—	x	x	x	x	x	x	x	x	x	x		x						x	x			x		x		
" SULFATE, $(NH_4)_2SO_4$	x		—	—	+	x	x	x	x	—	—	—	+	+	x	x	x	x	x	x	x	x	x	x			x		x	x	x		x		x		
AMYL ACETATE, $C_5H_{11}COOCH_3$	—		x	x	x	x	x	x	x	—	x		+	+	+	x	x	x	x	x			x						x	x	x		x		x	x	
" ALCOHOL, $C_5H_{11}OH$	x		x	x			x		x	x	x								x	x									x	x	x		x	x	x		
" CHLORIDE, $C_5H_{11}Cl$	x		—	—	—		x	—	x	x	o		—	+	—	x	x	x	x	x			x						x	x	x		x		x		
ANTIMONY TRICHLORIDE, $SbCl_3$	o		o	o	o				x	—	o	x	x	x	x	x	x		x	x			x							x	x		x		x		
ARSENIC ACID, $HAsO_3$	o		—	—		x	x	x	x	—		—			—				x	x			x	x					x	x					x		
BARIUM CARBONATE, $BaCO_3$			x	x	x		x	x	x	x	o		+	x	x	x	x	x	x	x		x	x				x			x					x		
" HYDROXIDE, $Ba(OH)_2$	x			x		x	x	x	+	o	o		x	x		+	+	+	x	x		x	x				+			x					x		
" SULFIDE, BaS	o		x	x		x	x	x	x	o	o		—						x	x				o						—					x		
BENZALDEHYDE, C_6H_5CHO	x		x	x			x		x		—	o							x	x									x	x	x		x	x	x	x	
BENZENE, C_6H_6	+	+	x	x	x	x	x	x	x	x	x	+	+	+	x	+	+	+	x	x	x		x	x	x	x			x	x		x	x		x		
BENZOIC ACID, C_6H_5COOH	o		x	x	+		x	x	x	+	x	o	+	+	+	x	x	x	x	x			x	x						x					x		
BORAX, $Na_2B_4O_7$	x	—	x	x	x	x	x		x	—	—		x	x	x				x	x				o					x	x	x		x	x	x	x	
BORIC ACID, H_3BO_3	o	o	+	+	+	—	x	x	x	+	+	+	+	+	x	x	x	x	x	x	x		x	x	x		x		x	x		x	x		x		
BROMINE, Wet, Br_2	o		o	o	o	o	o	o	o	o	o	—	o	o	o	o	x	o	x	o	—		x	o	—		o		o	x	x		x		x	x	
BUTANOL, C_4H_9OH	x		x	x			x		x	x	x		x	x	x	x	x	x	x	x										x					x		
BUTYL ACETATE, $C_4H_9COOCH_3$	—			x			x	x	x	x	x	x	+			x	x	x	x	x			x			—			x	x	x		x	x	x	x	x
BUTYRIC ACID, C_3H_7COOH	o	o	o	x	o		x	x	x	—	—	o	+	+	+	x	x	x	x	x			x				x			x					x		
CALCIUM BISULFATE, $CaHSO_4$	o		o	x		o	x			o	o		o	o					x	x										x					x		
" BISULFITE, $CaHSO_3$	x		o	x		o	x	x	o	—	—	x	o						x	x							x			x	x		x		x		
CALCIUM CARBONATE, $CaCO_3$	x		x	x		x	x	x	x	x	o	x	x	x	x	x	x	x	x	x			x				x			x					x		
" CHLORATE, $CaClO_3$			—	x	o		+	—	+	—			+	+	+		+	+	+	+			x						x	x					x		
" CHLORIDE, $CaCl_2$	+	+	—	—	—	—	+	x	x	+	—	o	+	+	+	+	x	+	x	x	—	x	x				x		x	x	x	x	x	x	x	x	
" HYDROXIDE, $Ca(OH)_2$	x		x	x	x	x	x	x	+	+	—		x	x	x	x	x	x	x	x			x				x			x					x		
" HYPOCHLORITE, $Ca(OCl)_2$	—	o	o	—	—	—	—	—	x	o	o	o	o	o	o	o	—	o	—	o	o	x	x		x		x		x	x	x	o	x		x	x	
" SULFATE, $CaSO_4$	—		x	x			x	x	x	x	—		+			+	+	+	x	x			x							x					x		
CARBON DIOXIDE (Dry), CO_2	x		x	x	x	x	x		x	x	x	x	x	x	x	x	x		x	x				x				x		x					x		
" " (Wet or H_2CO_3)			x	x	x	—	x	x	x	—	—	—	—	x	x	x	x	x	x	x	x		x	x					x	x	x		x	x	x	x	x
CARBON DISULFIDE, CS_2	x	+	+	+	x	x	x	x	x	—	—	+	+	+	+				x	x			x	—					x	x	x	x	x		x		
CARBON TETRACHLORIDE (Moist) CCl_4	—	—	o	—	—	—	x	x	x	—	—	+	+	+	x	+	x	+	x	x	x	x	x	x			x		x	x	x	x	x	x	x	x	
CHLORACETIC ACID, $ClCH_2CO_2H$	o	o	o	o	o		—	o	x	o	o	o	—	—	+	x	x	—	x	x	—		x	x	x		x			x			x		x		
CHLORIC ACID, $HClO_3$			o	o																				o						x							
CHLORINE (DRY), Cl_2	x	x	x	x	x		x	x	x	x	o	x	x	x	x	x	x	x	x	x			x	x	x		o	+	x	x	x		x		x		
" (Wet), Cl_2	o	o	o	o	o	o	o	o	—	o	o	—	o	—	o	o	x	o	x	o		o	x	x	x		—	o	—	x	x		x		x		
CHLOROBENZENE, C_6H_5Cl	x		x	x	x		x	x	x	+			—	—	—				x	x			x							x	x		x		x		
CHLOROFORM, $CHCl_3$	x		x	x	x		x	x	x	x	—	x	x	x	x	x	x	x	x	x			x				x		x	x	x		x		x		

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS–CORNING (continued)

MATERIALS
X - Very Good Service
+ - Moderate Service
– - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS
SOLIDS ASSUMED IN SOL'N.
ROOM TEMPERATURES ASSUMED UNLESS OTHERWISE STATED

METALS: columns CARBON STEEL through MOLYBDENUM. CARBONS & CERAMICS: columns CARBON & GRAPHITE through CONCRETE-Mortar Bonded.

CHEMICALS	CARBON STEEL, Fe	CAST IRON & DUCTILE IRON Fe	304 STAINLESS STEEL: Fe, 18Cr, 8Ni	316 STAINLESS STEEL: Fe, 16Cr, 10Ni, 2Mo	347 STAINLESS STEEL: Fe, 17Cr, 9Ni; (Cx10)Cb	NI-RESIST IRON: Fe, 14Ni, 2Cr, 2Si	DURIMET 20: CARPENTER 20; Fe; 4Cu, 20Cr, 29Ni, 2Mo, 1Si	WORTHITE 3Mo, 2Cu, Fe, 20Cr, 24Ni, 3Si	DURIRON; Fe, 14Si; Durichlor, Fe, 14Si, 3Mo*	COPPER; BRASS; BRONZES; EVERDUR	ALUMINUM; Al (and Alloys)	LEAD, Pb	MONEL; 67Ni, 30Cu, 1.4 Fe	NICKEL Ni	INCONEL; 76Ni, 15Cr, 8Fe	HASTELLOY B; Ni, 26Mo, 4Fe	HASTELLOY C; Ni, 16Mo, 4Fe, 14Cr, 4W	HASTELLOY D; Ni, 8Si, 3Cu	CHLORIMET 3; 3Fe, 1Si, 60Ni, 18Mo, 18Cr	CHLORIMET 2; 63Ni, 32Mo, 3Fe, 1Si	STELLITE; Co, 28Cr, 4W	ZIRCONIUM; Zr	TANTALUM; Ta	SILVER; Ag	PLATINUM; Pt	DOWMETAL; (Mg alloys)	TITANIUM; Ti	MOLYBDENUM Mo	CARBON & GRAPHITE	GLASS, "PYREX" brand	SILICAWARE	SILICATE CEMENTS	CHEMICAL STONEWARE	TRANSITE (asbestos & cement)	CHEMICAL PORCELAIN	CONCRETE-Unbonded	CONCRETE-Mortar Bonded
CHROMIC ACID, CrO_3 sol'n	–	+	o	–	o	o	+	x	x	o	+	+	o	o	–	o	+	o	+	o	x	x	x	o	x	–	x	+	o	x	x	x	x		x		
COPPER CHLORIDE, $CuCl_2$	o		o	o	o		o	x	o	o	o		o	o	o	x	x	x	–	o		–	x	–			x			x	x		x		x		
" CYANIDE, $Cu(CN)_2$			x	x	x		x	x	x	o	o		o	o	o	x	x	x	x	x			x							+					x		
" NITRATE $Cu(NO_3)_2$	o		x	x			x	x	x	o	o		o	o	o	o	x	o	x	x			x	o						x					x		
" SULFATE $CuSO_4$	o	o	x	x	x	–	x	x	x	o	o	–	–	–	–	x	x	x	x	x	x	x	x	–	x				x	x	x	x	x		x		
CRESYLIC ACID	o		x	x	x		x	x	x	o	–		–	x	–	–	–	–	x	x										x					x		
DICHLORETHANE, $C_2H_4Cl_2$	o		x	x	x		x		x				x	x	x	x	x		x	x										x					x		
DIETHYLAMINE, $(C_2H_5)_2NH$	x			x			x												x	x									x	x					x		
DIPHENYL, $C_6H_5C_6H_5$	x		x				x		x					x					x	x										x					x		
ETHERS, Various	x		x	x	x		x	x	x	x	x	x	+	+	+	x	x	x	x	x									x	x	x		x	x	x	x	x
ETHYL ACETATE, $C_2H_5COOCH_3$	x		x	x		x	x	x	x	x	x		x	x	x	x	x	x	x	x			x						x	x	x		x	x	x	x	x
" ALCOHOL, C_2H_5OH	+	+	x	x	x	x	x	x	x	+	–	+	+	+	+	x	x	+	x	x		x	x				x		x	x	x	x	x	x	x		x
ETHYL CHLORIDE, C_2H_5Cl	x		x	x	x	o	x	-	x	-	-		+	+	x	x	x	x	x	x			x						x	x					x		
ETHYLENE CHLOROHYDRIN, $Cl(C_2H_4)OH$	x		x				x		x			x							x	x									–	x	x		x		x		
" DICHLORIDE, $C_2H_4Cl_2$	x		x	x	x		x		x	–	o	x	+	+	–	x			x	x			x				x		x	x	x		x		x		
" GLYCOL, CH_2OHCH_2OH	–	+	x	x	x	x	x	x	x	+	x	+	+	+	+				x	x									x	x	x	x	x		x		
" OXIDE, CH_2OCH_2	x		x				x		x										x	x										x					x		
FATTY ACIDS, Various	o	o	x	x	x	–	x	x	x	–	x	o	+	x	x	x	x	x	x	x	x		x	x	x				x	x	x	x	x	x	x	x	x
FERRIC CHLORIDE, $FeCl_3$	o	o	o	o	o	o	o	o	–	o	o	o	o	o	o	o	+	o	–	o	–	o	x	o			x	o	x	x	x	x	x		x	x	
" NITRATE, $Fe(NO_3)_3$	o		x	x	x		x	x	x	o	o		o	o	o	o	+	o	x				x	o						x					x		
" SULFATE, $Fe_2(SO_4)_3$	o		–	x	x	o	x	x	x	o	o	x	o	o	o	o	+	o	x		x		x	o			x		–	x	x		x		x		
FERROUS CHLORIDE, $FeCl_2$	o	o	o	o	o	x	–	o	+	o	o	o	o	o	o	–	+	+	+	–			x	o					x	x	x	x	x		x		
" SULFATE, $FeSO_4$	o	o	+	o	x	–	x	x	x	–	+	–	o	o	o	+	+	+	x	x	–		x	o			x		x	x	x	x	x		x		
FLUORINE, F_2			o	o			–		o	o	o	–	o	x	x	+	x		+				o	x			o	o	o	o					o		
FORMALDEHYDE, CH_2O	–	–	–	–	–	–	x	x	x	x	–	o	–	x	–	x	x	x	x	x	x		x	x		–	x		x	x	x		x		x	x	
FORMIC ACID, HCOOH	o	o	+	+	·		x	x	x	o	–	o	+	+	–	–	x	–	x	x	x	x	x				o	+	x	x	x	x	x		x		
FUEL OIL	x		–	x	x	x	x		x	x	x		x	x	+	x	x	x	x	x			x							x					x		
GALLIC ACID, $(OH)_3C_6H_2COOH$	o		x	x	x		x		x	x	x		–	+	+	x	x	x	x	x										x					x		
GASOLINE, Refined	x		x	x	x	x	x		x	x	x		+	+	+	x	x	x	x	x			x						x	x	x		x		x		
GLYCEROL, $CH_2OH.CHOH\ CH_2OH$	+		+	+	+	x	x		x	x	x	–	+	x	x	x	x	x	x	x				x			x		x	x	x		x		x	x	
HYDROBROMIC ACID, HBr	o		o	o	o		o	o	–	–	o	o	o	o	o	x	–	–	–	+			x				x		x	x	x		x		x		
HYDROCHLORIC ACID, (Conc.), HCl	o	o	o	o	o	o	o	o	+	o	o	o	o	o	o	+	–	o	+	x	x	x	x	x	x		o	x	x	x	x	x	x		x		
" (Dilute)	o	o	o	o	o	–	o	o	x	o	o	–	–	–	–	+	–	–	x	x	–	x	x	x	x		–		x	x	x		x		x		
" (Dry Gas)	x		–	x			x		x		o	–	–	–	–	x	x		x	x		x	x						x	x					x		
HYDROCYANIC ACID, (Conc.), HCN	o		x	x	x	x	x	x	x	o	x	–	x	–	–	x	x	x	x	x			x							x					x		
" " (Dil. & Gas)			o	o																			x							x					x		
HYDROFLUORIC ACID, (Conc.), HF	–	o	o	o	o	o	+	–	o	o	o	o	+	–	–	+	+	+	x	x	–		o	x	x	x	o		o	o			o		o		
" " (Dilute)	o	o	o	o	o	–	+	o	o	–	o	+	+	+	–	+	+	+	x	x	–		o		x	o	o		x	o		o	o		o		
HYDROFLUOSILICIC ACID, H_2SiF_6	o		o	o	o	o	+		o	o	–		–	–	–	–	–	–	x	x			o						x	–					o		
HYDROCARBONS (Aliphatic)	x	x	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x		x	x	x	x		+	x	x	x		x		x		
" (Aromatic)	x	x	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x		x	x	x	x			x	x	x		x		x		
HYDROGEN GAS, H_2	x						x		x	x	x	x	x	x					x	x				x				x		x					x		
HYDROGEN PEROXIDE (Conc.), H_2O_2	o	o	+	o	–	o	+	–	+	o	x	–	–	–		–	x	–	x	x	x		x	o	x		x			x	x		x		x		
" " (Dilute)	o	o	+	+			x	x	x	o	x	o	+	+	+	x	x	–	x	x	x	x	x	x	x		-		x	x	x	x	x		x		
HYDROGEN SULFIDE (Dry) H_2S	x		–	x		–	x		x	o	o	x	–	x	+	–	x	–	x	+			x	o				+		x	x		x		x	x	
" " (Wet)	–		–	x	–	–	x	x	+	o	o	o	o	x	+	–	+	–	x	+				o						x					x		
IODINE, I_2 Wet	o	o	o	o	o		o		o	o	o	o	o	o	–	o	–	o	+	o	–		x	–	x	–			o	x	–		x		x	x	
IODOFORM, CHI_3	o		o	x	x		x		x		x								x	x										x					x		
KEROSENE	x		x	x	x		x		x	x	x		x	x	x	x	x	x	x	x			x						x	x					x		
KETONES, Various	x		x				x		x		–	x							x	x									–	x					x		
LACTIC ACID, $CH_3CHOHCOOH$	o	o	–	–	x	–	x	x	x	–	–	o	–	–	–	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x		x		x		
LEAD ACETATE, $Pb(CH_3COO)_2$	o		x	x	+		x	x	x	–	o		x	+		x	x	x	x	x			x				x			x					x		
MAGNESIUM CHLORIDE, $MgCl_2$	–	–	–	+	–	x	x	x	x	+	–	o	+	+	+	x	x	x	x	x	–		x	x			x			x	x	x	x	x	x	x	x
" HYDROXIDE, $Mg(OH)_2$	x		x	x	+		x	x	+	–	o		x	x	x	x	x	x	x	x			x	x			x			x					x		
" SULFATE, $MgSO_4$	+	o	+	+	+	x	x	x	x	+	x	+	+	+	+	x	+	x	x	x		x	x	x			x			x	x	x	x	x	x	x	x
MALEIC ACID, $CO_2HC_2H_2CO_2H$	o		x	x			x	x	x							x			x	x				x						x					x		

*NOTE: Duriron is as shown. Durichlor is also satisfactory on Chlorides and HCl

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING (continued)

MATERIALS
X - Very Good Service
\+ - Moderate Service
— - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

	METALS																												CARBONS & CERAMICS								
CHEMICALS SOLIDS ASSUMED IN SOL'N. ROOM TEMPERATURES ASSUMED UNLESS OTHERWISE STATED	CARBON STEEL, Fe	CAST IRON & DUCTILE IRON Fe.	304 STAINLESS STEEL; Fe. 18Cr, 8Ni	316 STAINLESS STEEL; Fe. 16Cr, 10Ni, 2Mo	347 STAINLESS STEEL; Fe, 17Cr, 9Ni; (Cx10)Cb	NI-RESIST IRON; Fe. 14Ni, 2Cr, 2Si	DURIMET 20: CARPENTER 20; Fe; 4Cu, 20Cr, 29Ni, 2Mo, 1Si	WORTHITE 3Mo, 2Cu, Fe, 20Cr, 24Ni, 3Si	DURIRON; Fe, 14Si; Durichlor, Fe, 14Si, 3Mo*	COPPER; BRASS; BRONZES; EVERDUR	ALUMINUM; Al (and Alloys)	LEAD, Pb	MONEL; 67Ni, 30Cu, 1.4 Fe	NICKEL Ni	INCONEL; 76Ni, 15Cr, 8Fe	HASTELLOY B; Ni, 26Mo, 4Fe	HASTELLOY C; Ni, 16Mo, 4Fe, 14Cr, 4W	HASTELLOY D; Ni, 8Si, 3Cu	CHLORIMET 3; 3Fe, 1Si, 60Ni, 18Mo, 18Cr	CHLORIMET 2; 63Ni, 32Mo, 3Fe, 1Si	STELLITE; Co, 28Cr, 4W	ZIRCONIUM; Zr	TANTALUM; Ta	SILVER; Ag	PLATINUM; Pt	DOWMETAL; (Mg alloys)	TITANIUM; Ti	MOLYBDENUM Mo *NOTE: Duriron is as shown. Durichlor is also satisfactory on Chlorides and HCl	CARBON & GRAPHITE;	GLASS, "PYREX" brand	SILICAWARE	SILICATE CEMENTS	CHEMICAL STONEWARE	TRANSITE (asbestos & cement)	CHEMICAL PORCELAIN	CONCRETE-Unbonded	CONCRETE-Mortar Bonded
MALIC ACID, $CO_2H\,CH_2\,CHOH\,CO_2H$	o		x	x	x		+		x	o	-		+	+	+	x	x	x	x				x							x	x		x		x		
MERCURIC CHLORIDE, $HgCl_2$	o		o	o	o		-	-	+	o	o	-	-		+	o	x	o	+	o		x	x	o			x			x					x		
MERCURY, Hg	x		x	x	x		x		x	o	o	o	+	+	x	x	x	x	x	x				o			-			x					x		
METHANOL, Conc., CH_3OH	+	+	+	+	+	x	x	x	x	+	-	+	+	+	+	x	x	+	x	x		x	x	x						x		x			x		
" (Dilute)	-						x		x	-	-					x	x	-	x	x			x							x					x		
METHYL CHLORIDE, CH_3Cl	o		-	-	+		x	x	x	x		x	x	x	x				x	x			x							x					x		
NAPHTHA, Petroleum	x		x	x	x	x	x		x	x	x		+	+	+	x	x	x	x	x									x	x	x		x		x		
NICKEL CHLORIDE, $NiCl_2$	o		-	-			+	o	+	-	o		-	x		o	x	o	x	x		x	x				x		x	x					x		
" SULFATE, $NiSO_4$	o	o	-	-			x	x	x	+	-	+	+	-	-	o	+	o	x	x		x	x						x	x					x		
NITRATING ACID (>15% H_2SO_4)	x	x	-	-	-		x	x	x	o	o		o	o		o	x	o	x	x	x		-	x	x		-		o	x			x		x		
" " (<15% H_2SO_4)	o		-	-	-		x	x	x	o	o		o	o		o	x	o	x	x	x		-	o	x		x		o	x			x		x		
" " (<15% HNO_3)	o		-	o	-		x		x	o	o		o	o		o	x	o	x	o	x	o	-	o	x		-		o	x			x		x		
" " (< 1% Acid)	o		-	x	-		x		x	o	o		o	o		o	x	o	x		x	o	-	o	x				o	x			x		x		
NITRIC ACID, Conc., HNO_3	o	o	+	+	x		x	x	x	o	-	-	o	o	-	o	+	o	x	o	x	x	x	o	x		x	+	o	x	x	x	x		x		
" " Dilute	o	o	x	x	x	o	x	x	x	o	o	o	o	o	o	o	x	o	x	o	x	x	x	o	x		x	o	-	x	x		x		x		
NITROBENZENE, $C_6H_5NO_2$	x		x	x			x	x	x			o							x	x			x							x					x		
NITROUS ACID, HNO_2	o		x	x	-		x	x	x	x			x	o					x				x							x	x		x		x		
OLEIC ACID, $C_8H_{17}CH{:}CH(CH_2)_7CO_2H$	-	-	-	x	x	-	x	x	x	-	x	o	x	x	x	x	x	x	x	x	x		x	x	x				x	x	x		x	x	x	x	x
OXALIC ACID, $CO_2H\,CO_2H$	o	o	-	-	-	-	x	x	x	+	-	o	+	-	x	+	+	+	x	x	x	x	x	x	x		-	+	x	x	x	x	x	x	x	x	
PHENOL (Conc.) C_6H_5OH	+	+	-	x	-	x	x	x	x	o	-	-	+	+	x	+	+	+	x	x	x	x	x	x	x	x	-		x	x	x		x	x	x	x	
" (Dilute)	+	+	x	x	x		x		x	-	x	-	+	+	-	+	+	+	x	x		x								x					x		
PHOSPHORIC ACID (100%), H_3PO_4	o	o	-	-	x		x		x		o	+	-	o	-	+	x	x	x	x	x	x	x	+	x			x	+	-	x		x	x	x	x	x
" " (>45% Hot)	o	o	o	o	x	o	x	x	x	o	o	+	o	o	o	-	-	-	x	x	x	-	x		x				x	-		x	o		o		
PHOSPHORIC ACID (>45% Cold)	o	o	-	x	x	-	x	-	x	o	o	+	-	-	-	+	x	+	x	x	x	x	x	x	x		-		x	x			-		-		
" ACID (<45%) "	o	o	-	x	x	-	x	-	x	o	-	+	-	-	-	+	x	+	x	x	x	x	x	x	x		x		x	x			-		-		
" ANHYDRIDE, Dry or Moist	o		x	x			x		x										x	x									x	x							
" " Molten, P_2O_5	x		x	x			x		x	o	o		o	o					x	x										o							
PHTHALIC ANHYDRIDE, $C_6H_4(CO)_2O$	x		x				x	x	x							x	x		x	x			x							x					x		
PICRIC ACID, Sol'n., $HO.C_6H_2(NO_2)_3$			x	x	+		x	x	x	o	-	-	o	o	o	x	x	x	x	x										x					x		
POTASSIUM BROMIDE, KBr	o		-	-			x		x	x	-	x	+	x		x	x	x	x	x			x	o			x			x					x		
" CARBONATE, K_2CO_3	-		x	x		-	x	x	x	-	o	x	x	x	+	x	x	x	x	x			-							-					x		
" CHLORATE, $KClO_3$	x		x	x			x	-	x	-	+		+	+	+	o	x	o	x	o			x							x					x		
" CHLORIDE, KCl	x		-	-		x	x	x	x	-	-		+	+		x	x	x	x	x			x				x			x					x		
" CYANIDE, KCN	x		x	x		x	x		x	o	o		x			x	x	x	x	x			x	o	x					-					x		
" DICHROMATE, $K_2Cr_2O_7$			x	x	-		x	x	x	x	x		-	-	+	o	x	o	x	x		x	x	x			x			x					x		
" FERROCYANIDE, $K_4Fe(CN)_6$	o		x	x			x	x	x	x	-	x	x	x	x	x	x	x	x	x			x	o						x					x		
" HYDROXIDE, KOH	+	-	+	+	-	-	x	x	+	o	o	o	x	x	x	+	+	+	x	x		x	-	x			-	+		-		o			-		
" NITRATE, KNO_3	x		x	x	x		x	x	x	x	x	-	+	+	+	o	x	o	x	x			x	o						x					x		
" PERMANGANATE, $KMnO_4$	+	+	+	+	+		x	x	x	x	x	o	-	+	+	o	x	o	x	o			x				x			x					x		
" SULFATE, K_2SO_4	x		+	+	+	x	x	x	x	+	x	x	+	+	+	+	+	+	x	x			x				x			x		x			x		
" SULFIDE, K_2S	-		x	x		-	x		x										x	x				o						-					x		
PYROGALLOL, $C_6H_3(OH)_3$			x	x			x		x	x				+		x	x	x	x	x										x					x		
SILVER NITRATE, $AgNO_3$			x	x			x	x	x	o	o	o			+	+	+	+	x	x		x	x							x					x		
SODIUM, Molten 210°- 400°F.	x	x	x	x	x		x	x	x	x	x		x	x	x	x	x		x	x		x	x			-		x		-					o		
SODIUM ACETATE; $NaCH_3COO$	o		-	x			x	x	x	x	-	x	+			x	x	x	x	x							x			x					x		
" BICARBONATE, $NaHCO_3$	-		x	x	x	x	x	x	x	-	x	x	x	x	x	x	x	x	x	x		x	x	x					x	x	x		x	x	x	x	x
" BISULFATE, $NaHSO_4$	o	o	-	x	x		x	x	x	-	o	x	+			x	x	x	x	x	x		-		x		x		x	x	x		x		x		
" BISULFITE, $NaHSO_3$	o		x	x			x	x	-	-	x	x							x	x									x	x	x		x		x		
" BORATE $NaBO_2$			x	x			x		x	x	-		+			x	x	x	x	x			x							x	x			x	x	x	
" CARBONATE, Na_2CO_3	+	+	+	+	x	x	x	x	x	+	o	-	+	+	-	+	x	x	x	x	x		-	x	x	x	x		x	-	-	o	x	x	x	x	
" CHLORATE, $NaClO_3$	-		x	x			-	-	x	+	+				+	o	x	o	x	o			x				x			x	x		x	x	x	x	x
" CHLORIDE, NaCl	+	+	-	-	-	-	x	x	+	+	-	+	+	+	-	+	+	-	x	x	-	x	x	x			x		x	x		x	x		x		
" CYANIDE, NaCN	x		x	x			x	x	x	o	o	x	x						x	x				o			x			-					x		
" FLUORIDE, NaF	o		-	-			+	-	o	-	-		+			x	x	x	x	x		x	o				x			-					x		
" HYDROXIDE, (Conc.), NaOH	-	-	-	-	x	x	x	x	-	-	o	o	x	x	x	x	+	x	x	x	x	x	o	x	x		x		x	-	o	o	o		o		

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING (continued)

MATERIALS
X - Very Good Service
+ - Moderate Service
— - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS
SOLIDS ASSUMED IN SOL'N.
ROOM TEMPERATURES ASSUMED
UNLESS OTHERWISE STATED

CHEMICALS	METALS																												CARBONS & CERAMICS								
	CARBON STEEL, Fe	CAST IRON & DUCTILE IRON Fe.	304 STAINLESS STEEL: Fe, 18Cr, 8Ni	316 STAINLESS STEEL: Fe, 16Cr, 10Ni, 2Mo	347 STAINLESS STEEL: Fe, 17Cr, 9Ni, (Cx10)Cb	NI-RESIST IRON: Fe, 14Ni, 2Cr, 2Si	DURIMET 20: CARPENTER 20: Fe, 4Cu, 20Cr, 29Ni, 2Mo, 1Si	WORTHITE 3Mo, 2Cu, Fe, 20Cr, 24Ni, 3Si	DURIRON; Fe, 14Si; Durichlor, Fe, 14Si, 3Mo*	COPPER; BRASS; BRONZES; EVERDUR	ALUMINUM; Al (and Alloys)	LEAD, Pb	MONEL; 67Ni, 30Cu, 1.4 Fe	NICKEL Ni	INCONEL; 76Ni, 15Cr, 8Fe	HASTELLOY B; Ni, 26Mo, 4Fe	HASTELLOY C; Ni, 16Mo, 4Fe, 14Cr, 4W	HASTELLOY D; Ni, 8Si, 3Cu	CHLORIMET 3; 3Fe, 1Si, 60Ni, 18Mo, 18Cr	CHLORIMET 2; 63Ni, 32Mo, 3Fe, 1Si	STELLITE; Co, 28Cr, 4W	ZIRCONIUM; Zr	TANTALUM; Ta	SILVER; Ag	PLATINUM; Pt	DOWMETAL; (Mg alloys)	TITANIUM; Ti	MOLYBDENUM Mo *NOTE: Duriron is as shown. Durichlor is also satisfactory on Chlorides and HCl	CARBON & GRAPHITE;	GLASS, "PYREX" brand	SILICAWARE	SILICATE CEMENTS	CHEMICAL STONEWARE	TRANSITE (asbestos & cement)	CHEMICAL PORCELAIN	CONCRETE-Unbonded	CONCRETE-Mortar Bonded
SODIUM HYDROXIDE, (Dilute)	x	+	+	+	x		x	x	+	x	o	o	—	—	—	x	+	x	x	x	x	x	—		x	—	x	+	x	—	o	o	—		—		
" HYDROSULFITE							x		x	—	x		o	o	o	—	x	—	x	x										x	x		x		x		
" HYPOCHLORITE, NaOCl	o	o	—	—	—	—	—	—	x	o	o	o	o	o	o	o	—	o	+	o	—		—	x	x		x		o	x			x		x		
" HYPOSULFATE	—		x	x			x		x	o	o		x						x	x				o						x					x		
" NITRATE, Na NO3	x	+	x	x	x	—	x	x	x	+	x	o	+	+	x	o	+	o	x	o	x		—	—	x				x	x	x	x	x		x		
" PEROXIDE, Na2 O2	—		x	x	+		x		x	—	—		x	+	+	+	x	+	x	x			o	o						—					x		
" PHOSPHATE, (Tri) Na3 PO4	x		x	x	+		x		x	—	o		+	+		x	x	x	x	x			x	x			x			—	—		x	x	x		
" SILICATE, Na2SiO3	x		x	x	+	x	x		x	—	—		+	x	+	x	x	x	x	x			x							—					x	x	
" SULFATE, Na2SO4	x	x	—	—	x	x	x	x	x	x	x	—	+	x	x	x	x	x	x	x	—		—	x			x		x	x			x		x		
" SULFIDE, Na2S	+	x	—	x	x	x	x	x	x	o	o	—	+	+	+	x	x	x	x	x	x		—	o			x		x	—	—		x	x	x		
" SULFITE, Na2 SO3	+	x	—	—	—	x	x	x	o	—	—	x	—	—	—	o	x	o	x	x	x		—				x		x	x	x		x		x		
STANNIC CHLORIDE, Sn Cl4	o		o	o	o		x	—	x	o	o	x	o	o	o	o	x	o	—	o			x				x			x					x		
STANNOUS CHLORIDE, Sn Cl2	o		o	—			x	—	x	o	o		o	o	o	x	x	x	x	x		x	x				x			x					x		
STEARIC ACID, CH3 (CH2)16 COOH	—	—	x	x	x	—	x	x	x	—	—	—	x	x	x	x	x	x	x	x	x		x	x			x		x	x			x		x		
SULFUR, Molten, S	—	x	—	—	—	—	x	x	x	o	x	o	—	—	x	o	o	o	x	—	o		x	o			x	+	—	x			—		—		
SULFUR CHLORIDE, (Wet), S2 Cl2	—		o	—		x	—	—	x	o	o		—	—					x					o						x					x		
" DIOXIDE (Dry), SO2	x	x	x	x	—	x	x	x	x	x	x	x	o	o	o	o	x	o	x	—	x		x	o		x			x	x	x		x		x		
" DIOXIDE (Wet)	o		—	x			x		—	o		x	o	o	o	o	x	o	x				x				+		x	x	x				x		
" TRIOXIDE, SO3	x		x	x		x	x	x	—	—	x		o	o	o				x				o	o						x			x		x		
SULFURIC ACID (Fuming to 98%)	—	—	o	o		—	x	x	o	o	—	o	o	o	o	x	o	x	x	x		o	o	o			o		o	x	x	x					
" " (Hot Conc.) H2 SO4	o		o	o			+		x	o	o	—	o	o	o	o	o	x	+	+	o	o	—				o			x							
" " (Cold Conc.)	+	+	x	x	—		x	x	x	o	—	x	+			x	x	x	x	x	—	o	—		x		o	—	o	x					x		
" " (75%-95%)	+	—	o	o	—	—	x	x	x	o	o	x	o	o	—	x	x	—	x	x	—	—	—	o	x		o		x	x			x		x		
" " (10%-75%)	o	o	o	o	—	—	x	x	x	o	o	x	—	o	—	x	x	x	x	x	—	x	—	x	x		—	x	x	x	x		x		x		
" " (<10%)	o	o	o	—	—	—	—	x	x	o	—	x	—	—	—	x	x	x	x	x	—	x	x	x	x		x		x	x	x		x		x		
SULFUROUS ACID, H2 SO3	o	o	—	x	—	o	x	x	o	o	—	—	o	o	o	o	+	+	x	x	x	x	x	x			x		x	x	x	x	x		x		
SULFURYL CHLORIDE, SO2 Cl2							+		x										+	+			x							x	x		x		x		
TANNIC ACID	—		x	x			x	x	x	—	x		+	+	+	x	x	x	x	x		x	x	x			x		x	x			x		x	x	
TARTARIC ACID, (CHOH COOH)2	—		x	x			x	x	x	—	o	x	+	+		x	x	x	x	x		x	x	x			x	+	x	x	x		x		x		
TOLUENE, CH3 C6 H5	x		x				x		x	x	x	x	x						x	x		x							x	x	x		x		x		
TRICHLORETHYLENE, Dry, Cl2 C CHCl	—	—	—	x	—	—	x	x	x	—	—		x	x	x	x	x	x	x	x	x		x			x	x		x	x			x		x		
WATER, Fresh H2O	x		x	x			x		x	x	x		x	x					x	x			x	x				x	x	x	x		x	x	x	x	x
WATER, Distilled Lab.	o		x	x		o	x		x	x	o		o	—					x	x				x						+					x		
ZINC CHLORIDE, Zn Cl2	o	o	o	—	o	—	x	x	x	o	o	—	+	+		+	+	+	x	x		x	x	x			x		x	x		x			x	x	
" SULFATE, Zn SO4	o	o	+	+	+	x	x	x	x	+	—	+	+	+	+	+	+	+	x	x			x	x			x		x	x					x		

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING (continued)

MATERIALS
X - Very Good Service
+ - Moderate Service
— - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS SOLIDS ASSUMED IN SOL'N. ROOM TEMPERATURES ASSUMED UNLESS OTHERWISE STATED	RUBBERS						THERMOPLASTICS														
	HARD RUBBER (Natural)	SOFT RUBBER (Natural)	NEOPRENE	BUTADIENE DERIVATIVES	NITRILE Rubber (Chemigum)	VITON	ASPHALTIC, BITUMASTIC	CELLULOSE ACETATE	CELLULOSE ACETATEBUTYRATE	ETHYL CELLULOSE (Ethocel)	CELLULOSE NITRATE	ACRYLIC (Lucite, Plexiglas)	COUMARONE RESINS	POLYETHYLENE	POLYVINYL CHLORIDE, Rigid or Unplast.	TYGON (P. V. C. & Copolymers)	SARAN (Vinyl chloride, vinyldene chloride)	KEL-F (Polytrifluorochloroethylene)	TEFLON (Polytetrafluoroethylene)	USCOLITE CP (styrene-acrylonitrile-butadiene)	PENTON (Chlorinated Polyether)
ACETIC ACID, 100%, CH_3COOH	x	—	o	o	o	o	o	o		x	o	o		o	o	o	—	x	x	o	+
ACETIC ACID, Dilute	x	—	o	x	o		x	x	x	x	x	x	x	x	—	—	x	x	x	—	x
ACETIC ANHYDRIDE, $(CH_3CO)_2O$	x	—	o	—	o	o	o	o		o	o	o			o	o	—		x		+
ACETONE, CH_3COCH_3	o	o	o	x	—	o	o	o	o	o	o	o	o	o	o		o		x	o	+
ACETYL CHLORIDE, CH_3COCl																		x	x		
ALUMINUM CHLORIDE, $AlCl_3$	x	x	x	x	x	x	x				x			x	x	x	x	x	x	x	x
" HYDROXIDE, $Al(OH)_3$						x								x	x			x	x		x
" SULFATE, $Al_2(SO_4)_3$	x	x	x	x	—	x	x				x	x	x	x	x	x	x	x	x	x	x
ALUMS, CONC., $Al_2(SO_4)_3 \cdot K_2SO_4$, etc.			x											x	x	x	x	x	x	x	x
ALUMS, DILUTE	x	x	x	x	x		x				x	x	x	x	x	x	x	x	x	x	x
AMINES, various	—					o									o	—		x	x		
AMMONIA (Gas), Moist, NH_3	—	—	x	x		o		—	x	x		x		x	—		o	x	x	—	x
AMMONIUM CARBONATE, $(NH_4)_2CO_3$	x				o		x							x	x		x	x	x	x	x
" CHLORIDE, NH_4Cl	x	x	x	x	—	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x
" HYDROXIDE, NH_4OH	—	x	—		x	+	—					x		x	x	—	o	x	x	x	x
" NITRATE, NH_4NO_3	—	—	—	x		+	x	x			x	x		x	x		x	x	x	x	x
" PERSULFATE, $(NH_4)_2S_2O_8$							x								x	x		x	x		x
" PHOSPHATE, $(NH_4)H_2PO_4$															x			x	x	x	x
" " $(NH_4)_2HPO_4$															x			x	x	x	x
" " $(NH_4)_3PO_4$	x													x	x	x		x	x	x	x
" SULFATE, $(NH_4)_2SO_4$	x	x	x	x			x				x	x	x		x	x	x	x	x	x	x
AMYL ACETATE, $C_5H_{11}COOCH_3$	o	o	o	o		o	o	o	o	o	o	o	o	—	o		o	x	x		x
" ALCOHOL, $C_5H_{11}OH$	—	—	x	x		x	o	x	o	o	o	x	—	—	x		x	x	x	x	x
" CHLORIDE, $C_5H_{11}Cl$	—	o	—	x		—	o								o		x	x	x		x
ANTIMONY TRICHLORIDE, $SbCl_3$				x		x									x		x	x	x	x	x
ARSENIC ACID, $HAsO_3$			x			x								x	—			x	x		x
BARIUM CARBONATE, $BaCO_3$						x									x			x	x	x	x
" HYDROXIDE, $Ba(OH)_2$						x	x							x	x			x	x	x	x
" SULFIDE, BaS	x					x								x	—	x	x	x	x	x	x
BENZALDEHYDE, C_6H_5CHO	o	o	o	x			o							o	o		—	x	x		—
BENZENE, C_6H_6	o	o	o		o	—	o	—	o	o		o		—	o	o	—	x	x		+
BENZOIC ACID, C_6H_5COOH							x								x	x	x	x	x		x
BORAX, $Na_2B_4O_7$	x	x	x	x		x	x	x	x	x	x	x	x		x			x	x	x	x
BORIC ACID, H_3BO_3	x	x	x			x									—	x	x	x	x	x	x
BROMINE, Wet, Br_2	—	o		—		—	o							o	o	—	o	x	x		—
BUTANOL, C_4H_9OH	—	—	—									x			x		x	x	x	x	x
BUTYL ACETATE, $C_4H_9COOCH_3$	o	o	o	o		o	o	o	o	o	o	o			o		o	x	x		+
BUTYRIC ACID, C_3H_7COOH	x	—	o			o	o								o		—	x	x		x
CALCIUM BISULFATE, $CaHSO_4$																		x	x		
" BISULFITE, $CaHSO_3$	x	x	x	x											x		x	x	x	x	x
CALCIUM CARBONATE, $CaCO_3$	x	x	—			x									x		x	x	x		x
" CHLORATE, $CaClO_3$							x								x			x	x	x	x
" CHLORIDE, $CaCl_2$	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
" HYDROXIDE, $Ca(OH)_2$	x	x	x			x	x								x		x	x	x	x	x
" HYPOCHLORITE, $Ca(OCl)_2$	x	x	o	x	—		—							x	x	x	x	x	x	x	x
" SULFATE, $CaSO_4$	x	x	x			x	x								x		x	x	x	x	x
CARBON DIOXIDE (Dry), CO_2	x	x	x				x								x		x		x	x	x
" " (Wet or H_2CO_3)	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x		x	x	x

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING (continued)

MATERIALS
X - Very Good Service
+ - Moderate Service
— - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS
SOLIDS ASSUMED IN SOL'N.
ROOM TEMPERATURES ASSUMED
UNLESS OTHERWISE STATED

	RUBBERS						THERMOPLASTICS														
CHEMICALS	HARD RUBBER (Natural)	SOFT RUBBER-(Natural)	NEOPRENE	BUTADIENE DERIVATIVES	NITRILE Rubber (Chemigum)	VITON	ASPHALTIC, BITUMASTIC	CELLULOSE ACETATE	CELLULOSE ACETATEBUTYRATE	ETHYL CELLULOSE (Ethocel)	CELLULOSE NITRATE	ACRYLIC (Lucite, Plexiglas)	COUMARONE RESINS	POLYETHYLENE	POLYVINYL CHLORIDE, Rigid or Unplast.	TYGON (P. V. C. & Copolymers)	SARAN (Vinyl chloride, vinyldene chloride)	KEL-F (Polytrifluorochloroethylene)	TEFLON (Polytetrafluoroethylene)	USCOLITE CP (styrene-acrylonitrile-butadiene)	PENTON (Chlorinated Polyether)
CARBON DISULFIDE, CS_2	o	o	o	x		x	o	o	o	o	x	x		o	o		—	x	x		—
CARBON TETRACHLORIDE (Moist) CCl_4	o	o	o	x	—	x	o	x	—		x	x		o	—	o	—	x	x		x
CHLORACETIC ACID, $ClCH_2CO_2H$	—	—	—	x		x	o			—					x	o	—	x	x		+
CHLORIC ACID, $HClO_3$																		x	x		
CHLORINE (DRY), Cl_2	x	—	o	—		x	o	—	—					x	—	x	—	x	x	x	+
" (Wet), Cl_2	x	x	o	x			—	—	—					x	—	x	—	x	x	x	+
CHLOROBENZENE, C_6H_5Cl	o	o	o			—	o					—		o	o		—	x	x		+
CHLOROFORM, $CHCl_3$	o	o	o			—	o	o	o	o		o		o	o		—	x	x		+
CHROMIC ACID, CrO_3 sol'n	o	o	o	o	o	—	o	o	o	o		o	o	x	—	x	x	x	x	—	—
COPPER CHLORIDE, $CuCl_2$	—	x	x	x		x	x							x	x		x	x	x	x	x
" CYANIDE, $Cu(CN)_2$							x								x				x	x	x
" NITRATE $Cu(NO_3)_2$	x		x			x								x	x		x	x	x	x	x
" SULFATE $CuSO_4$	x	x	x	x	o	x	x	x	x		x	o		x	x	x	x	x	x	x	x
CRESYLIC ACID	o	o	o			—									—			+	x		x
DICHLORETHANE, $C_2H_4Cl_2$																		—	x		
DIETHYLAMINE, $(C_2H_5)_2NH$			o												o			x	x		x
DIPHENYL, $C_6H_5C_6H_5$																		x	x		
ETHERS, Various	o	o	o	o		o	o	o	o	o	o	o		o	o		—	x	x		x
ETHYL ACETATE, $C_2H_5COOCH_3$	o	o	o	o		o	o	o	o	o	o	o		o	o		—	x	x		+
" ALCOHOL, C_2H_5OH	x	x	x	x	x	x	x	x	—	—		—		o	x	—	x	x	x	x	x
ETHYL CHLORIDE, C_2H_5Cl	o		—			x	o								o		—	x	x		x
ETHYLENE CHLOROHYDRIN, $Cl(C_2H_4)OH$	—	—	—	—			o	o	o						o		o	x	x		x
" DICHLORIDE, $C_2H_4Cl_2$	o	o	o	o		—	o	o				o		—	o		—	x	x		+
" GLYCOL, CH_2OHCH_2OH	—	—	—	x	x	x	x	x	x		x	x		o	x	—		x	x	x	x
" OXIDE, CH_2OCH_2						—									o		o		x		x
FATTY ACIDS, Various	o	o	o	x		x	o	x	x		x			o	—	x	x	x	x	x	x
FERRIC CHLORIDE, $FeCl_3$	x	x	—	x		x	x			—	x			x	x	x	—	x	x	x	x
" NITRATE, $Fe(NO_3)_3$	o		x			x	x								x		x	x	x	x	x
" SULFATE, $Fe_2(SO_4)_3$	x	x	x	x		x	x			—	x				x	x	x	x	x	x	x
FERROUS CHLORIDE, $FeCl_2$	x	x	x	x		x	x				x				x		—	x	x	x	x
" SULFATE, $FeSO_4$	x	x	x	x	x	x	x				x			x	x	x	—	x	x	x	x
FLUORINE, F_2							o							—	—				—	o	o
FORMALDEHYDE, CH_2O	—	—	—	x		o	x	o	x		x	x	x	x	—	—	x	x	x	—	x
FORMIC ACID, HCOOH	—	o	—	x	x	+	o			—		o		x	—	x	—	x	x	—	x
FUEL OIL									x					o	x			x	x		
GALLIC ACID, $(OH)_3C_6H_2COOH$						+									x	x		x	x		x
GASOLINE, Refined	—	o	—	x		x	o	x	x		x	x					x	x	x	—	x
GLYCEROL, $CH_2OH.CHOHCH_2OH$	x	x	—	—	x	x	x	x	x		x	x		x	x	x	x	x	x	x	x
HYDROBROMIC ACID, HBr	—	x	—	x		+	o	x						x	x	—	x	x	x	—	x
HYDROCHLORIC ACID. (Conc.), HCl	x	x	—	x	o	—	x	o	o	o	o	x	x	x	x	x	x	x	x	x	x
" " (Dilute)	x	x	—	x	—		x	x	x	—	x	x	x	x	x	x	x	x	x	x	x
" (Dry Gas)							o								x			x	x	x	
HYDROCYANIC ACID, (Conc.), HCN							x								x			x	x	—	
" " (Dil. & Gas)	—		—												x		x		x		—
HYDROFLUORIC ACID, (Conc.), HF	o	o	o		o							x		x	—	o	o	x	x		+
" " (Dilute)	x	x	—		x	+	o					x		x	—	—	—	x	x	x	x
HYDROFLUOSILICIC ACID, H_2SiF_6			x													—			x		x
HYDROCARBONS (Aliphatic)	o	o	x	x					—	—	x	x				—		x	x		

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING (continued)

MATERIALS
X - Very Good Service
+ - Moderate Service
— - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS SOLIDS ASSUMED IN SOL'N. ROOM TEMPERATURES ASSUMED UNLESS OTHERWISE STATED	RUBBERS						THERMOPLASTICS														
	HARD RUBBER (Natural)	SOFT RUBBER (Natural)	NEOPRENE	BUTADIENE DERIVATIVES	NITRILE Rubber (Chemigum)	VITON	ASPHALTIC BITUMASTIC	CELLULOSE ACETATE	CELLULOSE ACETATEBUTYRATE	ETHYL CELLULOSE (Ethocel)	CELLULOSE NITRATE	ACRYLIC (Lucite, Plexiglas)	COUMARONE RESINS	POLYETHYLENE	POLYVINYL CHLORIDE, Rigid or Unplast.	TYGON (P. V. C. & Copolymers)	SARAN (Vinyl chloride, vinyldene chloride)	KEL-F (Polytrifluorochloroethylene)	TEFLON (Polytetrafluoroethylene)	USCOLITE CP (styrene-acrylonitrile-butadiene)	PENTON (Chlorinated Polyether)
HYDROCARBONS (Aromatic)	o	o		o				x	–	–		–				o		+	x		
HYDROGEN GAS, H_2						x	x											x	x		x
HYDROGEN PEROXIDE (Conc.), H_2O_2	–	–	o	x			–	–				x			x	–		x	x	–	+
" " (Dilute)	–	–	o	x	x		–	–				x		x	x	x	x	x	x	x	
HYDROGEN SULFIDE (Dry) H_2S	x	x		x		x	x								x			x	x	x	x
" " (Wet)						x									x			x	x		x
IODINE, I_2 Wet	–	–	o	–		x	o	–						–	o		–	x	x		
IODOFORM, CHI_3						–													x		
KEROSENE	o	o	o			x						x			x		x	x	x	x	x
KETONES, Various	o		o			o	o		o			–		o	o	o	o	+	x	o	+
LACTIC ACID, $CH_3CHOHCOOH$	x	–	x			+		–	x	–				x	x	x	x	x	x	–	x
LEAD ACETATE, $Pb(CH_3COO)_2$							x								x			x	x	x	x
MAGNESIUM CHLORIDE, $MgCl_2$	x	x	x	x		x	x	x	x		x		x	x	x	x	x	x	x	x	x
" HYDROXIDE, $Mg(OH)_2$	x		x			x									x		x	x	x	x	x
" SULFATE, $MgSO_4$	x	x	x	x		x	x	x	x		x		x	x	x		x	x	x	x	x
MALEIC ACID, $CO_2HC_2H_2CO_2H$			x			+	o								–		–	x	x	x	x
MALIC ACID, $CO_2HCH_2CHOHCO_2H$	x	x	x	x		–									x			x	x		x
MERCURIC CHLORIDE, $HgCl_2$	x		–			x	x	x							–	x	x	x	x	x	x
MERCURY, Hg						x	x								–		x		x		x
METHANOL, Conc., CH_3OH	–	x	–		x	–	x					o		–	x		x	x	x	x	x
" (Dilute)	x	x													x			x	x	x	x
METHYL CHLORIDE, CH_3Cl	o		o			–	o								o		–	x	x		x
NAPHTHA, Petroleum	–	o	x	x		+	o				x	x			x			x	x		x
NICKEL CHLORIDE, $NiCl_2$	x		x			x	x							x	x	x	x	x	x	x	x
" SULFATE, $NiSO_4$	x	x	x			x	x							x	x	x	x	x	x	x	x
NITRATING ACID (>15% H_2SO_4)	–	–					o									o		x	x		
" " (<15% H_2SO_4)	–	–					o									–		x	x		
" " (<15% HNO_3)	–	–					o									–		x	x		
" " (< 1% Acid)	–	–					o									–		x	x		
NITRIC ACID, Conc., HNO_3	o	o	o	o	o	o				o				o	o	o	–	x	x	o	o
" " Dilute	–	o	o	x	o	–	–			–		x		–	x	–	x	x	x	x	+
NITROBENZENE, $C_6H_5NO_2$	o	o	o			o	o							–	o		–	x	x		+
NITROUS ACID, HNO_2	–	o	o	x			x											x	x		x
OLEIC ACID, $C_8H_{17}CH{:}CH(CH_2)_7CO_2H$	o	o	o	x		+	o	x	x		x			o	x	x	x	x	x	x	x
OXALIC ACID, CO_2HCO_2H	x	x	–	x		–	x							x	x	y	x	x	x	x	x
PHENOL (Conc.) C_6H_5OH	–	o	–	x		x	o	o	o	–		x			–	·	–	x	x	o	+
" (Dilute)	–		–				–								x	–	–	x	x	o	
PHOSPHORIC ACID (100%), H_3PO_4	x	x	x	x			x	x		o				x	x	x		x	x	x	
" " (>45% Hot)	–	–	–		x	+								–	x	x		x	x	x	
PHOSPHORIC ACID (>45% Cold)	–	–	–				x							x	x	x	x		x	x	x
" ACID (<45%) "	x	x	–											x	x	x	x		x	x	x
" ANHYDRIDE, Dry or Moist														x					x		
" " Molten, P_2O_5																			x		
PHTHALIC ANHYDRIDE, $C_6H_4(CO)_2O$	x	x					x										x		x		
PICRIC ACID, Sol'n., $HOC_6H_2(NO_2)_3$			–				o								o	x	o		x		x
POTASSIUM BROMIDE, KBr	x		x												x		x		x	x	x
" CARBONATE, K_2CO_3	x		x			x	x							x	–		x		x	x	x

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING (continued)

MATERIALS
X - Very Good Service
\+ - Moderate Service
— - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS SOLIDS ASSUMED IN SOL'N. ROOM TEMPERATURES ASSUMED UNLESS OTHERWISE STATED	RUBBERS: HARD RUBBER (Natural)	SOFT RUBBER-(Natural)	NEOPRENE	BUTADIENE DERIVATIVES	NITRILE Rubber (Chemigum)	VITON	THERMOPLASTICS: ASPHALTIC, BITUMASTIC	CELLULOSE ACETATE	CELLULOSE ACETATE BUTYRATE	ETHYL CELLULOSE (Ethocel)	CELLULOSE NITRATE	ACRYLIC (Lucite, Plexiglas)	COUMARONE RESINS	POLYETHYLENE	POLYVINYL CHLORIDE, Rigid or Unplast.	TYGON (P. V. C. & Copolymers)	SARAN (Vinyl chloride, vinyldene chloride)	KEL-F (Polytrifluorochloroethylene)	TEFLON (Polytetrafluoroethylene)	USCOLITE CP -(styrene-acrylonitrile-butadiene)	PENTON (Chlorinated Polyether)
POTASSIUM CHLORATE, $KClO_3$						x									x		x		x	x	x
" CHLORIDE, KCl	x		x			x	x							x	x		x		x	x	x
" CYANIDE, KCN	x		x			x									x	x	x		x	x	x
" DICHROMATE, $K_2Cr_2O_7$		x	x				x							x	x	x	x		x	x	x
" FERROCYANIDE, $K_4Fe(CN)_6$							x								x		x		x		x
" HYDROXIDE, KOH	x	x	x		o	x	x							x	x		—		x	x	x
" NITRATE, KNO_3	x		x				x							x	x		x		x	x	x
" PERMANGANATE, $KMnO_4$	—	o	o			x	o							x	x		—		x	x	x
" SULFATE, K_2SO_4	x		x		x	x	x								x		x		x	x	x
" SULFIDE, K_2S															x				x	x	
PYROGALLOL, $C_6H_3(OH)_3$												x				x			x		
SILVER NITRATE, $AgNO_3$	x	x				x						x		x	x		x		x	x	x
SODIUM, Molten 210°- 400°F.									o					o	o	o	o		—		o
SODIUM ACETATE; $NaCH_3COO$			x			o	x								x		x		x		x
" BICARBONATE, $NaHCO_3$	x	x	x	x			x	x	x		x	x			x		x		x	x	x
" BISULFATE, $NaHSO_4$	x	x	x	x											x	x	x		x		x
" BISULFITE, $NaHSO_3$	x	x	—	x			x							x	x	x	x		x	x	x
" BORATE Na_3BO_3	x	x	x	x		x	x	x	x		x	x			x	x			x	x	
" CARBONATE, Na_2CO_3	x	x	x	x	x	x	x	—	x		—	o		x	x	x	x	x	x	x	x
" CHLORATE, $NaClO_3$	x	x	x	x		x	x	x	x		x	x		x	x		x		x	x	x
" CHLORIDE, NaCl	x	x	x		x	x	x	x	x			x		x	x	x	x	x	x	x	x
" CYANIDE, NaCN	x	x	x			x	x								x	x	—		x	x	x
" FLUORIDE, NaF	x	x				x									x		x		x	x	x
" HYDROXIDE, (Conc.), NaOH	x	x	x	x	x	—	x	o	—	x	o	x		x	x	—	o	x	x	x	x
HYDROXIDE, (Dilute)	x	x	x	x	x		x	—	x	x	—	x		x	x	x	—	x	x	x	x
" HYDROSULFITE	x	—		x															x		
" HYPOCHLORITE, NaOCl	x	—	o	x		—	—	—			x				x	—	x		x	x	x
" HYPOSULFATE																			x		
" NITRATE, $NaNO_3$	x	—	x	x	x	x	x	x	x		x				x	x	x		x	x	x
" PEROXIDE, Na_2O_2															x				x	x	
" PHOSPHATE, (Tri) Na_3PO_4	x	x	—	x			x			x		x			x	x			x	x	
" SILICATE, Na_2SiO_3	x	x	x	x		x	x								x				x	x	
" SULFATE, Na_2SO_4	x	x	x			x	x							x	x	x	x		x	x	x
" SULFIDE, Na_2S	x	—	x	x		x	x							x	x	x	x		x	x	
" SULFITE, Na_2SO_3	x	x	o	x		x	x								x	x	x		x	x	x
STANNIC CHLORIDE, $SnCl_4$						x	o								x	x		x	x	x	x
STANNOUS CHLORIDE, $SnCl_2$	x	x	—				x							x	—		x		x	x	x
STEARIC ACID, $CH_3(CH_2)_{16}COOH$	—		o			x	o							x	x	x	x		x	x	x
SULFUR, Molten, S															o	o			x		o
SULFUR CHLORIDE, (Wet), S_2Cl_2																			x		
" DIOXIDE (Dry), SO_2	—	—	o	—			x			—					x	—	—		x		x
" DIOXIDE (Wet)	—		o			x									—		—		x		x
" TRIOXIDE, SO_3	x	x	o	x		x	o			o					x				x		
SULFURIC ACID (Fuming to 98%)			o		o		x	o	o	o	o	o			o		—		x	o	o
" " (Hot Conc.) H_2SO_4	o	o	o			o													x	o	—
" " (Cold Conc.)	o	o	o			+						—			x	o	—		x	o	—
" " (75%-95%)			o		o		x							x	x	o	—		x	o	+
" " (10%-75%)	x	x	—	x	—	x	x	x	x	o	o	x		x	x	—	x	x	x	—	x
" " (<10%)	x	x	x	x	x	x	x	x	x	—	—	x		x	x	x	x	—	x	x	x
SULFUROUS ACID, H_2SO_3	—	—	x				x							o	x	—	—		x	x	x
SULFURYL CHLORIDE, SO_2Cl_2														o					x		
TANNIC ACID	x	—	x				x			—				x	x		x		x	x	x
TARTARIC ACID, $(CHOHCOOH)_2$	x	x	x			x	x	x	x						x		x		x	x	x
TOLUENE, $CH_3C_6H_5$	o	o	o	o		—		—	—	o		o		—	o	o	—	—	x		+
TRICHLORETHYLENE, Dry, $Cl_2C{:}CHCl$	o	o	o			—	o					o		o	o	o	—	o	x		+
WATER, Fresh H_2O	x	x	x	x		x	x	x	x	x	x	x	x		x		x		x	x	x
WATER, Distilled Lab.	x		x									x			x				x	x	x
ZINC CHLORIDE, $ZnCl_2$	x	x	x	x	x	x	x			x				x	x		x		x	x	x
" SULFATE, $ZnSO_4$	x	x	x			x	x							x	x	x	x		x	x	x

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING (continued)

MATERIALS
X - Very Good Service
+ - Moderate Service
— - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS SOLIDS ASSUMED IN SOL'N. ROOM TEMPERATURES ASSUMED UNLESS OTHERWISE STATED	THERMOSETTING PLASTICS																		WOODS					
	SHELLAC COMPOUNDS	ORGANIC POLYSULFIDES	POLYSTYRENE (Styron)	VINYLIDENE CHLORIDES	VINYL CHLORIDE ACETATES	CAST PHENOL FORMALDEHYDE	HAVEG 41 (Mod Phenolic w. asbestos)	HERESITE (phenol formaldehyde)	MOLDED PHENOL FORMALDEHYDE (Durez)	PHENOL FURFURAL PLASTICS	UREA FORMALDEHYDE	CASEIN PLASTICS	EPOXY RESINS	FURANE RESINS Haveg 61, Duralon	SILICONE RESINS	PERMANITE (Furan, Glass Fiber)	NYLON (Adipic Acid—Hexameth. Diamine)	DURCON 6 (Modif. Epoxy)	CYPRESS	FIR	MAPLE	OAK	PINE	REDWOOD
ACETIC ACID, 100%, CH_3COOH		x	o	o	o	—	—	x	x	—			—	x	o	—	—	x	—	—	x	x	x	—
ACETIC ACID, Dilute	x	x	o	—	—	x	x	x	x	x		x	x	x	x	x	o	x	x	x	x	x	x	x
ACETIC ANHYDRIDE, $(CH_3CO)_2O$			o			—	o	x	x	x				o		—		x						
ACETONE, CH_3COCH_3	o	x	—	o	o	—	o		—	—	x	x	x			x	x							
ACETYL CHLORIDE, CH_3COCl																		x						
ALUMINUM CHLORIDE, $AlCl_3$	x		x	x	x	x	x	x	x	x			x	x		x	x	x						
" HYDROXIDE, $Al(OH)_3$																	x	x						
" SULFATE, $Al_2(SO_4)_3$	x	x	x	x	x	—	x	x	x			x		x		x	x	x	x	x	x	—	x	x
ALUMS, CONC., $Al_2(SO_4)_3 \cdot K_2SO_4$, etc.							x	x					x					x						
ALUMS, DILUTE	x	x	x	x	x	—	x	x	x			x	x	x				x	x	x	x	—	x	x
AMINES, various							x	x									x	x						
AMMONIA (Gas), Moist, NH_3	x		o	x	x	x			x	—			x	x	—			x						
AMMONIUM CARBONATE, $(NH_4)_2CO_3$			x						x	x			x	x			x	x						
" CHLORIDE, NH_4Cl	x		x	x	x	x	x	x	x	x		x	x	x		x	o	+*						
" HYDROXIDE, NH_4OH			x	o			x	x	o	o			x	x	—	x	x	x						
" NITRATE, NH_4NO_3	—		x	x	x	x			x	x		x	x				x	x						
PERSULFATE, $(NH_4)_2S_2O_8$													x	x				x						
PHOSPHATE, $(NH_4)H_2PO_4$																		x						
" $(NH_4)_2HPO_4$																		x						
" $(NH_4)_3PO_4$							x	x										x						
" SULFATE, $(NH_4)_2SO_4$	x	x		x	x	x	x	x	x	x		x	x			x		o						
AMYL ACETATE, $C_5H_{11}COOCH_3$	o		o	o	x	—			—	—		x	x			x	x	x						
" ALCOHOL, $C_5H_{11}OH$	o		x	—	—	x			x	x		x	x				x	x						
" CHLORIDE, $C_5H_{11}Cl$				x	x	—			—	—		x	x					x						
ANTIMONY TRICHLORIDE, $SbCl_3$													x				o	x						
ARSENIC ACID, H_3AsO_4																	x	x						
BARIUM CARBONATE, $BaCO_3$													x				x	x						
" HYDROXIDE, $Ba(OH)_2$													x				x	x						
" SULFIDE, BaS																	x	x						
BENZALDEHYDE, C_6H_5CHO	o			x		x			x	x			—					x	x					
BENZENE, C_6H_6			o		o		—	x	x	x			x	x		x	x	x*						
BENZOIC ACID, C_6H_5COOH													x				o	+*						
BORAX, $Na_2B_4O_7$	x		x	x	x	x			x	x							x	x	x	—	—	—	x	—
BORIC ACID, H_3BO_3							x	x	x	x				x		x	x	x						
BROMINE, Wet, Br_2			—				o	x	—	—	—		o	o		o	o	x*						
BUTANOL, C_4H_9OH													—			x		x						
BUTYL ACETATE, $C_4H_9COOCH_3$			o	o	o	—			—	—	o	x	x					x						
BUTYRIC ACID, C_3H_7COOH													—				o	x						
CALCIUM BISULFATE, $CaHSO_4$																		x						
" BISULFITE, $CaHSO_3$						x			x	x								x						
CALCIUM CARBONATE, $CaCO_3$																	x	x						
" CHLORATE, $CaClO_3$													x					x						
" CHLORIDE, $CaCl_2$	x	x	x	x	x	—	x	x	—	—			x	x		x	o	x	x	x	x	x	x	—
" HYDROXIDE, $Ca(OH)_2$													x			x	x	x						
" HYPOCHLORITE, $Ca(OCl)_2$		x	x		x	o	—	—	o	o			x	x			o	x	o	o	o	o	—	o
" SULFATE, $CaSO_4$													x				x	x						
CARBON DIOXIDE (Dry), CO_2													x					o						
" " (Wet or H_2CO_3)	x	x	x	x	x	x	x	x	x	x	x	x						x	x	x	x	x	x	x

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING (continued)

MATERIALS
X - Very Good Service
+ - Moderate Service
– - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS
SOLIDS ASSUMED IN SOL'N.
ROOM TEMPERATURES ASSUMED
UNLESS OTHERWISE STATED

	THERMOSETTING PLASTICS																		WOODS					
CHEMICALS	SHELLAC COMPOUNDS	ORGANIC POLYSULFIDES	POLYSTYRENE (Styron)	VINYLIDENE CHLORIDES	VINYL CHLORIDE ACETATES	CAST PHENOL FORMALDEHYDE	HAVEG 41 (Mod Phenolic w. asbestos)	HERESITE (phenol formaldehyde)	MOLDED PHENOL FORMALDEHYDE, (Durez)	PHENOL FURFURAL PLASTICS	UREA FORMALDEHYDE	CASEIN PLASTICS	EPOXY RESINS	FURANE RESINS Haveg 61, Duralon	SILICONE RESINS	PERMANITE (Furan, Glass Fiber)	NYLON (Adipic Acid—Hexameth. Diamine)	DURCON 6 (Modif. Epoxy)	CYPRESS	FIR	MAPLE	OAK	PINE	REDWOOD
CARBON DISULFIDE, CS_2	–		o	o		x			x	x			o	x		x	x	x						
CARBON TETRACHLORIDE (Moist) CCl_4	o	–	o	x	x	x	x	x	x	x			x	x		x	x	x						
CHLORACETIC ACID, $ClCH_2CO_2H$		x	x				x	x	x	x							o	x						
CHLORIC ACID, $HClO_3$																		o						
CHLORINE (DRY), Cl_2			x	x	x	–	–	–	–	–			–		–	–	o	o						
" (Wet), Cl_2			x	x	x	–	–		–	–			o		–	–	o	+						
CHLOROBENZENE, C_6H_5Cl		o	o	o			–						–	x		x		–*						
CHLOROFORM, $CHCl_3$													x				x	x*						
CHROMIC ACID, CrO_3 sol'n			o	x		o	o	x	o	o			o	o		o	o	x						
COPPER CHLORIDE, $CuCl_2$	–						x						x	x			o	x						
" CYANIDE, $Cu(CN)_2$													x					x						
" NITRATE, $Cu(NO_3)_2$																	x	x						
" SULFATE $CuSO_4$	x		x			x	x	x	x	x			x	x		x	o	x						
CRESYLIC ACID																	o	x						
DICHLORETHANE, $C_2H_4Cl_2$																		x						
DIETHYLAMINE, $(C_2H_5)_2NH$																		x						
DIPHENYL, $C_6H_5C_6H_5$																		x						
ETHERS, Various			o	o	o	–	–		–	–		x	–	x		x		x						
ETHYL ACETATE, $C_2H_5COOCH_3$			o	o	o	–	o		–	–		x	x	x		x	x	x						
" ALCOHOL, C_2H_5OH	o	–	–	x	x		x		x	x	x		x	–			x	x						
ETHYL CHLORIDE, C_2H_5Cl													x				x	x						
ETHYLENE CHLOROHYDRIN, $Cl(C_2H_4)OH$				–		–			–	–			x					x	x					x
" DICHLORIDE, $C_2H_4Cl_2$			o	o	o		x						x			x	x	x						
" GLYCOL, CH_2OHCH_2OH			x	–	–	–	x		–	–			x	x			x	x				x		
" OXIDE, CH_2OCH_2																	x	x						
FATTY ACIDS, Various			o	x	–	–	x	x	x	–	x		x	x	–		x	x	x	x	x	x	x	–
FERRIC CHLORIDE, $FeCl_3$	x		x	x	x	x	x	x	x	x	x		x	x			o	+*						
" NITRATE, $Fe(NO_3)_3$							x						x	x		x		x						
" SULFATE, $Fe_2(SO_4)_3$	x		x	x	x	x	x	x	x	x	x		x	x		x	x	x						
FERROUS CHLORIDE, $FeCl_2$	x		x	x	x	x	x		x	x	x		x	x			o	x						
" SULFATE, $FeSO_4$	x		x	x	x	x	x	x	x	x	x		x	x		x	o	+						
FLUORINE, F_2							o						o	o			o							
FORMALDEHYDE, CH_2O	x			x	x		x	x			x	x	x				x	x						
FORMIC ACID, HCOOH	–		x	x	x	x	x	x	x	x	x	x	x	x			o	x						
FUEL OIL			–	x			x											+*						
GALLIC ACID, $(OH)_3C_6H_2COOH$																	x	x						
GASOLINE, Refined			–	–	–	–	x		–	–		x	x	x		x	x	x						
GLYCEROL, $CH_2OH.CHOH.CH_2OH$			x	–	–	–			–	–			x			x	x	x						
HYDROBROMIC ACID, HBr	x	x	x	x	x	x	x		x	x			x	–		x	o	x						
HYDROCHLORIC ACID (Conc.), HCl	x	o	o	o		–	x	x	–	–			x	–	–	x	o	x	o	–	o	o	o	o
" " (Dilute)	x	x	x	x	x	x	x	x	–	–		x	x		–	x	o	x	x	x	x	x	x	–
" (Dry Gas)													x					x						
HYDROCYANIC ACID, (Conc.), HCN													x					x						
" " (Dil. & Gas)													x					x						
HYDROFLUORIC ACID, (Conc.), HF			x			–	o	o	–	–		–	x	o	o	–		x						
" " (Dilute)			x				o	–	x	x			x	x	o	x	o	x						
HYDROFLUOSILICIC ACID, H_2SiF_6																x		x						
HYDROCARBONS (Aliphatic)	–	–	x	–	–	–	x	x	–	–	x	x						+*						

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS–CORNING (continued)

MATERIALS
X - Very Good Service
+ - Moderate Service
— - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS
SOLIDS ASSUMED IN SOL'N.
ROOM TEMPERATURES ASSUMED UNLESS OTHERWISE STATED

	THERMOSETTING PLASTICS																		WOODS					
CHEMICALS	SHELLAC COMPOUNDS	ORGANIC POLYSULFIDES	POLYSTYRENE (Styron)	VINYLIDENE CHLORIDES	VINYL CHLORIDE ACETATES	CAST PHENOL FORMALDEHYDE	HAVEG 41 (Mod Phenolic w. asbestos)	HERESITE (phenol formaldehyde)	MOLDED PHENOL FORMALDEHYDE (Durez)	PHENOL FURFURAL PLASTICS	UREA FORMALDEHYDE	CASEIN PLASTICS	EPOXY RESINS	FURANE RESINS Haveg 61, Duralon	SILICONE RESINS	PERMANITE (Furan. Glass Fiber)	NYLON (Adipic Acid—Hexameth. Diamine)	DURCON 6 (Modif. Epoxy)	CYPRESS	FIR	MAPLE	OAK	PINE	REDWOOD
HYDROCARBONS (Aromatic)	o	o	o	–	–	–	x	x	–	–		x						x						
HYDROGEN GAS, H_2													x				x	x						
HYDROGEN PEROXIDE (Conc.), H_2O_2		o	o	o		–	x	x	x	–							o	x						
" " (Dilute)		o	o	–		x	x	x	–	–			o	o			o	x						
HYDROGEN SULFIDE (Dry) H_2S		–		x		–	x		x	–			x	x		x	o	x						
" " (Wet)																		x						
IODINE, I_2 Wet							o	x					o	o		o	o	x						
IODOFORM, CHI_3																	x	x						
KEROSENE																	x	x						
KETONES, Various			o	–			x						–			x	x	x						
LACTIC ACID, $CH_3CHOHCOOH$			x				x	x					x	x		x	–	x						x
LEAD ACETATE, $Pb(CH_3COO)_2$							x						x	x		x		x						
MAGNESIUM CHLORIDE, $MgCl_2$	x	x	x	x	x	x	x	x	x	x	x		x	x			x	x						
" HYDROXIDE, $Mg(OH)_2$																	x	x						
" SULFATE, $MgSO_4$	x	x	x	x	x	x			x	x	x		x	x			x	x						
MALEIC ACID, $CO_2H\,C_2H_2\,CO_2H$													x				x	+*						
MALIC ACID, $CO_2H\,CH_2\,CHOH\,CO_2H$			x														x	x						
MERCURIC CHLORIDE, $HgCl_2$													x					x						
MERCURY, Hg													x				x	x						
METHANOL, Conc., CH_3OH			x				–		x	x			x	x			x	x						
" (Dilute)			x						x	x			x			x		x						
METHYL CHLORIDE, CH_3Cl													x				x	x						
NAPHTHA, Petroleum			–	–	–	–			–	–		x	x				x	x						
NICKEL CHLORIDE, $NiCl_2$													x	x			x							
" SULFATE, $NiSO_4$			x						x	x			x	x			x	x						
NITRATING ACID (>15% H_2SO_4)							o	x					o					x*						
" " (<15% H_2SO_4)							–	x										x						
" " (<15% HNO_3)							–	x										x						
" " (< 1% Acid)							–	x										†*						
NITRIC ACID, Conc., HNO_3			o	o	o	o	o	x	o	o			o	o	–	o	o	x						
" " Dilute			x	–	–	–	–	x	–	–			o		–	o		x						
NITROBENZENE, $C_6H_5NO_2$													–					x						
NITROUS ACID, HNO_2		x																x						
OLEIC ACID, $C_8H_{17}CH{:}CH(CH_2)_7CO_2H$			x	x	x	–	x	x	x	–	x		x				x	x	x	x	x	x		–
OXALIC ACID, $CO_2H\,CO_2H$			x			x	x	x	x	x			x	x		x	o	x						
PHENOL (Conc.) C_6H_5OH			o			–	–	x	–	–				x		x	o	x						
" (Dilute)			o						x	x			–	x				x						
PHOSPHORIC ACID (100%), H_3PO_4				x	x		x	x						–	–	–	–	x						
" " (>45% Hot)							x	x	o	o			x	x	o			x						
PHOSPHORIC ACID (>45% Cold)			x				x	x					x		—			x						
" ACID (<45%) "							x	x							—	x	o	x						
" ANHYDRIDE, Dry or Moist																		x						
" " Molten, P_2O_5																		x						
PHTHALIC ANHYDRIDE, $C_6H_4(CO)_2O$													x					x						
PICRIC ACID, Sol'n., $HOC_6H_2(NO_2)_3$																		x						
POTASSIUM BROMIDE, KBr																		x						
" CARBONATE, K_2CO_3													x				x	x						

(continued)

TABLE 7.2: METAL, CARBON, CERAMIC, RUBBER, PLASTIC AND WOOD CONSTRUCTION MATERIALS—CORNING (continued)

MATERIALS
x - Very Good Service
+ - Moderate Service
– - Limited or Variable Service
o - Unsatisfactory
Blank - No Information

CHEMICALS
SOLIDS ASSUMED IN SOL'N.
ROOM TEMPERATURES ASSUMED
UNLESS OTHERWISE STATED

	THERMOSETTING PLASTICS																		WOODS					
CHEMICALS	SHELLAC COMPOUNDS	ORGANIC POLYSULFIDES	POLYSTYRENE (Styron)	VINYLIDENE CHLORIDES	VINYL CHLORIDE ACETATES	CAST PHENOL FORMALDEHYDE	HAVEG 41 (Mod Phenolic w. asbestos)	HERESITE (phenol formaldehyde)	MOLDED PHENOL FORMALDEHYDE (Durez)	PHENOL FURFURAL PLASTICS	UREA FORMALDEHYDE	CASEIN PLASTICS	EPOXY RESINS	FURANE RESINS Haveg 61, Duralon	SILICONE RESINS	PERMANITE (Furan, Glass Fiber)	NYLON (Adipic Acid—Hexameth. Diamine)	DURCON 6 (Modif. Epoxy)	CYPRESS	FIR	MAPLE	OAK	PINE	REDWOOD
POTASSIUM CHLORATE, $KClO_3$																	o	x						
" CHLORIDE, KCl							x						x	x		x	x	x						
" CYANIDE, KCN																	x	x						
" DICHROMATE, $K_2Cr_2O_7$													x					x*						
" FERROCYANIDE, $K_4Fe(CN)_6$													x				x	x						
" HYDROXIDE, KOH			x				o		o	o			x	x		x	x	x						
" NITRATE, KNO_3													x					x						
" PERMANGANATE, $KMnO_4$			x						x	x			x	x			o	x						
" SULFATE, K_2SO_4			x				x		x	x			x	x		x	x	x						
" SULFIDE, K_2S																	x	x						
PYROGALLOL, $C_6H_3(OH)_3$																		x*						
SILVER NITRATE, $AgNO_3$						–			–				x				x	x						
SODIUM, Molten 210°- 400°F.			o	o			o	o										x						
SODIUM ACETATE; $NaCH_3COO$													x				–	x						
" BICARBONATE, $NaHCO_3$	x		x	x	x	x	x		x	x			x	x		x	x	x						
" BISULFATE, $NaHSO_4$			x	x	x	–	x	x	x	–		x	x	x		x		x						
" BISULFITE, $NaHSO_3$									x			x	x				o	x*	x	x	x	x	x	
" BORATE $Na_2B_4O_7$	x		x	x	x	–			–	–							x	x*						
" CARBONATE, Na_2CO_3			x			x	x	x	x	x		o	x	x		x	x	x*	+	+	+	x	+	+
" CHLORATE, $NaClO_3$	x	x	x	x	x	x			x	x	x	x					o	x	x	x	x	x	x	
" CHLORIDE, NaCl			x				x	x	x	x			x	x	x	x	x	x	x	x	x	x	+	+
" CYANIDE, NaCN													x				–	x						
" FLUORIDE, NaF																	x	x						
" HYDROXIDE, (Conc.), NaOH			x			o	o	o	o	o	o		x	x	–	x	x	x	–	–	o	o	o	
HYDROXIDE, (Dilute)		x	x	x	x	–	o	–	o	o	x		x	x	–		x	x	–	–	o	o	–	–
" HYDROSULFITE						x			x	x								x						
" HYPOCHLORITE, NaOCl			x	x	x	–	o	x	–	–			o	o		o	o							
" HYPOSULFATE																								
" NITRATE, $NaNO_3$			x			x	x	x	x	x			x	x			o	x						
" PEROXIDE, Na_2O_2																		x						
" PHOSPHATE, (Tri) Na_3PO_4			–			–	–		x	–			x	x		x	x	x						
" SILICATE, Na_2SiO_3			x			x			x	x							x	x						
" SULFATE, Na_2SO_4							x	x					x	x		x	x	x						
" SULFIDE, Na_2S			x				x	x				–	x				x	+*	–	–	o	o	–	–
" SULFITE, Na_2SO_3						–	x	x	–	–			x	x		x	x	x						
STANNIC CHLORIDE, $SnCl_4$							x									x	o	x						
STANNOUS CHLORIDE, $SnCl_2$													x					x						
STEARIC ACID, $CH_3(CH_2)_{16}COOH$							x	x					x				x	x						
SULFUR, Molten, S							x	o										x						
SULFUR CHLORIDE, (Wet), S_2Cl_2																		x						
" DIOXIDE (Dry), SO_2				x	x		x						x				–	x						
" DIOXIDE (Wet)																	o	x						
" TRIOXIDE, SO_3				x	x								x				x	x						
SULFURIC ACID (Fuming to 98%)			o			o			o	o			o	o	o			x	o	o	o	o	o	o
" " (Hot Conc.) H_2SO_4							o						o	o				x	o	o	o	o	o	o
" " (Cold Conc.)							–						o			o	o	x	o	o	o	o	o	o
" " (75%-95%)			–				–		–	–			–	–	–			x						
" " (10%-75%)	x	x	x	x	x	–	x		–	–		o	x	x	–		–	x	–	–	–	–	–	–
" " (<10%)	x	x	x	x	x	–	x		x	x	x	–		x	–	x	–	x	–	–	x	–	–	–
SULFUROUS ACID, H_2SO_3			x			x	x		x	x		x	x	x	–	x	o	+*				x	x	
SULFURYL CHLORIDE, SO_2Cl_2									x									x						
TANNIC ACID			x			x	x		x	x	x	x	x	x		x		x				x	x	
TARTARIC ACID, $(CHOH\ COOH)_2$						–	x		–	–	x		x	x		x	x	x						
TOLUENE, $CH_3C_6H_5$	o	o	o	–	–	–	–		–	–		x		x		x	x	x	–	–	x	x	x	
TRICHLORETHYLENE, Dry, Cl_2C CHCl							x						x				x	x						
WATER, Fresh H_2O	x	x	x	x	x	x			x	x	x	o						x	x	x	x	x	x	x
WATER, Distilled Lab.																		x						
ZINC CHLORIDE, $ZnCl_2$			x			–	x		x	–			x	x		x	–	x						
" SULFATE, $ZnSO_4$			x				x		x	x			x	x		x	x	x						

*Durcon 5 would be the preferred formula

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER

LISTING OF GATES HOSE STOCK TYPES

Stock Type	Composition
D	Natural Rubber and Styrene Butadiene.
D_2	Similar to Type D stock except it is white and compounded to handle food products.
D_3	Gum Rubber, tan color.
H	Isobutylene and Isoprene (Butyl).
P	Ethylene, Propylene and Diene (EPDM).
M	Chlorosulfonated Polyethylene (Hypalon).
A	Polychloroprene (Neoprene).
A_2	Similar to Type A stock except white color and is used principally for edible products.
C	Acrylonitrile and Butadiene (Buna-N).
C_2	A blend of Type C stock and plastic. Used primarily as hose cover material.
C_3	Modification of Type C. Has some properties similar to Type A stock.
K	Specially compounded cross-linked polyethylene (Gatron).
V	Fluorocarbon (FPM).
W	Epichlorohydrin.
Z	Polyamide Resins (Nylon type)

GATES CHEMICAL RATING SYSTEM

Code:

1 This fluid is expected to have minor or no effect on the polymer.

2 This polymer should give reasonably satisfactory service. Due to the nature of this chemical and under prolonged continuous exposure, the rubber may exhibit minor to moderate deterioration and/or solution discoloration. Environmental changes such as temperature, concentration, etc., may promote increased degradation.

x The polymer is unsatisfactory for this chemical and should not be used.

- Insufficient or no data available for this material. Testing is advised.

Ratings shown in the table are based on a temperature of 70°F and 100% concentrated or saturated solutions unless otherwise noted.

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL RESISTANCE TABLE

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D3 D2 D	H	P	M	A2 A	C	C2	C3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
A																	
Absorption Oil	X	X	X	2	2	1	2	X	2	-	-	1	-	-	-	-	1
Acetaldehyde	2	1	1	X	X	X	X	X	1	-	2	-	1	1	1	1	1
Acetal	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	1
Acetamide	-	2	2	-	-	2	-	X	-	-	-	X	-	-	-	-	-
Acetic Acid (10%)	X	2	-	2	2	X	2	X	2	2	-	X	X	2	2	2	X
Acetic Acid (25%)	X	2	2	2	2	X	2	X	2	-	X	X	X	2	2	2	X
Acetic Acid (50%)	X	2	X	-	2	X	2	X	2	X	X	X	X	2	2	2	X
Acetic Acid, Glacial	-	2	-	X	X	X	X	X	2	X	X	X	-	2	2	-	-
Acetic Acid, Anhydride	X	2	-	2	X	X	X	X	2	X	X	X	X	2	2	2	X
Acetic Oxide	X	2	-	2	X	X	X	X	-	-	X	-	1	1	1	2	-
Acetone	X	2	2	X	X	X	X	X	2	X	1	X	1	1	1	1	1
Acetonitrile	2	2	2	2	2	X	2	X	-	-	-	-	-	-	-	-	-
Acetophenone	X	1	1	-	X	X	X	X	2	-	-	X	-	-	-	-	-
Acetylene								Use Acetylene Welding Hose					-	1	1	1	2
Acrolein (Inhibited)	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acrylonitrile	2	X	X	X	X	X	X	X	2	-	-	X	1	1	1	-	-
Aero-Safe 2300	-	2	1	-	-	X	-	-	-	-	-	-	1	-	-	1	1
Aeroshell Type 1A,1AC,4	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Air, 150° F.	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
Air, 180° F.	X	1	1	2	2	2	2	2	X	1	2	1	1	1	1	1	1
Air, 200° F.	X	1	1	X	X	X	X	X	X	2	X	1	1	1	1	1	1
Aircraft Hyd. Oil AA	-	X	X	-	-	1	-	-	-	-	-	-	1	1	1	1	1
Alkazene	X	X	X	X	X	X	X	X	-	-	-	2	-	-	-	-	-
Alkylaryl Sulfonates	-	-	-	X	-	-	-	-	-	-	-	2	-	-	-	-	-
Allyl Chloride	X	-	-	-	X	X	X	X	1	-	-	-	-	1	1	-	-
Aluminum Acetate	1	2	-	X	2	2	2	2	-	-	-	X	-	1	1	-	X
Aluminum Bromide	1	1	1	1	1	1	1	1	-	-	-	1	X	2	2	-	X
Aluminum Chloride	1	1	1	1	1	1	1	1	1	-	-	1	X	2	2	X	X
Aluminum Fluoride	1	1	1	1	1	1	1	1	1	-	-	X	X	2	2	2	X
Aluminum Hydroxide	1	1	1	1	1	1	1	1	1	-	-	2	-	1	1	-	1
Aluminum Nitrate	1	1	1	1	1	1	1	1	1	-	-	X	X	1	1	2	-
Aluminum Salts	1	1	1	1	1	1	1	1	1	-	-	-	-	2	2	2	-
Aluminum Sulfate	2	1	1	1	1	1	1	2	1	-	-	-	X	X	2	X	X
Alums (Ammonium Or Potassium)	1	1	1	1	1	1	1	1	1	-	-	-	X	2	2	X	X
Amines (Mixed)	2	2	2	-	2	2	2	-	-	-	-	X	-	1	-	X	X
Ammonia (Anhydrous)							Use Anhydrous Ammonia Hose Only						1	1	1	-	-
Ammonia (Aqueous)	1	1	1	1	1	1	1	1	1	-	1	2	-	1	1	-	X
Ammonium Bisulfate (50%)	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Ammonium Carbonate	-	2	2	-	2	X	2	X	1	1	-	-	1	1	1	-	-
Ammonium Chloride	1	1	1	1	1	1	1	1	1	-	X	-	-	2	2	-	X
Ammonium Hydroxide	2	2	1	1	2	2	2	-	1	2	X	2	2	1	1	-	X
Ammonium Metaphosphate	2	1	1	2	2	2	2	2	1	-	-	-	1	1	1	X	-
Ammonium Nitrate (Fertilizer)	1	1	1	1	1	1	1	1	1	1§	-	-	1	1	1	2	X
Ammonium Nitrite	X	-	-	-	2	X	2	-	-	-	-	-	-	1	1	-	-
Ammonium Persulfate	-	-	-	-	X	X	X	X	-	-	-	X	-	1	1	X	X
Ammonium Phosphate (Mono, Di, Tri Basic)	1	1	1	1	1	1	1	2	1	-	-	-	X	2	1	X	-
Ammonium Sulfate	1	1	1	1	1	2	1	2	1	-	-	-	1	1	1	X	X
Ammonium Thiocyanate	1	-	-	1	1	1	-	-	1	-	-	-	1	1	1	-	-
Amyl Acetate	X	2	2	X	X	X	X	X	1	X	1	X	X	1	1	X	1
Amyl Alcohol	2	2	2	2	2	2	2	2	1	2	-	-	1	1	1	1	1
Amyl Borate	X	X	X	-	2	2	2	-	-	-	-	-	-	-	-	-	-
Amyl Chloride	X	X	X	X	X	-	X	X	1	-	-	2	-	1	1	-	-
Amyl Chloronaphthalene	X	X	X	X	X	X	X	X	-	-	-	2	-	1	1	-	-
Amyl Naphthalene	X	X	X	X	X	X	X	X	-	-	-	2	-	1	1	-	-
Amyl Phenol	-	-	-	-	-	-	-	-	2	-	-	-	-	1	1	-	-
Aniline	X	2	2	X	X	X	X	X	2	X	-	2	2	1	1	2	X
Aniline Dyes	X	2	2	X	X	X	X	X	1	-	-	2	X	1	1	-	-
Aniline Hydrochloride	2	2	2	-	X	2	X	-	-	-	-	-	-	X	X	-	X
Animal Fats	X	X	2	2	2	2	1	-	1	-	-	1	1	1	1	1	-
Anti Freeze (Glycol Base)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Antimony Chloride (50%)	-	2	-	-	-	-	-	-	1	-	X	2	X	X	X	-	-
Aqua Regia	X	X	X	X	X	X	X	X	2	X	X	2	-	X	X	-	-
Arco A.T.F. Dexron	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Arsenic Acid	X	2	2	-	-	-	-	-	1	-	-	-	2	-	1	2	-
Askarel (Transformer Oil)**	X	X	X	X	X	X	X	X	2	-	-	1	1	1	1	-	1
Asphalt (Under 180° F.)†	X	X	-	X	2	2	2	X	2	1	-	1	1	1	1	-	2
Asphalt (Cut Back)	X	X	-	X	2	2	2	X	2	-	-	1	1	1	1	-	1

** Contamination Of Fluid May Be A Problem.
†Above This Temperature Use Hot Asphalt Hose.
§(5%)

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D_3 D_2 D	H	P	M	A_2 A	C	C_2	C_3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
A -Continued																	
ASTM Oil No. 1	X	X	X	2	1	1	1	2	1	1	1	1	1	1	1	1	1
ASTM Oil No. 2	X	X	X	-	-	1	-	-	1	1	1	1	1	1	1	1	1
ASTM Oil No. 3	X	X	X	X	X	1	X	X	1	1	1	1	1	1	1	1	1
ASTM Reference Fuel A	X	X	X	1	(1)	1	(1)	2	1	1	1	1	1	1	1	1	1
ASTM Reference Fuel B	X	X	X	X	(2)	1	(2)	X	2	2	-	1	1	1	1	1	1
ASTM Reference Fuel C	X	X	X	X	X	2	X	X	X	X	-	1	1	1	1	-	1
ATF Special (Automatic Transmission Fluid)	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
B																	
Baltic Types 100, 150, 200, 300, 500	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Banvel (Ag. Spray)	-	-	-	-	-	-	-	-	1	-	1	-	-	-	1	-	-
Bardol B	X	X	X	X	X	X	X	X	-	-	-	2	1	1	1	-	-
Barium Carbonate	1	1	1	1	1	1	1	1	1	-	-	-	2	1	1	-	1
Barium Chloride	1	1	1	1	1	1	1	1	1	-	X	-	X	1	1	-	2
Barium Hydroxide	X	1	-	1	1	1	1	1	1	-	-	-	2	1	1	-	-
Barium Sulfate	X	-	-	2	-	-	-	-	1	-	2	1	1	1	1	-	2
Barium Sulfide	2	1	1	1	1	1	1	1	1	-	-	-	X	1	1	-	X
Beer*	1	-	-	-	2	-	2	-	-	-	-	-	2	1	1	1	1
Beet Sugar Liquors	1	1	1	1	X	1	1	1	1	-	-	1	1	1	1	1	-
Bellows 80 - 20 Hydraulic Oil	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Benzaldehyde	X	2	2	X	X	X	X	X	1	X	-	X	1	-	-	1	-
Benzene (Benzol)	X	X	X	X	X	X	X	X	2	X	1	2	1	1	1	1	1
Benzenesulfonic Acid (10%)	X	2	-	2	X	-	X	-	1	-	-	2	X	-	2	X	-
Benzine (Petroleum Ether)	X	X	X	-	X	2	X	-	2	-	-	2	1	1	1	1	1
Benzophenone	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Benzyl Alcohol	X	2	2	X	X	X	X	X	-	X	-	1	1	1	1	-	-
Benzyl Benzoate	-	2	2	-	-	-	-	-	-	-	-	2	1	1	1	-	-
Benzyl Chloride	-	-	-	-	X	X	X	-	-	-	-	2	1	-	-	-	-
Bismuth Carbonate	X	-	-	2	X	-	X	-	1	-	-	2	1	1	1	-	-
Bitumastic	X	X	X	X	2	2	2	-	-	-	-	2	1	1	1	-	1
Black Sulfate Liquor	2	2	2	2	2	2	2	-	1	-	-	1	1	1	1	-	-
Blast Furnace Gas	X	X	X	X	X	X	X	-	1	-	-	1	1	1	1	-	1
Borax	2	2	2	1	2	2	2	-	1	-	-	1	2	1	1	-	2
Bordeaux Mixture	2	2	-	-	2	2	2	2	1	-	-	2	-	1	1	-	-
Boric Acid	1	1	1	1	1	1	1	1	1	-	X	1	X	2	1	1	X
Brake Fluid (Petroleum Base)	X	X	X	X	2	1	2	X	1	-	-	-	1	1	1	-	1
Brake Fluid (Synthetic Base)	1	1	1	X	X	X	X	X	-	-	-	X	1	1	1	-	1
Bromine								No Hose Available					-	-	-	-	-
Bunker Oil	X	X	X	X	2	2	2	-	-	-	-	1	1	1	1	1	1
Butadiene (Monomer)	X	-	-	X	2	2	2	-	1	-	-	2	-	1	1	-	1
Butane (Gas)								Use LPG Hose Only					1	1	1	1	1
Butane (Liquid)								Use LPG Hose Only					1	1	1	1	1
Butter Oil	X	-	-	-	2	-	2		-	-	-	-	1	1	1	1	1
Butyric Acid	2	2	2	X	X	-	-	-	-	-	X	-	X	1	1	1	2
Butyl Acetate	X	2	-	X	X	X	X	X	2	-	-	X	2	1	1	1	1
Butyl Alcohol (Butanol)	1	1	1	2	2	X	2	X	1	-	1	X	1	1	1	1	1
Butyl Amine	X	X	-	X	X	X	X	X	-	-	-	X	1	1	1	1	1
Butyl "Carbitol"	X	2	2	-	2	2	2	X	-	-	-	1	1	1	1	1	1
Butyl Ether	X	2	-	-	2	2	2	X	1	-	-	X	1	1	1	1	1
Butyl Mercaptan (Tertiary)	-	-	-	-	-	-	-	-	-	-	-	2	-	1	1	-	-
Butyl Stearate	X	X	X	-	X	X	-	-	1	-	-	-	1	1	1	1	1
Butyraldehyde	X	X	X	X	2	-	-	-	-	-	-	X	-	-	-	-	1
C																	
Cake Alum	1	1	1	1	1	1	1	1	1	-	-	-	2	2	1	-	-
Calcine Liquor	-	1	1	-	-	1	2	2	-	-	-	1	1	1	1	2	-
Calcium Acetate	2	1	1	X	X	X	X	X	-	-	-	X	1	1	1	1	1
Calcium Bisulfate	1	1	1	1	1	1	2	-	1	-	-	1	-	2	1	-	X
Calcium Bisulfite	2	1	-	1	1	1	1	-	-	-	-	1	-	1	1	-	-
Calcium Carbonate	1	1	1	1	1	1	1	1	1	-	1	1	1	1	1	1	1
Calcium Chlorate	2	2	2	1	1	1	1	-	1	-	-	-	-	2	1	-	-
Calcium Chloride	1	1	1	1	1	1	1	1	1	1	X	1	X	2	1	-	2
Calcium Hydroxide	1	1	-	1	1	2	2	-	1	-	-	X	X	X	1	-	2
Calcium Hypochlorite (5%)	X	2	-	2	X	-	X	-	2	-	-	-	-	X	2	X	X
Calcium Hypochlorite (15%)	X	2	-	2	X	-	X	-	2	-	X	-	-	X	2	X	X

*Use Food Grade Hose Only.   O Cover stock rating only; rating for tube stock "X".

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D3 D2 D	H	P	M	A2 A	C	C2	C3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
C -Continued																	
Calcium Nitrate	1	1	1	1	1	1	1	1	1	·	·	1	1	1	1	1	1
Calcium Silicate	2	2	·	2	·	2	·	·	·	·	·	1	1	1	1	1	1
Calcium Sulfate	·	1	1	1	1	1	1	1	1	·	·	1	1	1	1	·	1
Calcium Sulfide	2	1	·	1	2	1	2	·	·	·	·	2	1	1	1	2	·
Caliche Liquors*	2	1	·	1	·	1	·	·	1	·	·	·	·	1	1	·	·
Cane Sugar Liquors	2	2	2	1	1	1	2	·	1	·	·	·	1	1	1	1	2
Carbamates	X	X	X	X	X	X	X	X	·	·	·	2	·	·	·	·	·
Carbolic Acid (Phenol)	X	2	2	X	X	X	X	X	2	X	X	2	X	1	1	2	X
Carbon Disulfide	X	X	X	X	X	2	·	X	2	·	·	1	2	1	1	2	2
Carbon Dioxide (Dry)	1	1	1	1	1	1	1	1	1	·	·	1	1	1	1	1	1
Carbon Monoxide (Hot, 150° F.)	X	X	X	1	2	2	2	X	2	·	·	1	1	1	1	1	1
Carbon Tetrachloride	X	X	X	X	X	X	X	X	X	X	1	1	X	2	2	2	2
Carbonic Acid	1	1	1	1	1	1	1	·	1	1	·	·	X	1	1	2	X
Carter Motor Oil	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Castor Oil	X	2	·	2	2	2	2	·	1	1	·	2	1	1	1	1	1
Caustic Potash (30%) (Potassium Hydroxide)	2	2	2	1	2	X	X	X	2	·	X	·	1	1	1	X	X
Caustic Soda (50%)	1	2	·	1	2	X	X	X	2	·	·	X	2	1	1	X	X
Cellosolve Acetate	X	2	2	X	X	X	X	X	1	·	·	X	1	1	1	·	·
Cellosolve, Butyl	X	2	2	X	X	X	X	X	2	·	·	·	1	1	1	·	·
Cellugard, Cellugard 200	·	1	1	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Cellulube Types 90, 150, 220, 300, 550, 1000, 220A, ST 220, A60	X	1	1	X	X	X	X	X	1	·	·	1	1	1	1	1	1
China-Wood Oil (Tung Oil)	X	·	X	2	X	2	2	X	1	·	·	·	1	1	1	1	1
Chlorine Water (25% Chlorine)	2	X	2	2	X	X	X	X	1	1	·	·	·	X	X	·	·
Chlorine Gas (Wet)							No Hose Available						X	X	X	X	X
Chlorine Gas (Dry)							No Hose Available						2	X	X	·	2
Chlorine Trifluoride							No Hose Available						X	·	·	X	·
Chloroacetic Acid	X	X	X	2	2	X	X	X	1	·	·	·	X	X	X	·	2
Chlorobenzene	X	X	X	X	X	X	X	X	·	·	·	1	1	1	1	1	1
Chlorobromo Methane	X	X	X	X	X	X	X	X	2	·	·	2	1	1	1	·	1
Chloroform	X	X	X	X	X	X	X	X	X	·	2	1	1	1	1	1	1
O-Chloronaphthalene	X	X	X	X	X	X	X	X	·	·	·	·	1	1	1	·	1
Chlorosulfonic Acid							No Hose Available						·	·	·	·	·
Chlorothene	·	·	·	·	X	X	X	X	◇	·	·	2	·	1	1	·	1
Chlorotoluene	X	X	X	X	X	X	X	X	·	·	·	2	1	1	1	1	1
Chlorox	2	2	·	2	·	·	·	·	2	·	1	·	·	2	1	·	·
Chromic Acid (10%)	X	X	·	2	X	X	X	X	1	·	X	1	X	X	2	X	X
Chromic Acid (25%)	X	X	·	2	X	X	X	X	2	·	X	1	X	X	2	X	X
Chromic Acid (50%)	X	X	·	2	X	X	X	X	X	·	X	1	X	X	2	X	X
Chromic Acid (100%)	·	·	·	·	·	·	·	·	X	·	·	1	X	X	X	X	X
Citgo FR Fluids	·	1	1	·	·	X	·	·	·	·	·	·	·	·	·	·	·
Citgo Glycol FR - 20 XD	·	1	1	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Citgo Pacemaker Invert FR Fluid	·	X	X	·	·	1	·	·	·	·	·	·	·	·	·	·	·
Citgo Tractor Hyd. Fluid	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	·	1
Citric Acid	2	2	2	1	1	X	1	·	1	1△	X	1	X	X	1	1	X
Cobalt Nickel Plating Solution	·	·	·	·	·	·	·	·	1	·	X	·	·	·	2	·	·
Cocoa Butter	X	·	·	·	2	2	2	X	·	·	·	·	1	1	1	·	·
Cod Liver Oil	X	2	2	X	X	X	X	X	1	·	·	1	1	1	1	1	1
Coke Oven Gas	X	X	X	2	X	X	X	X	1	·	·	1	1	1	1	2	·
Condor Types 1000, 1002, 1004, 1006, 1008, 1010, 1012, 1014, 1016	·	X	X	·	·	2	·	·	·	·	·	·	·	·	·	·	·
Copper Arsenate (Cupric Arsenate)	2	·	·	2	·	·	·	·	1	·	·	1	1	1	1	·	·
Copper Chloride (Cupric Chloride)	2	2	·	2	2	2	2	·	1	·	X	1	X	X	1	·	X
Copper Cyanide (Cupric Cyanide)	2	2	2	2	2	2	2	·	1	·	·	1	·	1	1	·	X
Copper Nitrate (Cupric Nitrate)	2	1	1	1	1	1	1	1	1	·	·	1	X	1	1	·	X
Copper Sulfate (Cupric Sulfate)	2	2	1	1	1	1	1	1	1	·	·	1	X	1	1	X	X
Cordage Oil	·	·	·	·	·	1	2	2	·	·	·	1	·	·	·	·	·
Corn Oil	X	2	2	X	X	2	2	X	1	2	·	1	1	1	1	1	1
Corn Syrup	2	2	2	2	2	2	2	·	2	·	·	2	1	1	1	1	·
Cottonseed Oil	·	·	2	2	1	2	1	2	1	1	·	1	1	1	1	1	1
Cottonseed Oil (170° F.)	X	·	2	2	2	2	1	X	X	2	·	1	1	1	1	1	1
Creosote (Wood or Coal Tar)	X	2	·	X	X	2	X	X	2	X	·	1	2	1	1	1	X
Cresol (Cresylic Acid)	X	2	·	X	X	X	X	X	2	·	X	1	2	1	1	1	·
Cresol 85%, Xylene 5%, DDT 10%	·	·	·	·	·	·	·	·	2	·	·	1	2	1	1	·	·
Crude Wax	·	2	·	·	·	2	·	·	2	·	·	1	1	1	1	·	1
Cumen	·	·	·	·	·	·	·	·	2	·	·	·	·	·	·	·	·
Cryolite (10%)	·	2	·	·	1	2	2	·	1	·	·	·	·	1	1	·	·
Cutting Oil	X	X	X	X	2	1	2	X	2	·	·	1	1	1	1	·	1
Cyclohexane	X	X	X	X	X	2	·	X	1	·	·	1	1	1	1	·	1

* Fertilizers Only ◇ Fluid discoloration may occur under certain conditions. Testing on the actual application for suitability is recommended.

△(20%)

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D_3 D_2 D	H	P	M	A_2 A	C	C_2	C_3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
C -Continued																	
Cyclohexanone	X	X	X	X	X	X	X	X	1	X	.	X	.	1	1	2	.
Cymene	X	X	X	X	X	X	X	X	2	.	.	2	.	.	.	.	1
D																	
Dasco FR150, FR200, FR200B, FR310	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Dasco IFR	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	1	1
DC200, DC510, DC550, DC560	.	.	.	.	.	1	.	.	.	.	.	.	.	1	1	1	1
Decalin	X	X	.	X	.	2	.	.	1	.	.	2	.	.	.	.	1
Deionized Water								No Hose Available					.	.	.	.	.
Dectol R&O Oils	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Denatured Alcohol	1	1	1	1	1	1	1	1	1	.	.	2	1	1	1	1	1
Developing Sol'ns. (Hypos)	2	2	.	2	2	.	.	.	.	.	.	.	.	1	1	.	.
Dexron	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Diacetone	X	2	2	X	X	X	X	X	1	.	.	X	1	1	1	.	1
Diacetone Alcohol	2	2	.	2	.	X	X	X	1	.	.	X	1	1	1	1	1
Dibenzyl Ether	X	2	2	X	X	X	X	X	.	.	.	X	1	1	1	1	1
Dibutyl Ether	X	2	.	X	X	X	X	X	1	.	.	X	1	1	1	1	1
Dibutyl Phthalate	X	2	1	X	X	X	X	X	1	.	.	2	1	1	1	1	1
Dibutyl Sebacate	X	2	X	.	X	X	X	X	1	X	.	1	.	.	.	.	1
Dichlorobenzene	X	X	X	X	X	X	X	X	X	.	.	1	.	1	1	.	1
Diesel Oil	X	X	X	X	(2)	1	(2)	2	1	.	1	1	1	1	1	1	1
Diethylamine	2	2	2	X	2	2	.	.	1	.	.	.	.	1	1	.	1
Diethylbenzene	X	X	X	.	.	.	.	X	.	.	.	1	.	.	.	.	.
Diethyl Ether	X	2	2	.	X	.	X	.	1	.	.	X	1	1	1	1	1
Diethyl Phthalate	X	2	.	.	.	X	X	X	1	.	.	.	.	1	1	.	1
Diethyl Sebacate	X	2	.	X	X	X	X	X	1	.	.	2	.	1	1	.	1
Diethylene Glycol	1	1	1	1	1	1	1	1	1	.	1	1	1	1	1	1	1
Di-Isobutyl Ketone	X	2	2	X	X	X	X	X	1	.	.	X	.	1	1	.	1
Di-Isobutylene	X	X	.	X	X	2	.	.	1	.	.	1	.	1	1	.	1
Di-Isopropyl Ketone	X	2	2	X	X	X	X	X	1	.	.	X	.	1	1	.	1
Dimethyl Aniline	X	2	X	X	X	X	X	X	1	.	.	.	.	.	.	.	1
Dimethyl Ether	X	2	X	X	X	X	X	X	1	.	.	X	1	1	1	1	1
Dimethyl Formamide	X	X	.	.	X	X	X	X	2	.	.	X	1	1	1	.	.
Dimethyl Phthalate	X	2	2	X	X	X	X	X	1	.	.	1	.	.	.	.	1
Dioctyl Phthalate	X	X	X	X	X	X	X	X	1	2	.	1	1	1	1	1	1
Dioctyl Sebacate	X	2	.	X	X	X	X	X	1	1	.	2	.	.	.	.	.
Dioxane (Diethylene Ether)	X	2	2	.	X	X	X	X	1	.	.	X	1	1	1	1	1
Dipentene	X	.	.	.	.	X	.	.	.	.	.	2	1	1	1	1	1
Dirco Oils	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	1	1
Dowtherm A	X	X	X	X	X	X	X	X	1	X	.	1	1	1	1	1	1
Dowtherm E	.	.	.	.	.	.	.	.	1	.	.	.	1	1	1	1	1
Duro FR - HD	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Duro Oils	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	1	1
DP47,200 Fluid - Dow	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
E																	
Energol HL 68	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Energol HLPC 68	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
EP Hydraulic Oils - Chevron	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	1	1
Epichlorohydrin	.	X	X	.	.	.	.	.	2	.	.	X	1	.	.	.	.
Ethanolamine	2	1	2	X	2	2	.	2	1	.	.	X	1	1	1	.	1
Ethyl Acetate	X	2	2	X	X	X	X	X	1	X	1	X	1	1	1	1	1
Ethyl Acetoacetate	X	2	2	X	X	X	X	X	.	.	.	X	1	1	1	1	1
Ethyl Acrylate	X	X	X	X	.	X	X	X	2	.	.	X	1	1	1	.	.
Ethyl Alcohol (Ethanol)	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2
Ethyl Amine	X	2	.	X	X	X	X	X	2	.	.	X	.	1	1	.	1
Ethyl Benzene	X	X	X	X	X	X	X	X	2	.	.	1	1	1	1	.	1
Ethyl Butyrate	X	2	.	.	X	X	X	X	1	.	.	.	.	1	1	1	.
Ethyl Cellulose	.	.	.	.	.	.	.	.	1	.	.	.	1	1	1	.	1
Ethyl Chloride	X	X	X	X	X	X	X	X	.	.	.	2	2	1	1	1	2
Ethyl Ether	X	2	X	X	X	X	X	X	2	2	.	X	2	1	1	1	1
Ethyl Mercaptan	X	X	X	X	X	X	X	X	.	.	.	2	2	.	.	.	.
Ethyl Oxalate	2	2	2	.	X	X	X	X	.	.	.	.	.	.	.	.	.
Ethyl Pentachlorobenzene	X	X	X	X	X	X	X	X	.	.	.	2	2	1	1	.	1
Ethyl Silicate	2	.	.	.	1	1	1	2	.	.	.	.	1	1	1	1	1

O Cover stock rating only; rating for tube stock "X".

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D_3 D_2 D	H	P	M	A_2 A	C	C_2	C_3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
E -Continued																	
Ethyl Bromide (D_1)	X	X	X	X	X	X	X	X	2	.	.	1	.	1	1	.	1
Ethylene Chloride (D_1)	X	X	X	X	X	X	X	X	X	X	1	2	2	1	1	1	2
Ethylene Chlorohydrin	.	2	2	.	X	X	X	X	.	.	.	.	.	.	.	.	.
Ethylene Diamine	2	2	2	X	2	2	2	.	.	.	.	.	.	.	.	.	1
Ethylene Glycol	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
F																	
Factovis 52	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	1	1
Fatty Acids	.	.	2	X	2	2	2	.	2	.	.	2	.	1	1	1	.
Ferric Chloride	.	1	.	2	.	.	.	.	1	.	.	2	X	X	X	X	X
Ferric Nitrate	2	2	.	2	2	.	.	.	1	.	.	.	X	1	1	.	.
Ferric Sulfate	2	2	2	2	2	2	2	2	1	.	.	.	X	1	1	X	X
Ferrous Chloride	.	1	.	2	.	.	.	.	1	.	.	.	X	1	2	.	2
Ferrous Nitrate	.	2	2	2	2	2	2		.	.	.	.	.	1	1	.	.
Ferrous Sulfate	.	2	2	2	2	2	2	.	1	.	.	.	X	1	1	.	2
Fertilizer (Liquid, Manure)	1		1	1		.	.	.	1	.	.	.	1	1	1	.	.
Fire Resistant Hydra-Fluid (Texaco)	.	X	X	.		1	.	.	.	.	.	.	1	1	1	1	1
Fluoboric Acid (65%)	2	.	.	2	2	.	.	.	1	.	.	X	.	1	1	.	.
Fluorine (Liquid)								No Hose Available					.	.	.	.	.
Fluosilicic Acid (50%)	.	X	.	2	2	X	X	X	1	.	X	X	.	.	.	1	.
Formaldehyde (37%)	X	2	1	2	2	2	.	.	2	2	.	1	.	1	1	1	1
Formic Acid	X	2	.	2	1	.	1	.	1	.	X	X	X	2	1	.	2
FR Fluid D	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
FR Hydraulic Fluid	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
FRM (Code 6SS22)	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Freon 114								Special Hose Required					X	1	1	.	.
Freon 12								Special Hose Required					X	1	1	.	.
Fuel Oil	X	X	X	X	②	1	①	2	1	.	.	1	2	2	2	1	1
Fumaric Acid	2	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
Furan (Furfuran)	X	X	X	.	X	X	X	X	.	.	.	.	1	1	1	1	1
Furfural (Ant Oil)	X	X	X	2	2	X	X	X	1	X	.	X	2	1	1	1	1
Fusel Oil	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Fyrguard 150, 200	.	1	1	.	.	1	.	.	.	.	.	.	1	1	1	1	1
Fyrquel 90, 150, 220, 300, 550, 1000, 15R&O, 220R&O, 550R&O	.	1	1	.	.	X	.	.	.	.	.	.	1	.	.	1	.
Firtec 290, MF	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
G																	
Gallic Acid	2	2	.	.	X	X	X	X	1	.	X	.	X	1	1	.	.
Gasoline (Standard)	X	X	X	X	①	1	①	2	1	1	.	1	2	1	1	1	1
Gasoline (Premium)	X	X	X	X	②	1	②	2	1	1	.	1	2	1	1	1	1
Gasoline (Unleaded Up To 50% Aromatics)	X	X	X	X	X	1	X	X	2	2	.	1	2	1	1	1	1
Glauber'S Salt	1	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.
Glucose	1	1	1	1	1	1	1	1	1	1	.	1	1	1	1	1	1
Glue	X	X	X	1	2	2	2	.	1	.	2	1	2	1	1	1	X
Glycerine (Glycerol)	1	1	1	1	1	1	1	1	1	1	.	1	2	1	1	1	1
Glycols	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Glycol FR Fluids	.	1	1	.	.	1	.	.	.	.	.	.	1	1	1	1	1
Grease	X	X	X	2	2	1	2	2	1	.	.	1	1	1	1	1	1
Green Sulfate Liquor	1	1	1	1	1	2	1	2	1	.	.	.	1	1	1	.	.
Gulf FR Fluid G-200	.	1	1	.	.	1	.	.	.	.	.	.	1	1	1	1	1
Gulf FR Fluid P-37, P-40, P-43, P-45, P-47	.	1	1	.	.	X	.	.	.	.	.	.	.	.	.	.	.
H																	
Halowax Oil	X	X	X	X	X	X	X	X	.	.	.	2	.	.	.	.	.
Harness Oil	.	.	.	.	.	1	.	.	1	.	.	.	1	1	1	.	.
Heptane	X	X	X	X	②	1	②	2	2	.	.	1	1	1	1	.	1
N-Hexaldehyde	X	1	2	.	2	X	2	X	1	.	.	X	1	1	1	1	1
Hexane	X	X	X	1	①	1	②	2	1	.	.	1	1	1	1	.	1
Hexene	X	X	X	.	②	2	.	.	.	.	.	.	1	1	1	.	1
Hexyl Alcohol (Hexanol)	2	.	X	X	2	1	2	X	1	.	.	1	1	1	1	1	2
Houghto - Safe 271, 416, 520, 525, 616, 620, 625, 640	.	1	1	.	.	1	.	.	.	.	.	.	1	1	1	1	1
Houghto - Safe 1010, 1055, 1115, 1120, 1130	.	1	1	.	.	X	.	.	.	.	.	.	1	1	1	1	1
Houghto - Safe 5046, 5046W	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	1	1

O Cover stock rating only; rating for tube stock "X".

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D3 D2 D	H	P	M	A2 A	C	C2	C3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
H-Continued																	
Hy-Chock Oil	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Hydrafluid AZR&O, A, B, AA, C	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Hydrafluid 760 (Texaco & Houghton)	-	X	X	-	-	1	-	-	-	-	-	-	1	1	1	1	-
Hydrasol A	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Hydraulic Oils (Shell)	-	X	X	-	-	1	-	-	-	-	-	-	1	1	1	1	1
Hydraulic Fluid HF-31	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydraulic Fluid HF-18, HF-20	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Hydraulic Safety Fluid 200 & 300 (Texaco)	-	1	1	-	-	1	-	-	-	-	-	-	1	1	1	1	1
Hydraulic Fluid (Std Petroleum Oils)	X	X	X	2	2	1	2	-	1	-	-	1	1	1	1	1	1
Hydraulic Fluid (Phosphate Ester Base)	-	1	1	-	X	X	X	X	1	-	1	1	1	1	1	-	-
Hydraulic Fluid (Water Glycol Base)	2	1	-	-	1	1	1	-	1	-	-	1	1	1	1	1	1
Hydrazine	X	2	2	X	X	X	X	X	-	-	-	X	-	-	-	-	-
Hydrobromic Acid (37%)	2	2	-	2	X	X	X	-	2	-	X	-	-	-	-	X	-
Hydrochloric Acid (15%)	2	2†	2	2	X	X	X	-	2	1	X	1	X	X	X	X	X
Hydrochloric Acid (37%)	2	2†	X	2	X	-	X	-	2	X	X	1	X	X	X	X	X
Hydrocyanic Acid (20%)	2	-	-	2	X	X	X	X	2	-	-	2	X	1	1	1	X
Hydrocyanic Acid (98%)	No Hose Available												X	1	1	1	X
Hydro-Drive Oil (Houghton)	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Hydrofluoric Acid (10%)	X	2	-	1	2	X	X	X	2	-	X	1	X	X	X	X	X
Hydrofluoric Acid (20%)	X	2	-	2	2	X	X	X	2	-	X	1	X	X	X	X	X
Hydrofluoric Acid (48%)	X	X	-	2	2	X	X	X	2	-	X	2	X	X	X	X	X
Hydrofluoric Acid (70%)	X	-	-	2	-	X	X	X	2	-	X	X	X	X	X	X	X
Hydrofluoric Acid (Conc.)	X	X	-	2	X	X	X	X	2	-	X	X	X	X	X	X	X
Hydrofluosilicic Acid (50%)	2	1	2	1	-	X	X	X	1	-	X	X	-	X	X	X	X
Hydrogen (Gas)	Contact Denver												1	1	1	1	1
Hydrogen Peroxide (10%)	X	X	-	2	X	X	X	-	1	-	X	1	X	2	1	1	X
Hydrogen Peroxide (30%)	X	X	-	2	X	X	X	-	2	-	X	1	X	2	1	1	X
Hydrogen Peroxide (70%)	X	-	-	-	X	X	X	-	-	-	X	1	X	2	1	1	X
Hydrogen Sulfide (Gas)	No Hose Available												X	2	1	2	X
Hydrolubric Oil (Houghton)	-	X	X	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Hydroquinone	X	X	X	X	X	-	-	-	-	-	-	2	-	1	1	-	-
Hykil No. 6 (33%); Water (67%)	-	-	-	-	-	2	-	-	1	-	-	-	1	-	-	-	-
Hypochlorous Acid	X	X	X	2	X	X	X	-	-	-	-	2	-	-	-	-	-
I																	
Imol, Imol S150, S220, S300, S500	-	X	X	-	-	1	-	-	-	-	-	-	1	1	1	1	-
Industron 53	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Ink (Printers)	X	X	X	-	-	-	-	X	2	-	-	X	2	2	1	-	2
Ink Oil	-	-	-	-	-	2	-	-	2	-	-	-	1	1	1	-	1
Insulating Oil (Transformer)*	X	X	X	X	2	1	2	-	1	-	-	1	1	1	1	-	1
Iodine	X	X	-	2	X	X	-	-	1	-	-	2	X	X	X	-	-
Irus Fluid 902	-	X	X	-	-	1	-	-	-	-	-	-	1	1	1	1	1
Irus Fluid 905	-	X	X	-	-	1	-	-	-	-	-	-	1	1	1	1	1
Isobutane	Use LPG Hose Only												1	1	1	2	1
Isobutyl Alcohol	2	2	1	1	2	2	2	2	1	-	-	-	1	1	1	1	2
Iso Octane	X	X	X	1	1	1	2	X	1	1	-	1	1	1	1	2	1
Iso Octyl Thioglycolate	-	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Isopropyl Acetate	X	2	X	X	X	X	X	X	1	-	-	X	1	1	1	1	1
Isopropyl Alcohol	2	2	2	2	2	2	2	2	1	-	-	-	1	1	1	1	2
Isopropyl Ether	X	2	X	X	X	X	X	X	-	-	-	X	1	1	1	1	1
Isocyanate (Toluene Diisocyanate)	-	2	2	-	-	-	-	-	X	-	-	2	-	-	-	-	-
J																	
Jet Fuel** JP-3	X	X	X	X	②	1	②	-	-	-	-	1	2	1	1	2	1
Jet Fuel** JP-4	X	X	X	X	②	1	②	-	-	1	-	1	2	1	1	2	1
Jet Fuel** JP-5	X	X	X	X	X	1	X	-	-	1	-	1	2	1	1	2	1
Jet Fuel** JP-6	X	X	X	X	X	1	X	-	-	1	-	1	2	1	1	2	1
Jet Fuel** JP-X	X	X	X	X	-	1	X	-	-	-	-	-	2	1	1	2	1
K																	
Kerosene	X	X	X	X	X	2	②	X	2	1	-	1	1	1	1	1	1

* Petroleum Type -- Oil Contamination Could Become A Problem
** Use Aircraft Fueling Hose Only For Fueling Operations
† If Under 0.035% Free Chlorine
O Cover stock rating only; rating for tube stock "X".

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D_3 D_2 D	H	P	M	A_2 A	C	C_2	C_3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
L																	
Lacquers	X	X	.	X	X	X	X	X	1	.	1	X	X	X	1	1	1
Lacquer Solvents	X	X	.	X	X	X	X	X	1	.	1	X	X	X	1	1	1
Lactic Acid	2	.	.	1	1	X	X	X	1	.	.	1	X	2	1	X	2
Lactol	.	.	.	.	2	2	2	.	1	.	.	.	1	1	1	.	1
Lard†	X	X	X	X	2	.	2	.	.	.	.	.	1	1	1	1	X
Lard Oil	.	.	.	.	2	.	2	.	.	1	.	.	1	1	1	1	.
Lasso (Ag. Spray)	.	.	1	.	.	.	.	.	1	.	1	.	.	1	1	.	.
Latex	2	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	1
Lead Acetate	2	2	2	X	X	X	.	.	1	.	.	X	2	1	1	.	1
Lead Arsenate	2	.	.	2	2	2	.	.	1	.	.	.	1	1	1	.	.
Lead Nitrate	2	2	.	.	2	2	.	.	1	.	.	.	1	1	1	.	.
Lead Sulfate	2	1	.	1	1	1	.	.	1	.	.	.	1	1	1	.	.
Lead Sulphamate	2	.	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.
Lecithin	.	.	.	.	2	X	.	.	.	.	.	.	.	1	1	.	.
Ligroin (Petroleum Ether)	X	X	X	X	X	1	.	.	2	.	.	1	2	1	1	.	.
Lime (Chlorinated)*	.	2	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.
Lime Bleach	2	2	2	X	X	2	X	.	.	.	.	.	X	2	1	.	.
Lindane (Ag. Spray)	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	.	.
Linoleic Acid	.	X	X	.	X	2	X	.	.	.	.	.	.	.	.	.	.
Linseed Oil (Boiled)	X	.	2	1	2	2	1	.	1	.	.	1	2	1	1	1	2
Liquid Soap	2	2	2	.	.	.	.	.	2	.	.	.	1	1	1	1	1
Lubricating Oils	X	X	X	2	2	1	2	2	1	1	1	1	1	1	1	1	1
M																	
Magnesium Carbonate	1	1	1	1	1	1	1	1	1	.	.	.	1	1	1	.	.
Magnesium Chloride	1	1	.	1	1	1	1	2	1	.	.	.	X	2	1	X	2
Magnesium Hydroxide	1	1	.	1	2	2	2	.	1	.	.	.	1	1	1	X	.
Magnesium Nitrate	1	2	2	1	2	2	2	.	1	.	.	.	1	1	1	X	1
Magnesium Sulfate	1	2	2	1	2	2	2	.	1	.	.	.	2	1	1	.	1
Magnus - Light	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Magnus - Medium	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Malathion (Ag. Spray)	.	.	2	.	.	.	.	.	1	.	1	.	.	1	1	.	.
Malic Acid	2	X	.	2	X	2	.	.	.	.	.	2	2	2	1	.	.
Mapp Gas						Use 20BHB LP Gas Hose							1	1	1	1	1
Maxmul (Pennzoil Hyd. Fluid)	X	X	X	.	2	1	2	.	2	.	.	1	1	.	1	.	.
Mercaptan (Ethyl)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mercuric Chloride	2	2	2	1	1	2	2	.	1	.	.	.	X	1	1	X	X
Mercuric Cyanide	2	2	2	1	1	2	2	.	1	.	.	.	.	.	.	X	.
Mercurous Nitrate	2	2	2	1	1	2	2	.	1	.	.	.	1	1	1	X	.
Mercury	2	2	.	1	1	2	2	.	1	.	.	.	1	1	1	X	X
Mercury Vapor	2	2	.	1	1	2	2	.	1	.	.	.	1	1	1	.	.
Mesityl Oxide	X	2	2	X	X	X	X	X	.	.	.	X	1	1	1	1	1
Methyl Acetate	X	2	2	X	X	X	X	X	2	.	.	X	1	1	1	1	1
Methyl Acrylate	X	X	X	X	X	X	X	X	.	.	.	X	1	1	1	1	1
Methyl Alcohol (Methanol)	1	1	1	1	1	1	1	1	1	2	1	X	1	1	1	1	2
Methyl Amine (25% Aqueous Solution)	2	2	2	.	2	X	.	X	2	.	.	.	1	1	1	.	.
Methyl Amyl Carbinol	.	.	.	.	.	.	.	.	1	.	.	.	1	1	1	.	.
Methyl Bromide	X	X	X	X	X	X	X	X	.	.	.	1	1	1	1	.	1
Methyl Butyl Ketone (MBK)	X	2	2	X	X	X	X	X	.	.	.	X	1	1	1	1	1
Methyl Cellosolve	X	X	X	X	.	.	.	.	.	.	.	X	.	.	.	.	.
Methyl Chloride	X	X	.	X	X	X	X	X	2	.	.	2	1	1	1	.	1
Methyl Ethyl Ketone (MEK)	X	2	2	X	X	X	X	X	2	X	2	X	1	1	1	1	1
Methyl Formate	X	2	2	X	2	X	X	X	.	.	.	.	1	1	1	1	1
Methyl Isobutyl Ketone (MIBK)	X	2	.	X	X	X	X	X	2	X	1	X	1	1	1	1	1
Methyl Isopropyl Ketone	X	2	.	X	X	X	X	X	2	.	.	X	1	1	1	1	1
Methyl Methacrylate	X	X	.	2	X	X	X	X	2	.	.	X	1	1	1	.	.
Methyl Salicylate	.	2	X	.	X	X	X	X	.	.	.	.	1	1	1	1	1
Methylene Chloride	X	X	X	X	X	X	X	X	◇	.	.	◇	1	1	1	.	1
Methylene Dichloride	X	X	X	X	X	X	X	X	.	.	.	2	1	1	1	.	1
Milk†	1	.	.	.	.	.	.	.	.	.	.	.	X	1	1	1	X
Mineral Oil	X	X	X	1	1	1	1	2	1	.	.	1	1	1	1	2	1
Mineral Spirits	.	X	X	X	.	1	2	2	1	.	.	.	1	1	1	2	1
Miners Oil	.	.	.	.	.	.	.	.	1	.	.	.	1	1	1	.	.
Mobile Hydraulic Oils	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	1	.
Mobile Therm 603	.	-	-	.	.	1	.	.	.	.	.	.	1	1	1	1	1
Mobilmet S122	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Molasses	2	.	.	.	2	2	2	.	1	.	.	.	2	1	1	2	X
Monochlorobenzene	X	X	X	X	X	X	X	X	X	X	.	1	1	1	1	.	1

* If Free Chlorine Does Not Exceed 20%
† Use Food Grade Hose Only

◇ Fluid discoloration may occur under certain conditions. Testing on the actual application for suitability is recommended

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D3 D2 D	H	P	M	A2 A	C	C2	C3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
M - Continued																	
Monoethanolamine	·	2	·	X	·	2	·	·	2	·	·	X	1	1	1	·	1
Mould Oil	·	·	·	·	·	·	·	·	1	·	·	·	1	1	1	·	·
Muriatic Acid (Hydrochloric)	2	2	X	2	X	X	X	X	2	X	X	1	X	X	X	X	X
Mustard	1	1	·	1	1	·	1	·	·	·	·	·	X	1	1	·	·
N																	
Naphtha (Low Aromatic Content**)	X	X	X	X	X	2	X	X	1	2	·	1	2	1	1	·	1
Naphthalene†	X	X	X	X	X	X	X	X	2	·	·	1	1	1	1	·	1
Natural Gas								Contact Denver					1	1	1	·	2
Neutral Oil	X	X	X	·	2	2	2	·	1	·	·	1	1	1	1	·	1
Nickel Acetate	2	1	·	·	·	·	·	·	·	·	·	X	1	1	1	1	1
Nickel Chloride	2	2	2	2	2	2	2	2	1	·	·	1	X	2	2	X	X
Nickel Nitrate	2	2	2	2	2	2	2	2	1	·	·	·	·	·	2	X	·
Nickel Plating Solution	2	·	·	2	·	2	·	·	1	·	·	·	·	1	1	·	·
Nickel Sulfate	2	2	2	2	2	2	2	2	1	·	·	1	·	2	1	X	X
Nicotine Salts	·	·	·	·	·	·	·	·	1	·	·	·	1	X	2	·	·
Niter Cake (Sodium Bisulfate)	1	1	1	1	1	1	1	1	·	1§	·	1	X	2	1	·	·
Nitric Acid (10%)	X	2	·	2	X	X	X	X	2	·	X	1	X	2	2	·	X
Nitric Acid (25%)	2	2	·	2	X	X	X	X	2	X	X	1	X	2	2	·	X
Nitric Acid (40%)	X	X	X	X	X	X	X	X	2	X	X	1	X	2	2	·	X
Nitric Acid (60%)	X	X	·	X	X	X	X	X	2	X	X	2	X	2	2	·	X
Nitric Acid (Red Fuming)	X	X	X	X	X	X	X	X	X	X	X	2	X	2	2	2	X
Nitrobenzene	X	X	X	X	X	X	X	X	2	X	·	2	1	1	1	1	1
Nitroethane	2	2	2	2	X	X	X	X	·	·	·	·	·	1	1	·	1
Nitrogen	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Nitrogen Tetroxide								No Hose Available					·	·	2	·	·
Nitromethane	2	2	2	·	X	X	X	X	·	·	1	·	·	1	1	·	1
Nitropropane	X	2	2	·	X	X	X	X	1	·	1	X	·	1	1	·	1
Nitrosyl Chloride	·	·	·	·	·	·	·	·	1	·	·	·	·	1	1	·	·
Nyvac FR Fluid	·	1	1	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Nyvac FR200 Fluid	·	1	1	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Nyvac 20 (WG), 30(WG)	·	1	1	·	·	1	·	·	·	·	·	·	1	1	1	1	1
n-Octane	X	X	X	X	·	2	·	X	2	·	·	2	1	1	1	·	1
O																	
Octyl Alcohol	2	·	X	·	2	2	2	2	·	·	·	1	1	1	1	1	2
Oil (SAE)	X	X	X	2	1	1	1	2	1	1	1	1	1	1	1	1	1
Oleic Acid	X	2	2	2	2	2	2	X	1	·	·	2	2	2	1	1	2
Oleum (Fuming Sulfuric Acid)	X	X	X	X	X	X	X	X	X	X	X	2	·	·	1	·	·
Olive Oil	X	2	2	X	X	2	2	X	·	·	·	1	2	1	1	1	2
Oxalic Acid	X	2	2	2	X	X	X	X	2	1†	X	2	X	2	1	2	X
Oxygen								Use 16B Hose					1	1	1	1	1
Ozone	X	2	1	2	2	X	2	X	2	2	·	2	1	1	1	1	1
P																	
Pacemaker Types 150T, 300T, 500T (Citgo)	·	X	X	·	·	1	·	·	·	·	·	·	·	·	·	·	·
Paint	·	·	·	·	·	·	·	·	·	·	1	·	·	1	1	1	1
Palm Oil	X	2	·	2	2	1	2	·	1	·	·	·	1	1	1	1	1
Palmitic Acid	X	2	2	X	2	2	2	X	1	2	·	1	1	2	1	1	X
Paraffin (Petroleum)	X	X	X	X	2	1	2	·	·	·	·	·	2	1	1	·	1
Paraformaldehyde	X	·	·	2	2	2	2	·	2	·	·	·	·	1	1	1	·
Peanut Oil	·	X	·	·	2	1	2	·	·	·	·	·	1	1	1	1	1
Pennant Motor Oils	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Perchloric Acid	2	2	·	2	2	·	·	·	2	·	X	·	·	2	1	·	·
Perchloroethylene	X	X	X	X	X	X	X	X	◇	X	2	1	1	1	1	·	1
Pentasol	2	2	2	2	2	2	2	2	2	·	·	1	1	1	1	1	1
Petroleum Oils	X	X	X	2	2	1	2	2	1	1	·	1	1	1	1	1	1
Phenol (Carbolic Acid)	X	2	2	X	X	X	X	X	2	X	X	1	X	1	1	·	X
Phorone	·	2	·	·	·	·	·	·	·	·	·	·	1	1	1	·	1
Phosphoric Acid (50%)	2	2	·	1	2	2	2	·	1	·	X	1	X	1	1	X	2
Phosphoric Acid (85%)	2	2	2	1	2	X	·	·	2	·	X	·	X	2	2	X	X
Picric Acid (Water Solution)	2	2	·	2	2	2	2	·	2	X	X	1	X	1	1	X	X
Pine Oil	X	X	X	X	·	2	·	X	1	·	·	2	1	1	1	·	·
Pinene	X	X	X	·	·	2	·	·	·	·	·	1	1	1	1	1	1
Piperazine Hydrochloride Solution (34%)	·	·	·	·	·	2	·	·	·	·	·	·	·	·	·	·	·

** For Special Naphthas Contact Gates

† Solid At Room Temp - Check Solvents

§(5%)

◇ Fluid discoloration may occur under certain conditions. Testing on the actual application for suitability is recommended.

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D3 D2 D	H	P	M	A2 A	C	C2	C3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
P -Continued																	
Plating Solution (Chrome)	-	2	2	-	-	-	-	-	-	-	X	2	-	X	X	-	-
Polyester Resin	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-
Polyurethane (To 125° F.) Foam	-	2	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Potassium Acetate	2	2	2	-	-	-	-	-	-	-	-	X	-	1	1	-	-
Potassium Carbonate	1	1	1	1	1	1	1	1	1	-	1	1	2	1	1	-	X
Potassium Chlorate	2	2	2	2	2	2	-	-	2	-	-	-	1	1	1	-	-
Potassium Chloride	1	1	1	1	1	1	1	1	1	1†	1	1	2	2	1	X	X
Potassium Cyanide	2	2	2	2	2	2	2	2	2	-	-	-	2	1	1	-	X
Potassium Dichromate	X	2	-	1	2	-	2	-	1	-	-	1	-	1	1	-	-
Potassium Hydroxide (30%) (Caustic Potash)	2	2	2	1	2	X	X	X	2	-	X	-	X	1	1	X	X
Potassium Nitrate	1	1	1	1	1	1	1	1	1	1†	-	1	X	1	1	-	2
Potassium Permanganate	X	-	-	-	X	-	-	-	1	-	X	2	2	1	1	-	-
Potassium Sulfate	2	1	1	2	1	1	1	1	1	-	-	-	2	1	1	1	2
Potassium Sulfite	2	2	2	2	2	2	2	2	2	-	-	-	1	1	1	-	-
Powerlube (Carter)	-	X	X	-	-	1	-	-	-	-	-	-	1	1	1	1	1
Primatol A, S, P (Agric. Spray)	X	X	2	X	-	X	-	X	2		-		-	-	-	-	-
Propane Gas								Use LPG Hose Only					1	1	1	-	1
Propionic Acid	2	2	2	2	X	X	X	X	1	-	-	-	1	1	1	-	-
Propyl Acetate	-	2	-	-	X	X	X	X	1	-	-	X	1	1	1	1	1
Propyl Alcohol (Propanol)	2	2	2	2	2	2	2	2	1	-	-	2	1	1	1	1	2
Propylene (Liquid or Gas)*							Use LPG Hose Only						1	1	1		1
Purina Insecticide	-	2	2	-	X	X	-	X	-	-	-	2	-	-	-	-	2
Puropale RX Oils	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Pydraul F-9	X	2	2	X	X	X	X	X	2	-	2	1	1	1	1	-	-
Pydraul 50E	-	2	2	-	-	-	-	-	-	-	2	2	1	1	1	-	-
Pydraul 150	X	2	2	X	X	X	X	X	2	-	2	1	1	1	1	1	1
Pydraul A-200	X	X	X	X	X	X	X	X	2	-	2	1	1	1	1	-	-
Pydraul 280	X	2	2	X	X	X	X	X	2	-	2	2	1	1	1	-	-
Pydraul 312	X	X	X	-	X	X	X	X	2	-	-	1	1	1	1	-	-
Pydraul 540	X	X	X	X	X	X	X	X	2	-	-	1	1	1	1	-	-
Pydraul 625	X	2	2	X	X	X	X	X	2	-	2	1	1	1	1	-	-
Pydraul 10-E, 29-E-LT, 30E, 60, 65E, 115E	-	2	2	-	-	X	-	-	-	-	-	-	1	1	1	1	1
Pydraul 135	-	2	-	-	-	X	-	-	-	-	1	1	1	1	1	-	-
Pyrene (Carbon Tetrachloride)	X	X	X	X	X	X	X	X	X	-	-	1	X	2	2	X	2
Pyridine (50%)	-	-	-	X	X	-	-	-	2	X	-	X	-	1	1	1	1
Pyrogard 51, 53, 55	-	2	2	-	-	X	-	-	-	-	-	-	1	1	1	-	-
Pyrogard 160, 230, 630	-	-	-	-	-	-	-	-	-	-	-	2	1	1	1	-	-
Pyrogard C, D	-	X	X	-	-	1	-	-	-	-	-	-	1	1	1	1	1
Pyronal (Transformer Oil)	-	-	-	-	-	-	-	-	-	X	-	1	-	-	-	-	-
Q																	
Quintolubric 822	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-
R																	
Ramrod (Ag. Spray)	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-
Rando Oils	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Rape Seed Oil	-	2	2	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Red Oil (Comm. Oleic Acid)	X	2	2	2	2	2	2	X	1	-	-	2	2	2	1	1	2
Refined Wax (Petroleum)	X	-	-	-	2	1	2	2	-	-	-	1	1	1	1	-	1
Regal Oils R&O	-	X	X	-	-	1	-	-	-	-	-	-	1	1	1	1	1
Rubilene Oils	-	X	X	-	-	1	-	-	-	-	-	-	-	-	-	-	-
S																	
Safetytex 215	-	1	1	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Salicylic Acid	2	2	2	-	-	X	-	-	-	-	-	2	-	1	1	2	-
Salt Water (Sea Water)	1	1	1	2	2	2	2	2	1	-	1	1	2	1	1	-	X
Santosafe W-G15, W-G20, W-G30	-	1	1	-	-	1	-	-	-	-	-	-	1	1	1	1	1
SCC 7204 (Stauffer)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sevin	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Sewage	X	-	-	2	2	2	2	-	1	-	1	-	X	1	1	2	1
SFR Fluid B (Shell)	-	2	2	-	-	X	-	-	-	-	-	-	-	-	-	-	-
SFR Fluid C (Shell)	-	2	2	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Silicone Grease	-	-	-	2	2	2	2	-	2	-	-	2	1	1	1	-	1
Silicone Oils	-	-	-	2	2	2	2	-	2	X	-	2	1	1	1	-	1
Silver Nitrate	1	1	1	1	1	1	1	1	1	-	-	1	2	1	1	1	2
Skydrol 500 A & 7000	X	2	1	X	X	X	X	X	1	X	2	X	1	1	1	1	-
Soap Oil	-	-	-	2	2	2	-	-	1	-	-	-	1	1	1	-	-
Soap Solutions	X	1	1	1	2	1	2	2	1	-	-	1	1	1	1	1	1
Soda Ash (Sodium Carbonate)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	X	2

† (5%)   *Only if temperature is above −45°F.

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D3 D2 D	H	P	M	A2 A	C	C2	C3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
S -Continued																	
Sodium Acetate	2	2	2	X	X	X	X	.	1	.	1	X	1	1	1	1	1
Sodium Bicarbonate	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	.	2
Sodium Bisulfate (Niter Cake)	1	1	1	1	1	1	1	1	1	1†	1	1	X	1	1	X	X
Sodium Bisulfite	1	1	1	1	1	1	1	1	1	1†	.	1	1	1	1	.	.
Sodium Borate	1	1	1	1	1	1	1	1	1	.	.	1	1	1	1	.	.
Sodium Chloride	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	X	X
Sodium Cyanide	1	1	1	1	1	1	1	1	1	.	.	1	2	1	1	X	X
Sodium Fluoride (70%)	2	2	2	.	.	.	.	.	2	.	.	.	.	.	2	.	.
Sodium Hydroxide (40%)	1	2	2	1	1	2	2	.	1	2	X	.	2	1	1	X	X
Sodium Hydroxide (50%, 115° F.)	1	1	.	1	2	X	X	X	2	X	X	X	2	2	2	X	X
Sodium Hydroxide (50%, 180° F.)	X	2	.	2	.	.	.	.	X	X	X	X	X	2	2	X	X
Sodium Hydroxide (60%)	2	2	2	2	2	X	X	X	.	2	X	X	X	2	2	X	X
Sodium Hypochlorite (5%)	X	.	1	1	.	X	X	X	2	1	.	1	X	X	2	X	X
Sodium Hypochlorite (20%)	X	.	1	1	X	X	X	X	2	.	.	X	X	X	2	X	X
Sodium Metaphosphate	2	2	2	2	2	2	2	.	1	.	.	2	X	1	1	1	X
Sodium Nitrate	X	2	2	2	X	X	.	.	1	.	1	.	1	2	2	2	2
Sodium Perborate	X	2	2	X	X	X	.	.	1	.	.	.	X	1	1	1	X
Sodium Peroxide	.	1	.	1	1	.	1	.	1	.	X	1	X	1	1	1	X
Sodium Phosphates	2	2	2	.	X	.	.	.	1	.	.	.	.	1	1	X	X
Sodium Sulfite	2	2	2	2	2	2	2	2	1	.	.	.	1	1	1	.	.
Sodium Thiosulfate (HPO)	1	1	.	1	1	1	1	1	1	.	.	.	X	1	1	2	X
Sodium Tripolyphosphate (STPP)	.	2	.	.	.	.	.	.	.	.	.	X	.	1	1	X	X
Solnus Oils	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Solvac 1535G	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Soybean Oil	X	2	.	2	2	2	2	.	1	1	.	1	1	1	1	.	.
Spent Acid	X	.	.	2	.	.	.	.	.	.	.	2	.	1	1	.	.
Stannic Chloride	2	X	.	X	X	2	2	X	1	.	X	1	X	.	.	.	X
Stanoil No.15, 18, 25, 31, 35, 51	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Stauffer Jet 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stauffer Jet 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Staysol FR	.	X	X	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Steam*							Use Steam Hose Only						1	1	1	.	2
Stearic Acid	2	2	.	2	2	2	2	.	1	.	.	.	X	2	1	X	X
Stoddard Solvent	X	X	X	.	.	.	2	.	2	.	.	1	2	1	1	.	1
Styrene (Monomer)	X	X	X	.	.	X	.	X	2	.	2	2	2	.	2	.	2
Sucrose Solutions	1	1	.	1	1	1	1	.	1	.	.	.	1	1	1	.	.
Sulfamic Acid (10%)	X	.	.	1	.	.	.	.	1	.	.	1	.	.	.	.	.
Sulfamic Acid (10%, 170° F.)	X	.	.	2	.	.	.	.	X	.	.	2	.	.	.	.	.
Sulfur (200° F.)							Use Molten Sulfur Hose						2	2	1	2	X
Sulfur Chloride	X	X	X	2	X	X	X	.	2	.	.	1	X	X	2	.	X
Sulfur Dioxide (Dry)	X	X	2	2	X	X	X	.	2	.	X	1	2	1	1	1	1
Sulfur Trioxide (Dry)	X	X	.	X	X	X	X	X	1	.	.	1	2	2	2	2	.
Sulfuric Acid (10%)	1	2	2	1	1	2	2	2	1	1	X	1	X	X	2	X	X
Sulfuric Acid (30%)	2	2	.	1	1	.	.	.	1	.	X	1	X	X	2	X	X
Sulfuric Acid (50%)	X	X	.	1	2	X	X	X	1	X	X	1	X	X	X	X	X
Sulfuric Acid (75%)	X	X	X	2	X	X	X	X	1	X	X	1	X	X	X	X	X
Sulfuric Acid (93%)	X	X	X	X	X	X	X	X	2	X	X	1	2	X	2	X	X
Sulfuric Acid (98%)	X	X	X	X	X	X	X	X	X	X	X	2	2	X	2	X	X
Sulfuric Acid, Fuming	X	X	X	X	X	X	X	X	X	X	X	2	2	.	1	.	X
Sulfurous Acid (10%)	X	2	.	1	.	X	.	.	1	.	X	1	X	2	1	X	X
Sulfurous Acid (75%)	X	X	.	1	X	X	X	.	1	.	X	1	X	X	2	X	X
Sun R&O Oils	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	1	1
Sunsafe F	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	1	.
Suntac HP Oils	.	X	X	.	.	1	.	.	.	.	.	.	1	.	1	1	.
Suntac WR Oils	.	X	X	.	.	1	.	.	.	.	.	.	1	.	1	1	.
Sunvis Oils 700, 800, 900	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	.	.
Super Hydraulic Oils (Conoco)	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	1	.
303 Fluid (Conoco)	.	X	X	.	.	1	.	.	.	.	.	.	1	1	1	.	.
Synthetic Oil (Citgo)	.	X	X	.	.	.	.	.	.	.	.	.	1	1	1	.	.
Syrup	1	.	.	.	2	.	2	.	1	.	.	.	.	1	1	.	.
T																	
Tall Oil (To 150° F.)	X	X	X	X	2	2	2	.	.	.	.	1	.	X	2	.	.
Tallow	.	2	2	.	2	2	2	.	1	.	.	.	2	2	2	1	2
Tannic Acid (10%)	2	X	.	2	2	X	.	.	1	.	.	1	2	1	1	2	X
Tar (Bituminous)	X	X	X	.	2	2	2	X	.	.	.	1	1	1	1	1	2

† (5%) * Consult Industrial Hose Catalog 39993 For Selecting The Correct Steam Hose.

(continued)

TABLE 7.3: POLYMERIC HOSE AND STEEL, ALUMINUM AND BRASS COUPLERS—GATES RUBBER (cont'd)

CHEMICAL	HOSE POLYMER TYPES												COUPLING MATERIAL				
	D3 D2 D	H	P	M	A2 A	C	C2	C3	K	W	Z	V	Iron or Carbon Steel	304 SS	316 SS	ALUM.	BRASS
T -Continued																	
Tartaric Acid	2	X	·	1	2	2	2	·	1	1△	·	1	·	2	2	2	·
Tellus Oils	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Teno' Oils	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	·	·
Tergitol	·	·	·	·	·	·	·	·	2	·	·	·	2	1	1	·	2
Terpineol	X	X	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·
Terresstic	·	X	X		·	1	·	·	·	·	·	·	1	1	1	·	·
Tetraethyllead (TEL)	·	·	·	·	·	·	·	·	2	·	·	·	·	·	·	·	·
Tetrahydrofuran (THF)	·	X	2	·	·	·	·	·	1	·	·	X	·	·	·	·	·
Titanium Tetrachloride		X	X	·	X	X	X	X	·	·	·	2	1	2	2	X	X
Toluene (Toluol)	X	X	X	X	X	X	X	X	◇	X	1	1	1	1	1	1	1
Toluene Diisocyanate	·	2	2	·	·	·	·	·	X	·	·	2	·	·	·	·	·
Transformer Oil* (Petroleum Type)	X	X	X	X	2	1	2	·	1	·	·	1	1	1	1	1	1
Transformer Oil* (Askarel Types)	X	X	X	X	X	X	X	X	2	·	·	1	·	·	1	·	·
Transmission Flüid (Type A)	X	X	X	·	2	1	2	2	·	2	·	1	1	1	1	·	1
Tributoxyethyl Phosphate	X	2	2	X		X	X	X	·	·	·	·	1	·	·	X	·
Tributyl Phosphate	X	X	X	X	X	X	X	X	·	·	·	X	1	·	·	X	·
Trichloroethylene	X	X	X	X	X	X	X	X	X	X	2	1	X	·	1	X	1
Tricresyl Phosphate	X	2	1	X	X	X	X	X	·	X	1	1	1	·	2	X	·
Triethanolamine (TEA)	2	2	1	2	2	2		·	1	·	·	X	·	1	1	·	1
Tripolyphosphate (STPP)	2	2	2	·	·	·		·	2	·	·	·	·	2	1	X	·
Tung Oil	X	2	·	2	2	2		·	2	·	·	1	1	1	1	1	1
Turpentine	X	X	X	X	X	2	·	·	X	2	·	1	·	1	1	1	2
Tycol Avalon 50, 57, 60	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	·	·
Tycol A Turbio 37, 50, 58, 60	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	·	·
U																	
Ucon M1	·	1	1	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Ucon Hydrolube Types 150CP, 200CP, 275CP, 300CP, 550CP, 900CP, 150DB, 275DB, 150LT, 200LT, 275LT, 300LT, 200NM, 300NM	·	1	1	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Union C-2 Fluid	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	·	·
Union C-P Oil	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Union ATF Dexron	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	·	·
Union ATF Type F	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Union Hydraulic Oil AW	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Union Hydraulic Tractor Fluid	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	1	1
Urea Solution	1	2	·	1	1	2	·	·	1	·	·	·	1	1	1	·	·
V																	
Varnish	X	X	X	X	X	X	X	X	2	·	1	2	2	1	1	·	2
Vegetable Oils**	X	X	·	·	2	·	2	·	·	·	·	·	1	1	1	1	·
Versilube F-50, F-44	2	2	2	2	2	2	2	2	·	·	·	1	1	1	1	1	1
Vinegar	2	2	·	X	2	X	X	X	1	2	·	1	X	2	1	X	X
Vinyl Acetate	X	2	X	X	X	X	X	X	1	·	·	X	·	1	2	1	2
Vinyl Chloride (Monomer)	X	X	X	X	X	X	X	X	2	·	·	2	2	1	1	2	X
Vinyl Fluoride	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·
Vitrea Oils	·	X	X	·	·	1	·	·	·	·	·	·	1	1	1	·	·
W																	
Water	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
Wines**	1	·	·	·	2	·	·	·	·	·	·	·	X	2	1	·	X
X																	
Xylene	X	X	X	X	X	X	X	X	◇	X	1	2	2	2	2	1	·
Z																	
Zeric	·	X	X	·	·	1	·	·	·	·	·	·	·	·	·	·	·
Zinc Acetate	2	2	2	X	X	X	·	·	·	·	·	X	1	1	1	1	1
Zinc Chloride Solutions	2	2	·	1	1	1	1	2	1	·	·	1	X	2	1	X	X
Zinc Chromate	·	·	·	1	·	·	·	·	·	·	·	·	·	1	1	·	·
Zinc Sulfate Solutions	X	2	2	2	2	2	2	2	1	·	·	·	X	2	1	X	X

△ (20%) * Oil Contamination May Be A Problem. ** Use Food Grade Hose Only. ◇ Fluid discoloration may occur under certain conditions. Testing on the actual application for suitability is recommended.

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER

Table A lists all those solvents denoted by a letter in Table B and should be referred to when indicated in the chemical listing. Always use the lowest temperature recommendation shown for either the chemical or the solvent. Table B shows lining materials, chemicals, solvents, concentration and temperature limits for use. The lining materials are described across the top as column headings. The various rubber groups are listed in their approximate order of relative cost, with natural rubber being the lowest. The chemicals are listed on the left hand side. These tables contain not only the common names of the chemicals, but also any names which may be synonymous.

To the immediate right of the chemicals is a list of letters that denote the common solvents for the chemical. In some instances, a reference is given to "See Solvents." This indicates that the chemical is solid, insoluble in water. The chemical will be dissolved in a solution of one of the indicated solvents or a solvent characteristic of the application. In the columns headed "Concentration," either the word "Any" or a percent concentration will appear. Any concentration refers to a water solution of chemical from very weak to a saturation value. The percent concentration refers to a limiting ratio of chemical to water in weight percent. If the concentration is left blank, then generally that chemical will be used in its pure form and not in solution with any other compound.

The temperatures shown in the tables are for pure chemicals. The rows of figures to the extreme right of the chemicals, each in a column for a given lining material, indicate the maximum recommended temperature which will give satisfactory service with the tank lining. In some instances, a lining material will be given a rating of 75°F for a particular chemical. This indicates that the chemical was determined to be satisfactory at room temperature, has a possibility for use and could be tried at somewhat higher temperatures. A blank space in any material column indicates no available data.

Code: Unmarked chemicals are liquids at room temperature. *Indicates a solid at room temperature. **Indicates a gas at room temperature. xLining material not recommended. -No information available.

Table A: Solvent Code

Index	Solvents (CHEMICAL RESISTANCE FOR LINING MATERIALS)	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
a	Alcohol	Any	80	x	185	120	110	110	100	150	210	150	210	210	75	75
aa	Acetic Acid	Any	70	110	100	x	x	x	180	75	170	170	x	400	x	75
ac	Acetone		x	x	150	x	x	x	100	400	180	180	210	210	75	75
al	Aluminum Salt Solution	Any	150	185	150	200	180	150	100	x	90	75	75	160	x	75
am	Ammonia Salt Solution	Any	150	150	185	200	200	150	150	x	75	75	70	190	x	75
b	Benzene	Any	x	x	x	x	x	x	x	100	100	100	70	210	x	75
ba	Butyl Acetate	Any	x	x	x	x	x	-	x	70	70	75	70	180	x	75
cb	Carbon Bi (Di) Sulfide	Any	x	x	x	x	x	x	80	75	70	180	180	180	75	75
cl	Chloroform	Any	x	x	x	x	x	x	x	x	130	130	130	210	75	75
ct	Carbontetrachloride	Any	x	x	x	x	x	150	80	75	70	70	100	210	75	75
cy	Cyclohexanol	Any	x	x	x	80	x	-	-	70	70	x	70	75	-	-
dg	Diethylene Glycol	Any	150	185	180	180	180	150	-	130	170	100	70	180	x	-
di	Dioxane	Any	x	-	80	x	x	x	-	100	100	70	70	180	x	x
e	Ether	Any	x	-	x	x	110	x	x	70	70	70	70	130	75	75
ea	Ethyl Acetate	Any	x	-	100	x	x	x	x	75	100	130	70	210	x	75
ed	Ethylene Dichloride	Any	x	x	x	x	x	x	x	150	150	120	150	210	x	75
eg	Ethylene Glycol	Any	150	185	185	150	180	150	200	100	70	120	-	210	-	-
es	Esters	Any	x	-	80	x	x	x	75	75	100	90	70	140	x	75
fe	Ferric Salt Solutions		150	180	150	150	200	150	75	x	70	x	x	210	x	75
g	Gasoline	Any	x	-	x	x	100	100	100	170	70	170	170	170	-	-
gl	Glycerine	Any	150	-	150	150	180	x	75	110	150	200	70	210	x	75
h	Acid Solutions Except	Any	120	120	150	150	110	150	140	x	100	100	x	250	x	75
	Organic Acids	Any	80	80	100	70	80	120	110	x	130	100	x	230	x	75
	Hydrochloric (HCl)	38	150	185	x	x	x	80	150	x	x	x	x	210	x	75
	Sulfuric (H_2SO_4)	50	80	150	100	80	80	150	170	x	x	x	200	400	x	70
	Nitric (HNO_3)	25	x	-	75	x	x	115	120	x	175	x	x	400	x	x
hc	Hydrocarbons	Any	x	x	x	80	100	-	-	75	-	-	-	75	-	-
ho	Alkaline or Basis Solutions	Any	150	185	185	200	150	150	100	75	140	x	x	x	75	75
k	Kerosene	Any	x	-	x	80	150	-	150	170	70	170	170	170	-	-
ke	Ketones	Any	x	x	100	x	x	x	70	150	150	150	150	180	70	70
m	Methanol	Any	100	-	185	100	150	120	100	150	150	90	150	210	75	75
me	Monobutyl Ether	Any	x	x	80	x	110	-	x	70	90	90	70	110	-	-
mo	Mineral Oil	Any	x	-	x	80	150	150	-	110	70	170	110	170	-	-
n	Naphtha	Any	x	x	x	x	80	x	70	70	70	70	-	75	x	-
o	Mineral Oils	Any	x	-	x	80	130	130	-	100	70	150	100	170	-	-
os	Organic Solvents	Any	x	x	x	x	x	x	75	100	130	75	75	130	75	75
pe	Petroleum Ether (Ligroin)	Any	x	x	x	80	130	-	-	110	110	110	-	140	-	-
ph	Petroleum Hydrocarbons	Any	x	x	x	80	130	-	-	100	100	100	-	130	-	-
py	Pyridine	Any	x	-	100	x	x	-	70	125	100	100	100	210	75	75
t	Toluene	Any	x	x	x	x	x	70	150	150	150	150	150	150	-	
ta	Tartaric Acid	Any	150	185	185	100	150	150	75	x	150	70	x	175	75	75
tu	Turpentine	Any	x	x	x	x	150	x	75	70	70	70	70	210	x	75
vo	Vegetable Oil	Any	x	x	100	x	150	-	-	170	70	70	170	170	-	-
w	Water	Any	150	170	185	200	150	150	-	70	75	75	75	75	75	75
xy	Xylene	Any	x	x	x	x	x	70	x	150	150	75	-	75	x	-

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

Table B: Chemical Resistance for Lining Materials

The list of "Chemical Resistance of Lining Materials" shows recommended maximum temperatures for concentration as water solutions against the lining. For chemicals insoluble in water, 100% liquid is listed or a reference to solvents is given.

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Acetaldehyde	a, ac, b, e, g, n, t, tu, xy, w	Any	75	-	80	x	x	x	x	125	210	210	75	600	x	x
Acetamide*	a, e, w	Any	x	-	150	100	200	-	-	-	-	-	-	-	-	-
Acetic Acid	a, e, gl, w	10	150	150	150	150	75	x	220	75	180	180	x	400	x	75
		25	80	150	150	75	x	x	210	75	180	180	x	400	x	75
		50	x	120	80	x	x	x	180	75	180	180	x	400	x	75
Acetic Aldehyde	a, ac, b, e, g, n, t, tu, xy, w	Any	x	-	80	x	x	x	x	125	210	210	75	600	x	x
Glacial		100	x	80	x	x	x	200	75	180	180	x	400	x	75	
Acetic Anhydride	a, e, w	25	x	120	150	x	x	x	80	170	180	70	-	210	x	x
		50	x	-	80	x	x	x	80	-	180	70	-	210	x	x
Acetic Ester	a, cl, e, w	Any	x	-	100	x	x	x	75	75	100	130	70	210	x	75
Acetic Ether	a, cl, e, w	Any	x	-	100	x	x	x	75	75	100	130	70	210	x	75
Acetic Oxide	a, e, w	25	x	120	150	x	x	x	-	170	180	70	-	210	x	x
		50	x	-	80	x	x	x	-	-	180	70	-	210	x	x
Acetone	a, cl, e, o, w	Any	x	x	150	x	x	x	100	400	180	180	210	210	75	75
Acetoacetic Ester	a, w	Any	80	-	80	x	x	x	-	75	170	75	-	75	-	-
Acetophenone	os, w	Any	x	-	80	x	x	x	-	200	350	150	150	175	-	75
Acetylbenzene	os, w	Any	x	-	80	x	x	x	-	200	350	150	150	175	-	75
Acetyl Chloride	a, ac, e	Any	x	-	x	x	x	-	-	-	200	-	-	-	-	-
Acetylene**	a, ac, w	Any	80	80	80	80	80	80	200	400	180	75	75	75	75	75
Acetylene Tetrabromide	a, e	100	-	-	x	x	x	x	-	-	-	-	-	-	-	-
Acetylene Tetrachloride	a, e	100	-	-	x	x	x	x	75	75	-	x	75	75	-	-
Acetyl Oxide	a, e, w	25	x	120	150	x	x	x	-	170	180	70	-	210	x	x
		50	x	-	80	x	x	x	-	170	180	70	-	210	x	x
Acrylamide		150	-	120	-	-	-	-	-	-	-	-	-	-	-	-
Acrylonitrile	os, w	Any	80	80	x	x	x	-	x	-	210	-	-	-	-	-
Adipic Acid	w	Any	80	80	x	x	x	-	-	-	-	-	-	-	-	-
Agar-agar*	aa, gl, w	Any	150	185	185	180	180	150	200	x	70	175	-	-	-	-
Agricultural Lime*	gl, h, w	Any	150	185	185	200	200	150	100	100	200	x	x	x	75	75
Air**		Any	150	185	185	200	200	150	-	-	-	-	-	-	-	-
Airshow		Any	-	-	x	-	70	-	-	-	-	-	-	-	-	-
Air-slaked Lime*	gl, h, w	Any	150	185	185	200	200	150	100	100	200	x	x	x	75	75
Alcohol	a, e, w	Any	80	x	185	120	110	110	100	150	210	150	210	210	75	75
Aldehyde	a, ac, b, e, g, n, t, tu, xy, w	Any	x	-	80	x	x	x	x	125	210	210	75	600	x	x
Algaroth Powder*	HCl	See Solvent														
Allyl Chloride	a, cl, e, pe	100	x	-	x	x	x	-	75	x	125	x	x	-	75	75
Allomaleic Acid*	a, w	Any	80	-	-	-	-	-	-	75	-	-	-	-	-	-
Alpha Chloropropylene	a, cl, e, pe	100	x	-	x	x	x	-	75	x	125	x	x	-	75	75
Alpha Chlorotoluene	a, e	100	x	-	x	x	x	-	x	x	100	x	100	210	x	-
Alpha Hydroxypropionic Acid	a, e, gl, w	50	120	-	150	80	80	130	100	x	70	70	x	200	x	75
Alpha Hydroxytoluene	a, cl, e, w	Any	x	-	185	x	x	-	-	75	100	100	100	210	x	75
Alum*		Any	150	185	185	200	200	150	210	x	200	110	-	170	-	-
Alumina Trihydrate*	h, ho	See Solvents														
Aluminum Acetate Solution*	w	Any	150	185	120	120	120	-	75	x	150	75	75	210	x	75
Aluminum Ammonium Sulfate	gl, w	Any	150	185	150	120	120	-	-	x	180	-	-	-	-	-
Aluminum Bromide*	a, e, cl, w	Any	150	185	120	180	180	150	-	x	75	75	-	180	-	-
Aluminum Chloride*	a, e, w	Any	150	185	150	200	200	150	220	x	70	x	x	180	x	x
Aluminum Flouride*	w	Any	150	185	185	200	200	150	-	x	75	100	75	x	75	75
Aluminum Gel*	h, ho	See Solvent														
Aluminum Hydroxide*	h, ho	See Solvent														
Aluminum Nitrate*	a, ac, w	Any	150	185	185	200	200	150	75	x	75	100	-	100	x	-
Aluminum Potassium Sulfate*	w	Any	150	185	185	200	180	150	200	x	150	70	100	200	180	75
Aluminum Sodium Sulfate*	w	Any	150	185	185	200	200	150	200	x	200	x	75	75	-	-
Aluminum Sulfate*	w	Any	150	185	185	200	200	150	200	x	180	x	100	200	x	75
American Ashes*	w	Any	150	185	180	200	180	150	150	100	180	x	x	180	75	75
Aminobenzene	a, b, e	100	x	x	75	x	x	150	x	70	70	100	75	210	75	75
Aminodimethylbenzene	a, e	100	x	-	100	x	x	x	-	-	-	-	-	100	-	-
Aminoethanol	a, cl, ct, w	Any	80	-	140	80	80	-	210	150	150	75	-	210	200	75
Aminoxylene	a, e	100	x	-	100	x	x	x	-	-	-	-	-	100	-	-
Ammonia Alum	gl, w	Any	150	185	120	120	120	150	-	x	180	-	-	-	-	-
Ammonia Water		38	150	150	185	200	200	150	200	75	200	75	100	210	75	-
Ammoniated Citric Acid		Any	150	185	185	150	110	150	-	-	-	-	-	-	-	-
Ammonium Bifluoride	a, w	10	x	x	x	x	80	100	70	x	x	-	x	x	-	70
Ammonium Carbonate*	w	Any	150	185	185	200	x	150	75	140	70	150	-	200	75	75

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS–GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Ammonium Chloride*	a, gl, w	Any	150	185	185	200	200	150	200	x	100	x	x	210	x	75
Ammonium Fluoride		Any	80	x	150	100	100	80	180	x	x	x	70	x	x	75
Ammonium Hydrate		38	150	185	185	200	200	150	200	75	200	75	100	210	75	-
Ammonium Hydroxide		38	150	x	185	200	100	150	200	75	200	75	100	210	75	-
Ammonium Metaphosphate		Any	150	185	185	200	200	150	-	70	100	75	-	210	-	-
Ammonium Murate*	a, gl, w	Any	150	185	185	200	200	150	200	x	100	x	x	210	x	75
Ammonium Nitrate*	a, ho, w	Any	150	150	185	200	200	150	200	80	200	140	x	210	x	x
Ammonium Persulfate*	w	Any	150	185	185	200	100	150	180	x	70	x	70	210	-	x
Ammonium Phosphate*	w	Any	150	185	185	200	200	150	-	x	70	x	70	75	75	-
Ammonium Sulfate*	w	Any	150	185	185	200	200	150	200	x	150	x	70	210	x	75
Amyl Acetate	a, e	100	x	-	x	x	x	x	75	75	70	70	-	210	-	75
Amyl Alcohol	a, e, w	Any	150	150	180	180	180	150	200	70	70	75	-	140	-	-
Amyl Borate		Any	x	-	x	100	100	-	-	-	-	-	-	-	-	-
Amyl Carbinol	a, e	100	x	-	-	x	120	100	-	-	-	-	-	140	-	-
Amyl Chloride	a, e	100	x	-	-	x	x	x	75	x	70	x	x	210	-	-
Amyl Chloronaphthalene		Any	x	-	x	x	80	x	-	-	-	-	-	-	-	-
Amyl Hydrate	a, e, w	Any	150	-	180	180	180	150	-	70	70	75	-	140	-	-
Amyl Naphthalene		100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Anderol L-774			x	x	-	-	-	x	-	-	-	-	-	-	-	-
Anhydrite*	gl, ho	See Solvents														
Anhydrous Ammonia**			x	x	100	100	100	x	-	170	200	170	-	75	-	-
Aniline	a, b, e	100	x	x	75	x	x	150	x	70	70	100	75	210	75	75
Aniline Chloride*	a, e, w	Any	80	x	x	-	x	x	75	x	x	x	x	210	x	x
Aniline Dyes			80	x	80	75	x	x	-	75	-	-	-	170	-	-
Aniline Hydrochloride*	a, e, w	Any	80	x	x	-	x	x	75	x	x	x	x	210	x	x
Aniline Oil	a, b, e	100	x	x	75	x	x	150	x	70	70	100	75	210	75	75
Aniline Salts*	a, e, w	Any	80	x	x	-	x	x	85	x	x	x	x	210	x	x
Animal Fats			x	x	75	100	150	150	-	-	-	-	-	-	-	-
Ant Oil	a, b, e	100	x	-	185	x	x	x	x	100	140	100	100	210	75	-
Antichlor*		Any	100	150	150	160	160	100	-	-	70	-	70	210	-	-
Antimony Chloride*	HCl	See Solvent														
Antimony Oxychloride*	HCl	See Solvent														
Apple Acid*	a, e, w	Any	80	150	x	x	x	120	140	x	150	75	75	150	x	75
Aqua Ammonia		30	150	150	185	150	100	80	200	75	200	75	100	210	75	-
Aqua Fortis		See Nitric Acid														
Aqua Regia			x	x	x	x	x	x	-	x	x	x	-	75	-	-
Arachidonic Acid			x	80	150	x	80	80	200	x	200	200	x	400	x	75
Aragonite*	h	See Solvent														
Arsenic Acid*	a, gl, ho, w	Any	150	-	150	150	150	150	75	x	150	x	x	150	x	x
Arsenic Trichloride	Conc HCl, os	100	x	-	x	150	200	-	-	-	-	-	-	-	-	-
Askerel (Transfomer Oil)			x	x	x	x	x	x	75	75	-	75	-	75	-	-
Asphalt			x	x	x	80	150	150	-	170	170	70	170	170	-	-
ASTM Oil #1, 2 & 3		•	x	x	x	150	180	150	-	170	170	170	170	170	-	-
ATE	hc	100	x	-	-	x	x	-	-	-	-	-	-	-	-	-
Azotic Acid		See Nitric Acid														
Baking Soda*	w	Any	150	185	185	200	200	150	75	100	150	x	-	150	-	-
Banana Oil	a, e	100	x	-	x	x	x	x	75	75	70	70	-	210	-	75
Bardol B			x	x	x	x	x	x	-	170	170	170	170	170	-	-
Barium Carbonate*	h (except H_2SO_4)	See Solvents							200							
Barium Chloride*	w	Any	150	185	185	200	200	150	200	70	120	x	75	100	x	75
Barium Hydrate*	a, e, w	Any	150	185	185	200	200	150	-	100	150	x	x	180	75	x
Barium Hydroxide*	a, e, w	Any	150	185	185	200	200	150	-	100	150	x	x	180	75	x
Barium Monohydrate*	a, e, w	Any	150	185	185	200	200	150	-	100	150	x	x	180	75	x
Barium Monosulfide*	w	Any	150	185	185	200	200	150	75	100	150	x	x	100	-	x
Barium Octahydrate*	a, e, w	Any	150	185	185	200	200	150	-	100	150	x	x	180	75	x
Barium Sulfate*	Conc. H_2SO_4	See Solvent														
Barium Sulfide*	w	Any	150	185	185	200	200	150	180	100	150	x	x	100	-	x
Barite*	Conc. H_2SO_4	See Solvent														
Basic Iron Sulfate*	w	Any	150	185	185	200	200	150	75	x	70	x	75	210	x	-
Battery Acid		See Sulfuric Acid														
Beer			80	80	80	80	-	80	x	70	170	170	-	-	-	-
Beet Sugar Liquor			80	80	150	80	80	150	-	170	170	170	170	170	-	-
Bengal Gelatin	aa, gl, w	Any	150	185	185	180	180	150	200	x	70	175	-	-	-	-
Benzaldehyde	am, em, w	Any	x	x	75	x	x	x	x	x	150	70	x	210	75	75
Benzene	a, aa, ac, cb, ct, e	Any	x	x	x	x	x	x	x	100	100	100	70	210	x	75
Benzene Carbanol	a, e, w	Any	x	-	75	x	x	150	x	x	150	70	x	210	75	75
Benzene Carboxylic Acid		Any	150	-	-	150	-	-	75	x	150	150	x	210	x	75
Benzene Sulfonic Acid*	a, w	10	x	-	70	-	x	140	200	x	120	x	70	210	-	-
Benzine (Ligroin)		100	x	x	x	80	130	-	-	110	110	110	-	140	-	-
Benzoic Acid		Any	150	150	-	150	-	-	200	x	150	150	x	210	x	75
Benzoic Aldehyde	a, e, w	Any	x	-	75	x	x	150	x	x	150	70	x	210	75	75
Benzol	a, aa, ac, cb, ct, e	Any	x	x	x	x	x	x	180	100	100	100	70	210	x	75
Benzol Hydride	a, aa, ac, cb, ct, e	Any	x	-	x	x	x	150	x	x	150	70	x	210	75	75
Benzophenol	a, ab, cl, e, ho, gl, o, w	Any	x	x	100	x	x	x	x	110	200	175	70	250	x	-

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS–GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chlorobutyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Benzyl Alcohol	a, cl, e, w	Any	x	-	185	x	x	-	100	75	100	100	100	210	x	75
Benzyl Benzoate	a, cl, e	100	x	-	80	x	x	-	-	100	100	70	-	180	-	75
Benzyl Chloride	a, e	100	x	-	x	x	x	-	x	x	100	x	100	210	x	-
Betula Oil	aa, e, w	Any	x	-	80	-	x	x	75	75	-	75	-	75	-	-
Bismuth Carbonate*	HCl, HNO_3	See Solvents														
Bismuth Oxycarbonate*	HCl, HNO_3	See Solvents														
Bismuth Subcarbonate*	HCl, HNO_3	See Solvents														
Black Sulfate Liquor		Any	75	185	150	100	200	150	200	170	-	-	-	-	-	-
Black Ash*	w	Any	150	185	185	200	200	150	75	100	150	x	x	100	-	x
Blanc Fixe*	Conc. H_2SO_4	See Solvents														
Blast Furnace Gas**		100	x	x	x	x	x	-	-	-	-	-	-	-	-	-
Bleaching Powder*	a, w	35	70	150	150	x	x	150	75	x	x	x	-	210	-	-
Blown Linseed Oil	a, cl, cb, e, t	100	x	-	150	80	180	130	75	75	70	70	-	200	-	-
Blue Copperas* Copper Sulfate	gl, w	Any	150	175	185	200	200	150	100	x	180	x	130	200	x	75
Blue Salts*	a, w	Any	150	185	185	200	200	150	100	x	70	x	70	120	x	-
Blue Vitriol*	gl, w	Any	150	175	185	200	200	150	100	x	180	x	130	180	x	75
Boiled Linseed Oil	a, cb, cl, e, t	100	x	-	150	80	180	130	75	75	70	70	-	200	-	-
Boletic Acid*	a, w	Any	80	-	-	-	x	-	-	75	-	-	-	-	-	-
Borax*	w, gl	Any	150	150	185	200	180	150	-	-	150	-	-	75	-	-
Borax Decahydrate*	w, gl	Any	150	-	185	200	180	150	-	-	150	-	-	75	-	-
Boracic Acid*	w	Any	150	185	185	200	200	150	150	x	200	100	130	300	x	75
Bordeaux Mixture*	w	Any	150	175	185	200	200	150	100	x	180	x	130	180	x	75
Boric Acid*	w	Any	150	185	185	200	200	150	200	x	200	100	130	300	x	75
Brake Fluid, Veg.			x	-	150	100	150	-	-	-	-	-	-	-	-	-
Brimstone*	a, b, cb, ct, e	See Solvents														
Bromine	a, cb, cl, e, w	Any	x	x	x	x	x	x	x	x	x	x	x	75	x	x
Bromine Trifluoride		100	x	x	x	x	x	-	-	-	-	-	-	-	-	-
Bromobenzene	os	100	x	x	x	x	x	-	-	-	-	-	-	-	-	-
Bromochloro Methane	os	100	x	x	x	x	x	x	-	150	150	x	70	210	-	75
Brown Acetate*	a, w	Any	80	-	180	x	120	-	130	70	130	70	70	150	-	75
Bunker Oil			x	x	x	80	150	150	-	170	170	170	170	170	-	-
Burnt Alum*	gl, w	Any	150	185	185	200	200	150	200	x	200	110	-	170	-	-
Butadiene		Any	x	-	-	x	70	-	70	75	75	75	-	75	-	-
Butane**		100	x	x	x	80	100	-	-	75	75	75	75	75	-	-
Butanoic Acid	a, e, w	Any	x	x	x	x	-	-	75	x	200	70	x	210	x	x
Butarol	a, e, w	Any	150	150	180	150	150	140	75	-	-	70	-	-	-	-
Butanone	a, e, o, w	Any	x	x	x	x	x	x	x	150	150	150	150	210	170	-
Butoxyethanol	ph, mo, w	Any	x	-	150	x	150	-	75	100	100	100	150	180	-	75
Butter	os	100	x	-	75	100	150	-	-	-	-	-	-	-	-	-
Butter of Tin	a, cb, t, w	Any	150	150	150	x	150	150	75	x	x	x	x	210	-	-
Butter of Zinc*	a, e, gl, w	Any	150	185	185	150	150	150	100	x	100	x	75	210	x	x
Butyl Acetate	a, e, hc, w	Any	x	x	x	x	x	-	x	70	70	75	70	180	x	75
Butyl Acetate Ricinoleate			x	x	x	x	x	x	-	-	-	-	-	-	-	-
Butyl Acrylate	w	Any	x	x	x	x	x	x	-	-	-	-	-	-	-	-
Butyl Alcohol	a, e, w	Any	150	150	150	100	150	x	75	-	-	70	-	-	-	-
Butylamine	a, e, w	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Butyl Benzoate	a, e	100	x	-	75	x	x	-	-	-	-	-	-	-	-	-
Butyl Carbitol	dg, me	100	x	x	180	-	150	-	-	-	-	-	-	-	-	-
Butyl Cellosolve	ph, mo, w	Any	x	-	150	x	150	-	75	100	100	100	150	180	-	75
Butyl Ether	os	100	x	x	x	80	150	140	-	-	-	-	-	-	-	-
Butyl Hydride**		100	x	x	x	x	x	-	-	75	75	75	75	75	-	-
Butyl Oleate	a, e, mo, vo	100	x	-	75	x	x	-	-	-	-	-	-	-	-	-
Butyl Octadecanoate*	a, e, mo, vo	See Solvents														
Butyl Stearate*	a, e, mo, vo	See Solvents														
Butyraldehyde	a, e, w	Any	x	-	75	x	x	-	-	-	-	-	-	-	-	-
Butyric Acid	a, e, w	Any	x	x·	x	x	-	-	75	x	200	70	x	210	x	x
Buytric Alcohol	a, e, w	Any	150	x	180	150	150	140	75	-	-	70	-	-	-	-
Cajeputene	a	100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Cake Alum*	w	Any	150	185	185	200	200	150	100	x	180	x	100	200	x	75
Calamine	a, cl, ct, w	Any	80	-	140	80	80	-	210	150	150	75	-	210	200	75
Calcine Liquor			-	-	200	-	200	-	-	-	-	-	-	-	-	-
Calcite*	h	See Solvents														
Calcium Acetate*	a, w	Any	80	-	180	x	120	-	130	70	130	70	70	150	-	75
Calcium Bisulfite	a, w	Any	120	150	120	120	200	150	75	x	180	x	x	75	x	75
Calcium Carbonate*	h	See Solvents														
Calcium Chlorate*	a, w	Any	150	-	185	200	200	150	200	140	150	140	-	210	x	75
Calcium Chloride*	a, w	Any	150	185	185	200	200	150	200	140	130	x	x	210	x	75
Calcium Hydrate	gl, h, w	Any	150	185	185	200	200	150	100	100	200	x	x	x	75	75
Calcium Hydroxide*	gl, h, w	Any	150	185	185	200	200	150	200	100	200	x	x	x	75	75
Calcium Hypochlorite*	w	15	80	150	150	x	80	150	200	70	70	70	x	210	75	-
Calcium Nitrate*	a, ac, w	Any	150	185	185	200	200	150	100	100	130	70	x	100	x	75
Calcium Oxychloride*	w	15	150	150	185	x	80	150	75	70	70	70	x	210	75	-
Calcium Sulfate*	gl, ho	See Solvents							200							
Calcium Sulfide*	h, w	Any	150	185	185	150	200	150	75	100	100	70	-	75	-	75
Calcium Silico-aluminate*		Any	80	-	-	x	x	-	-	-	-	-	-	-	-	-

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chlorobutyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Caliche Liquor*	a, gl, w	Any	150	180	185	200	150	150	100	130	170	75	x	210	75	75
Cane Sugar Liquor			150	150	150	200	200	-	-	170	170	200	170	170	-	-
Caproic Aldehyde		100	x	-	150	80	x	x	-	-	-	-	-	-	-	-
Caproxl Alcohol	e, a	100	x	-	•x	x	x	x	-	-	-	-	-	-	-	-
Caproyl Alcohol	a, e	100	x	-	x	x	120	100	-	-	-	-	-	-	-	-
Capryl Alcohol	a, cl, e	100	x	-	x	x	100	x	140	-	-	-	-	140	-	-
Caprylic Alcohol	a, cl, e	100	x	-	x	x	100	x	140	-	-	-	-	140	-	-
Carbamide*	a, b, e, w	Any	150	185	150	150	150	150	100	70	180	180	-	200	-	-
Carbitol			x	-	150	x	150	-	70	150	150	150	150	180	x	75
Carbazotic Acid*	a, b, cl, e, w	Any	x	-	-	x	x	x	75	x	70	x	x	210	x	-
Carbolic Acid	a, cl, e, gl, ho, o, w	Any	x	-	100	x	x	x	x	110	200	175	70	250	x	-
Carbon Bisulfide	a, b,, e, w	Any	x	x	x	x	x	x	80	75	70	180	180	180	75	75
Carbon Disulfide	a, b, e, w	Any	x	x	x	x	x	x	80	75	70	180	180	180	75	75
Carbon Dioxide**			150	185	185	200	200	150	200	170	170	170	170	170	75	75
Carbon Monoxide**			x	x	80	x	x	x	200	700	700	350	75	700	75	
Carbon Tetrachloride	a, b, cl, e, n, o	100	x	x	x	x	x	150	80	75	70	70	100	210	75	75
Carbonic Acid		Any	150	185	185	200	200	150	75	70	150	70	x	210	x	75
Carboxybenzene		Any	150	-	-	150	-	-	75	x	150	150	x	210	x	75
Casein			160	-	-	150	-	-	75	-	150	150	-	75	75	75
Castor Oil	a, b, cb, cl, e	100	80	-	150	120	150	-	-	110	170	200	170	170	-	-
Caustic Baryta*	a, e, w	Any	150	185	185	200	200	150	-	100	150	x	x	180	75	x
Caustic Lime*	gl, h, w	Any	150	185	185	200	200	150	100	100	200	x	x	x	75	75
Caustic Potash*	a, e, gl, w	Any	150	185	185	200	150	150	140	x	150	x	x	x	75	75
Caustic Soda*	a, gl, w	Any	150	185	185	200	150	150	200	100	200	x	110	x	100	150
Cellosolve	mo, ph, w	Any	x	-	150	x	x	-	75	100	100	100	150	180	-	75
Cellosolve Acetate	hc, w	Any	x	-	150	x	x	-	x	-	-	-	-	-	-	-
Cellosolve Butyl	mo, ph, w	Any	x	-	150	x	150	-	75	100	100	100	150	180	-	75
Celulose Acetate*	ac, ea, ed, xy	See Solvents														
Cellulubes			x	-	100	x	x	-	-	-	-	-	-	-	-	-
Cetylic Acid*	a, e	See Solvents														
Ceylon Gelatin*	aa, gl, w	Any	150	185	185	180	180	150	200	x	70	175	-	-	-	-
Chalk*	h	See Solvents														
Chile Niter*	a, gl, w	Any	150	180	150	200	150	150	100	180	200	75	x	210	75	75
Chile Nitrate*	a, gl, w	Any	150	180	150	200	150	150	100	180	200	75	x	210	75	75
Chile Saltpeter*	a, gl, w	Any	150	180	150	200	150	150	100	180	200	75	x	210	75	75
Chinabean Oil	a, cb, cl, e	100	x	-	x	80	120	-	-	110	170	170	-	-	-	-
Chinawood Oil	cb, cl, e, o	100	x	-	x	120	120	-	-	110	150	170	-	-	-	-
Chinese Gelatin*	aa, gl, w	Any	150	185	185	180	180	150	200	x	70	175	-	-	-	-
Chlorine Aqueon		Any	x	-	x	-	-	-	-	-	-	-	-	-	-	-
Chloride Dioxide**	ho, w	Any	x	-	x	x	x	x	200	x	x	70	-	75	-	x
Chlorine Gas, Dry	ho, w		x	x	x	x	x	150	200	-	70	-	-	-	-	-
Wet			x	185	x	x	x	150	200	-	-	-	-	-	-	-
Liquid			x	x	x	x	x	x	100	70	-	-	70	75	-	-
Water		3	150	150	x	x	x	150	180	-	x	-	-	-	-	-
Chlorine Trifluoride**			x	-	x	x	-	-	75	75	-	75	-	75	-	-
Chlorinated Lime*	a, w	35	70	150	150	x	x	150	75	x	x	x	-	210	-	-
Chlorinated Salt Brine			70	150	x	x	-	-	-	-	-	-	-	-	-	-
Chlorinated Solvents	a, e, es, o, os		x	-	x	x	x	x	-	75	-	-	-	75	-	-
Chlorinated Tar Camphor	b, ct, o	100	x	x	x	x	x	x	75	150	150	x	150	210	-	200
Chloroacetic Acid*	a, e, w	10	x	x	150	x	x	x	200	-	70	-	-	-	-	-
Chloroacetone	a, cl, e, w	Any	x	x	x	x	x	x	-	x	-	x	150	180	x	-
Chloroallylene	a, cl, e, pe	100	x	-	x	x	x	-	75	x	125	x	x	-	75	75
Chloroazotic Acid		See Aqua Regia														
Chlorobenzene	os	100	x	x	x	x	x	x	80	150	150	150	150	210	75	-
Chlorobromomethane	os	100	x	x	x	x	x	x	-	150	150	x	70	210	-	75
Chlorobutadiene	a, w	Any	x	x	x	x	x	x	-	75	125	70	-	210	x	-
Chloroethane**	os, w	100	x	-	x	x	x	x	x	200	200	150	150	210	x	75
Chloroethyl Alcohol	os, w	Any	x	-	80	x	x	x	140	150	150	150	150	210	-	-
Chloroform	a, b, e, o, n, w	Any	x	x	x	x	x	x	x	x	130	130	130	210	75	75
Chlorohydric Acid		See Hydrochloric Acid														
Chloromethane**	a, b, cl, ct, os, w	Any	x	-	80	x	x	x	75	x	100	x	-	210	-	70
Chloropentane	a, e	100	x	-	-	x	x	x	75	x	70	x	x	210	-	-
Chloroprene	a, w	Any	x	-	x	x	x	-	-	75	125	70	-	210	x	-
Chloropropanone	a, cl, e, w	Any	x	x	x	x	x	x	-	x	-	x	150	180	x	-
Chloropropene	a, cl, e, pe	100	x	-	x	x	x	-	75	x	125	x	x	-	75	75
Chloropropylene	a, e, cl, pe	100	x	x	x	x	x	-	75	x	120	x	x	-	75	75
Chloropropylene Oxide	os	100	x	-	x	x	x	x	75	130	200	75	75	75	-	-
Chloronaphthalene	b, ct, o	100	x	x	x	x	x	x	75	150	150	x	150	210	-	200
Chloro Nitro Ethane		100	x	x	x	x	x	x	-	-	-	-	-	-	-	-
Chlorosulfonic Acid		100	x	x	x	x	x	x	x	75	80	70	-	210	x	x
Chlorotoluene	a, e, ae, b, cl	100	x	-	x	x	x	-	x	x	100	x	100	210	x	-
Chlorotrifluoroethylene	a, b, ke		x	-	x	-	x	x	-	-	-	-	-	-	-	-
Chlorox		5	x	120	150	x	100	150	75	x	70	x	-	75	-	-

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS–GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Chrome Alum*	w	Any	150	185	185	200	200	150	75	x	75	x	70	140	-	-
Chrome Ammonium Alum*	a, w	Any	150	185	185	200	200	150	75	x	75	x	70	140	-	-
Chromic Acid	e, w	10	x	-	100	x	x	150	150	x	70	70	130	210	x	x
		25	x	-	75	x	x	120	x	x	70	x	130	210	x	x
		50	x	-	x	x	x	80	x	70	70	x	130	210	x	x
		80	x	-	x	x	x	-	x	75	x	x	130	210	x	x
Chromic Anhydride		See Chromic Acid														
Chromicoat			x	-	-	x	-	-	-	x	70	-	-	x	-	x
Chromium Ammonium Sulfate*	a, w	Any	150	185	185	200	200	150	75	x	75	x	70	140	-	-
Chromium Potassium Sulfate*	w	Any	150	185	185	200	200	150	75	x	75	x	70	140	-	-
Chromium Trioxide		See Chromic Acid														
Cinene	a	100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Circo Light Process Oil			x	x	-	150	180	150	-	-	-	-	-	-	-	-
Citric Acid*	a, e, w	Any	-	-	185	150	-	150	200	x	180	100	x	210	x	-
Cleaners Naphtha		100	x	-	x	x	80	80	-	-	-	-	-	-	-	-
Cobalt Chloride*	a, ac, w	Any	150	185	185	200	200	-	-	-	-	-	-	-	-	-
Cobaltons Chloride*	a, ac, w	Any	150	185	185	200	200	-	-	-	-	-	-	-	-	-
Cocoanut Oil	a, cb, cl, e	100	x	x	150	80	120	-	-	-	-	-	-	-	-	-
Cod Liver Oil	a, cb, cl, e, ea, pe	100	x	x	150	-	120	-	-	-	-	-	-	-	-	-
Cologne Spirits	a, cl, e	100	150	-	185	150	150	150	170	-	180	100	-	-	-	-
Copper Acetate*	a, e, w	Any	150	185	185	150	150	-	-	-	180	-	-	-	-	-
Copperas* Ferrous Sulfate	w	Any	150	185	185	200	200	150	75	x	70	75	-	210	x	75
Copper Arsenate*	h, ho	See Solvents														
Copper Chloride*	w	Any	150	150	185	200	200	150	200	x	x	x	x	150	x	75
Copper Cyanide*	h, ho	See Solvents							200							
Copper Nitrate*	a, w	Any	150	185	185	200	200	150	120	x	180	x	-	210	-	-
Copper Sulfate*	gl, w	Any	150	175	185	200	200	150	200	x	180	x	130	200	x	75
Corn Oil	b, cb, cl, e	100	x	-	100	x	x	150	-	170	170	170	170	170	-	-
Corn Syrup	a, gl, w	Any	120	-	185	120	120	150	-	170	170	170	170	170	-	-
Corrosive Sublimate*	a, e, gl, py, w	Any	150	185	150	x	150	150	-	70	70	-	-	210	-	-
Cottonseed Oil	a, b, cb, cl, e	100	x	x	100	150	150	140	-	170	170	170	170	170	-	-
Creosote	a, e, o	100	x	-	x	120	200	-	-	75	150	70	x	210	x	75
Cresol	a, e, gl, ho, w	Any	x	-	x	x	x	x	75	75	100	100	x	210	x	75
Cresyl Alcohol	a, e, gl, ho, w	Any	x	-	x	x	x	x	75	75	100	100	x	210	x	75
Cresylic Acid	a, e, gl, ho, w	Any	x	-	x	x	x	x	75	75	100	100	x	210	x	75
Crude Oil			x	70	x	150	180	150	-	-	-	-	-	-	-	-
Cryolite*	al, fe	See Solvents	150	185	180	180	180	150								
Cryscoat F H Rinse		0.1	x	-	-	x	-	-	-	70	70	-	70	70	-	x
Cryscoat HC			x	-	-	x	-	-	-	x	70	-	x	70	-	x
Cryscoat LT & SW			x	-	-	x	-	-	-	x	70	-	x	x	-	x
Cryscoat 47, 87, 89, & 89M			x	-	-	x	-	70	70	70	70	-	x	70	-	70
Crystal Ammonia*	w	Any	-	185	185	200	200	150	75	140	70	150	-	200	75	75
Cumene	a, b, ct, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Cupric Chloride*	w	Any	150	150	185	200	200	150	100	x	x	x	x	150	x	75
Cupric Cyanide*	h, ho	See Solvents														
Cupric Nitrate*	a, w	Any	150	185	185	200	200	150	120	x	180	x	-	210	-	-
Cupric Sulfate*	gl, w	Any	150	150	185	200	200	150	100	x	180	x	130	200	x	75
Cyclohexane	os	100	x	-	x	x	80	80	75	70	70	70	70	75	x	-
Cyclohexanol	o, os, w	100	x	-	x	150	x	-	-	-	-	-	-	-	-	-
Cyclohexanone	os	100	x	-	x	x	x	x	75	x	70	70	70	75	-	-
Cymene	a, cl, e	100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
DBP	os, w	Any	x	-	75	x	x	-	75	150	150	150	130	180	-	75
DDT & Kerosene			x	-	x	150	150	150	75	x	70	70	70	75	-	75
Decahydronaphthalene	a, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Decalin	a, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Decane	a	100	x	-	x	x	150	-	-	-	-	-	-	-	-	-
Decanol	a, e	100	x	-	x	x	100	x	140	-	-	-	-	140	-	-
Decyl Alcohol	a, e	100	x	-	x	x	100	x	140	-	-	-	-	140	-	-
Deionized Water			150	-	150	150	200	150	-	-	-	180	-	-	-	-
Denatured Alcohol		100	150	150	150	150	180	150	-	-	-	-	-	-	-	-
Developing Solution		Any	150	-	185	200	200	150	-	x	70	-	70	210	-	-
Diacetic Acid	a, w	Any	80	-	80	x	x	x	-	75	170	75	-	75	-	-
Diacetic Ester	a, w	Any	80	-	80	x	x	x	-	75	170	75	-	75	-	-
Diacetone	a, es, hc, w	Any	x	-	100	x	x	-	-	-	-	-	-	-	-	-
Diacetone Alcohol	a, es, hc, w	Any	x	-	100	x	x	-	-	-	-	-	-	-	-	-
Diamine	a,w	Any	-	-	100	x	-	-	75	x	75	75	x	75	-	x
Diaminoethane	a, e, w,	Any	80	-	100	80	80	-	-	75	75	70	-	210	-	75
Dibenzyl Ether	os	100	x	-	75	x	x	x	-	75	170	170	170	170	-	-
Dibromoethane	w	Any	x	-	x	x	x	x	75	70	75	x	70	75	75	-
Dibutyl Ether	os	100	x	x	x	80	x	140	-	-	-	-	-	-	-	-
Dibutylamine	a, e, hc	100	x	-	x	x	x	x	-	75	-	-	-	75	-	-
Dibutyl Phthalate	os, w	Any	x	-	75	x	x	-	75	150	150	150	130	180	-	75
Dichlorobenzine	a, b, e	100	x	-	x	x	x	-	x	70	70	70	150	200	-	75
Dichlorodifluoromethane	os, w	100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Dichloroethane		100	x	-	75	x	x	x	180	100	100	70	100	210	x	75

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chlorobutyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Dichloroisopropyl Ether	o, os	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Dichloromethane	a, e	100	x	-	x	x	x	x	-	100	70	100	70	75	-	-
Dichlorotetrafluoroethane		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Dicyclohexylamine	os, w	Any	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Diesel Oil	o, os	100	x	-	x	x	150	-	-	-	-	-	-	-	-	-
Diester Syn. Lube Oil		100	x	x	x	x	x	x	-	-	-	-	-	-	-	-
Diethylamine	a, w	Any	100	-	140	120	x	x	75	x	100	70	x	180	75	75
Diethylbenzene	a, b, ct, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Diethylene Dioxide	os, w	Any	x	-	x	x	x	x	-	100	100	70	70	180	x	x
Diethylene Ether	os, w	Any	x	-	x	x	x	x	-	100	100	70	70	180	x	x
Diethylene Glycol	a, ac, e, eg, w	Any	150	185	180	180	180	150	-	130	170	100	70	180	x	-
Diethylene Glycol Dialky Ether			x	-	150	x	150	-	75	x	70	x	x	210	x	-
Diethylene Glycol Monoalkyl Ether			x	-	150	x	150	-	75	x	70	x	x	210	x	-
Diethylene Glycol Monoalkyl Ether Acetate	dg, me	100	x	x	180	-	150	-	-	-	-	-	-	-	-	-
Diethylene Glycol Monobutyl Ether	dg, me	100	x	x	180	-	150	-	-	-	-	-	-	-	-	-
Diethylene Oxide	os, w	Any	x	-	x	x	x	x	-	100	100	70	70	180	x	x
Diethyl Ether	a, b, cl, n, o, w	Any	x	-	x	x	120	x	x	70	70	70	70	150	75	75
Diethyl Oxalate	a, e, ea, os, w	Any	x	-	x	x	x	x	-	-	-	70	-	75	-	-
Diethyl Oxide	a, b, cl, n, o, w	Any	x	-	x	x	120	x	x	70	70	70	70	150	75	75
Diethyl Sebacate			x	-	x	x	x	x	-	-	-	-	-	-	-	-
Digallic Acid*	a, ac, w	Any	100	150	185	x	x	150	75	x	180	x	x	210	x	70
Dihydroxysuccinic Acid*	a, e, w	Any	150	185	185	100	150	150	75	x	150	70	x	175	75	70
Dihydroxydiethyl Ether	a, ac, e, eg, w	Any	150	185	180	180	180	150	-	130	170	100	70	180	x	-
Di-isopropylbenzene	a, ac, b, ct, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Di-isopropyl Ether	os, w	Any	80	-	x	x	80	-	-	-	-	-	-	-	-	-
Di-isopropyl Ketone		100	x	-	100	x	x	x	-	-	-	-	-	-	-	-
Dimethyl Aniline	a, e	100	x	-	100	x	x	x	-	-	-	-	-	100	-	-
Dimethyl Benzene	a, e	100	x	x	x	x	x	150	x	150	150	75	-	75	x	-
Dimethyl Carbinol	a, e, w	Any	120	-	120	120	120	120	-	75	70	70	75	210	-	-
Dimethyl Ether	os, w	Any	x	-	x	x	150	-	-	-	-	-	-	-	-	-
Dimethyl Formamide	os, w	Any	x	-	100	x	x	x	x	-	-	-	-	-	-	-
Dimethyl Ketone	a, cl, e, o, w	Any	x	x	150	x	x	x	100	400	180	180	210	210	75	75
Dimethyl Methane**			x	-	x	x	x	x	-	75	75	75	75	75	-	-
Dinitro Toluene*	a, e	See Solvents														
Dioctyl Phthalate	mo	100	x	-	100	x	x	x	140	75	70	-	-	75	-	-
Dioctyl Sebacate		100	x	-	100	x	x	x	-	-	-	-	-	-	-	-
Dioxane	os, w	Any	x	-	80	x	x	x	-	100	100	70	70	180	x	x
Dioxolane	w	Any	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Dioxethylene Ether	os, w	Any	x	-	x	x	x	x	-	100	100	70	70	180	x	x
Dipentene	a	100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Diphenyl*	a, e	See Solvents														
Diphenyl Ether*	a, e	See Solvents							120							
Diphenyl Oxide*	a, e	See Solvents														
Dipping Acid		See Sulfuric Acid														
DMF	os, w	Any	x	-	100	x	x	x	-	-	-	-	-	-	-	-
DNT*	a, e	See Solvents														
Dodecanoic Acid*	a, e	See Solvents														
DOP	mo	100	x	-	100	x	x	x	75	75	70	-	-	75	-	-
Douglas Fir Oil		100	x	-	-	x	150	-	-	-	150	-	-	-	-	-
Dowfume W40		100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Dow Purifloc C-31			150	-	-	150	150	-	-	-	-	-	-	-	-	-
Dowtherm A	a, ct, e	100	x	-	x	85	75	x	-	170	-	170	-	-	-	-
Dowtherm E		100	x	-	x	x	x	x	75	75	-	x	-	75	-	-
Drycid(1)			70	100	-	85	-	70	70	x	70	-	x	70	-	70
Dry Cleaning Fluids		Any	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Dutch Liquid		100	x	-	75	x	x	x	180	100	100	70	100	210	x	75
Dutch Oil		100	x	-	75	x	x	x	180	100	100	70	100	210	x	75
Electrolyte Acid	See Sulfuric Acid															
EMK	a, e, o, w	Any	x	x	x	x	x	x	x	150	150	150	150	210	170	-
Engravers Acid		See Nitric Acid														
Epi	os	100	x	-	x	x	x	x	75	130	200	75	75	75	-	-
Epichlorohydrin	os	100	x	-	x	x	x	x	75	130	200	75	75	75	-	-
Epsom Salts*	a, gl, w	Any	150	185	185	200	200	150	75	100	150	100	140	210	x	70
Essence of Myrbane*	a, b, e, w	Any	x	-	80	x	x	x	75	170	150	150	70	210	-	-
Ethane**		100	x	-	x	x	150	-	-	-	-	-	-	-	-	-
Ethanethiol	a, e, n, w	Any	x	-	x	x	x	x	-	x	150	150	x	200	-	-
Ethanoic Acid		See Acetic Acid														
Ethanal	a, ac, b, e, g, n, t, tu, xy, w	Any	x	-	80	x	x	x	x	125	210	210	75	600	x	x
Ethanol	a, cl, e	100	150	150	185	150	150	150	170	-	180	100	-	-	-	-
Ethanolamine	a, cl, ct, w	Any	80	80	140	80	80	-	210	150	150	75	-	210	200	75
Ether	a, b, cl, n, o, w	Any	x	-	x	x	120	x	x	70	70	70	70	150	75	75
Ethine**	a, ac, w	Any	80	80	80	80	80	80	200	400	180	75	75	75	75	75
Ethyl Acetate	a, cl, e, w	Any	x	-	100	x	x	x	x	75	100	130	70	210	x	75

(1) Light-colored compounds recommended, but they may cause some cloudiness in the bleach.

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS–GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chlorobutyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Ethyl Acetic Acid	a, e, w	Any	x	x	x	x	-	-	75	x	200	70	x	210	x	x
Ethyl Acetoacetate	a, w	Any	80	-	80	x	x	x	-	75	170	75	-	75	-	-
Ethyl Acrylate		100	x	-	x	x	x	x	-	120	70	-	-	75	-	-
Ethyl Alcohol	a, cl, e	100	150	150	185	150	150	150	100	-	180	100	-	-	-	-
Ethyl Aldehyde	a, ac, b, e, g, n, t, tu, xy, w	Any	x	-	80	x	x	x	x	125	210	210	75	600	x	x
Ethyl Benzene	a, b, ct, e, w	Any	x	-	x	x	x	x	140	75	150	150	150	210	75	75
Ethyl Benzenoate	a, e	100	100	-	100	x	x	-	-	-	-	-	-	-	-	-
Ethyl Butanoate	a, e	100	x	-	x	x	x	x	140	180	180	100	150	210	-	75
Ethyl Butyrate	a, e	100	x	-	x	x	x	x	140	180	180	100	150	210	-	75
Ethyl Cellulose*	os	See Solvents														
Ethyl Chloride**	os, w	100	x	x	x	x	120	x	x	200	200	150	150	210	75	75
Ethyl Chlorocarbonate	a, b, cl, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Ethyl Chloroformate	a, b, cl, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Ethylene**		100	x	-	100	x	180	-	-	-	-	-	-	-	-	-
Ethylene Alcohol	a, cl, e	100	x	175	185	150	180	150	75	100	70	120	-	210	-	-
Ethylene Bromide	w	Any	x	-	x	x	x	x	75	70	75	x	70	75	75	-
Ethylene Chloride		100	x	-	75	x	x	x	x	150	70	150	-	210	75	75
Ethylene Chlorohydrin	os, w	Any	x	-	80	x	x	x	80	150	150	150	150	210	-	-
Ethylene Diamine	a, e, w	Any	80	-	100	80	80	-	-	75	75	70	-	210	-	-
Ethylene Dibromide	w	Any	x	-	x	x	x	x	75	70	75	x	70	75	75	-
Ethylene Dichloride		100	x	x	x	x	x	x	x	150	150	120	150	210	x	75
Ethylene Glycol	a, e, w	100	150	185	185	150	180	150	200	100	70	120	-	210	-	-
Ethylene Glycol Monobutyl Ether	mo, ph, w	x	-	150	x	150	-	75	100	100	100	150	180	-	75	
Ethylene Glycol Monobutyl Ether Acetate	hc, w	Any	x	-	150	x	150	-	x	-	-	-	-	-	-	-
Ethylene Oxide**	os, w	Any	x	-	x	x	x	x	x	75	200	75	70	300	75	-
Ethyl Ether	a, b, cl, n, o, w	Any	x	-	x	x	120	x	x	70	70	70	70	150	75	75
Ethyl Hydroxide	a, cl, e	100	150	-	185	150	150	150	185	-	180	100	-	-	-	-
Ethyl Mercaptan	a, e, n, w	Any	x	-	x	x	x	x	-	x	150	150	x	200	-	-
Ethyl Oxalate	a, e, ea, os, w	Any	x	-	x	x	x	x	-	-	-	70	-	75	-	-
Ethyl Oxide	a, b, cl, n, o, w	Any	x	-	x	x	120	x	x	70	70	70	70	150	75	75
Ethyl Pentachlorobenzene		Any	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Ethyl Silicate	a	100	x	-	180	180	180	150	-	75	-	-	-	210	-	-
Ethyl Sulfahydrate	a, e, n, w	Any	x	-	x	x	x	x	-	x	150	150	x	200	-	-
Exsiccated Alum*	gl, w	Any	150	185	185	200	200	150	200	x	200	110	-	170	-	-
Fat Lime*	gl, h, w	Any	150	185	185	200	200	150	100	100	200	x	x	x	75	75
Fatty Acids			x	80	150	x	80	80	200	x	200	200	x	400	x	75
Ferric Chloride*	a, gl, w	Any	150	185	185	200	200	150	200	x	x	x	x	210	x	75
Ferric Nitrate*	a, w	Any	150	185	185	200	200	150	200	x	70	x	-	210	-	-
Ferric Perchloride*	a, gl, w	Any	150	185	150	80	200	150	200	x	x	x	x	210	x	75
Ferric Sesquichloride*	a, gl, w	Any	150	185	150	80	200	150	200	x	x	x	x	210	x	75
Ferric Sesquisulfate*	w	Any	150	185	185	200	200	150	75	x	70	x	75	210	x	-
Ferric Subsulfate*	w	Any	150	185	185	200	200	150	75	x	70	x	75	210	x	-
Ferric Sulfate*	w	Any	150	185	185	200	200	150	200	x	70	x	75	210	x	-
Ferric Trichloride*	a, gl, w	Any	150	185	185	80	200	150	200	x	x	x	x	210	x	75
Ferric Trisulfate*	w	Any	150	185	185	200	200	150	75	x	70	x	75	210	x	-
Ferrous Chloride*	a, w	Any	150	185	185	80	200	150	200	x	70	x	x	210	x	x
Ferrous Nitrate		Any	150	185	185	200	200	150	200	-	-	-	-	-	-	-
Ferrous Sulfate*	w	Any	150	185	185	200	200	150	200	x	70	75	-	210	x	75
Fertilizer Solutions																
Aqua Ammonia & Nitrogen Solution (non-press)		25	150	150	185	200	200	150	200	75	200	100	100	-	-	-
Ammonium Phosphate (Neutral)			150	150	150	180	80	150	200	-	200	-	-	-	-	-
Balanced Mix (Complete Analysis)			150	150	150	180	100	150	200	-	200	-	-	-	-	-
Nitrogen (Low Pressure)		41	80	100	180	120	120	150	200	75	200	100	100	-	-	-
Filter Alum*	w	Any	150	185	185	200	200	150	100	x	180	x	100	200	x	75
Firwood Oil																
Fish Oil	a, b, cb, cl, e	100	x	-	x	x	150	-	-	150	x	x	x	x	x	75
Flaxseed Oil	a, cb, cl, e, tu, pe	100	x	-	150	180	180	130	75	75	70	70	-	200	-	-
Flores Martis*	a, gl, w	Any	150	185	150	80	200	150	200	x	x	x	x	210	x	75
Florinated Cyclic Ether		100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Flowers of Sulfur*	a, b, cb, ct, e	See Solvents														
Fluoboric Acid	a, w	65	150	-	150	80	150	150	-	-	-	-	-	-	-	-
Fluorine**		100	x	-	x	-	x	x	450	300	350	350	200	300	x	x
Fluorobenzene	a, e	100	x	-	x	x	x	x	-	-	-	-	-	-	-	
Fluorochloroethylene		100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Fluorolube	a, b, ke		x	-	x	-	x	x	-	-	-	-	-	-	-	-
Fluosilcic Acid	w	10	100	185	185	150	150	150	75	x	x	x	70	x	-	75
		50	80	185	185	80	80	150	75	x	x	x	70	x	-	-
Formaldehyde**	a, e, w	40	80	x	150	80	80	150	100	x	100	150	70	210	x	-
Formic Acid	a, e, w	Any	x	x	150	150	-	80	100	x	150	70	x	210	x	75
Formic Aldehyde**	a, e, w	40	80	x	150	80	80	150	100	x	100	150	70	210	x	-
Formonitrile	a, e, w	Any	80	-	150	x	x	150	120	x	150	70	x	210	-	75
Fraud's Reagent	w	10	150	-	150	x	x	150	200	x	x	x	-	210	x	x

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chlorobutyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Freon* 11		100	x	x	x	x	100	-	-	-	-	-	-	-	-	-
Freon* 12**	os, w	100	80	-	80	150	150	-	-	x	-	-	-	-	-	-
Freon* 13		100	120	185	185	200	200	-	-	-	-	-	-	-	-	-
Freon* 13 B1**		100	120	185	185	200	200	-	-	-	-	-	-	-	-	-
Freon* 14**	w	100	150	185	185	200	200	-	-	-	-	-	-	-	-	-
Freon* 22**	w	100	80	185	185	200	x	-	-	-	-	-	-	-	-	-
Freon* 23**		100	120	185	185	200	200	-	-	-	-	-	-	-	-	-
Freon* 113		100	x	x	x	150	150	-	-	-	-	-	-	-	-	-
Freon* 114**		100	120	185	185	200	200	-	-	x	-	-	-	-	-	-
Freon* 115**	a, e	100	150	185	185	200	200	-	-	-	-	-	-	-	-	-
Freon* 116**		100	150	185	185	200	200	-	-	-	-	-	-	-	-	-
Freon* 502**		100	100	185	185	200	150	-	-	-	-	-	-	-	-	-
Freon* 503		100	150	185	185	200	200	-	-	-	-	-	-	-	-	-
Freon* MF		100	x	x	x	x	150	-	-	-	-	-	-	-	-	-
Freon* TA		100	x	-	75	150	100	-	-	-	-	-	-	-	-	-
Freon* TF		100	x	x	x	120	150	-	-	-	-	-	-	-	-	-
Freon* TMC		100	x	x	x	75	75	-	-	-	-	-	-	-	-	-
Freon* T-P 35		100	x	x	x	120	150	-	-	-	-	-	-	-	-	-
Freon* T-WD 602		100	x	x	75	120	150	-	-	-	-	-	-	-	-	-
Fuel Oil (Acidic)		100	x	-	x	150	150	150	-	-	150	-	-	170	-	-
Fumaric Acid*	a, w	Any	80	-	-	-	x	-	-	75	-	-	-	-	-	-
Furan	a, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Furfural	a, b, e	100	x	-	185	x	x	x	x	100	140	100	100	210	75	-
Furfuran	a, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Fusel Oil	a, e, w	Any	150	-	180	180	180	150	-	70	70	75	-	140	-	-
Gallic Acid*	a, e, gl, w	Any	150	-	150	x	x	150	-	x	140	130	-	75	-	-
Gallotanic Acid*	a, ac, w	Any	100	150	185	x	x	150	75	x	180	x	x	210	x	70
Gasoline		100	x	-	x	x	100	100	100	170	70	170	170	170	-	-
Gaultheria Oil	aa, e, w	Any	x	-	80	-	x	x	75	75	-	75	-	75	-	-
Gelatin*	aa, gl, w	Any	150	-	185	180	180	150	200	x	70	175	-	-	-	-
Glauber's Salt*	gl, w	Any	150	-	150	200	200	150	100	140	180	150	140	210	x	75
Glucose	a, gl, w	Any	120	-	185	120	120	150	-	170	170	170	170	170	-	-
Glue	gl, h, w	Any	120	-	x	150	150	150	-	170	100	170	170	170	-	-
Glycerine	a, w	Any	150	-	150	150	180	x	75	110	150	200	70	210	x	75
Glycerol	a, w	Any	150	-	150	150	180	x	75	110	150	200	70	210	x	75
Glyceryl Triacetate	a, e, os, w	Any	x	-	80	80	80	x	-	-	-	70	-	75	-	-
Glyceryl Trioleate	a, cl, ct, e	Any	x	-	100	80	120	-	-	-	-	-	-	-	-	-
Glyceryl Tripalmitate*	cl, e	See Solvents														
Glycol		100	120	150	150	120	150	150	200	75	70	75	-	210	-	-
Glycol Chlorohydrin	os, w	Any	x	-	80	x	x	x	140	150	150	150	150	210	-	-
Glycol Alcohol	a, w	Any	150	-	150	150	180	x	75	110	150	200	70	210	x	75
Graham's Salt*	w	Any	150	150	185	200	200	150	-	x	70	x	-	210	-	-
Grain Alcohol	a, e, cl	100	150	150	185	150	150	150	170	-	180	100	-	-	-	-
Grain Oil	a, e, w	Any	x	x	150	100	150	150	-	70	70	75	-	140	-	-
Gray Acetate*	a, w	Any	80	-	180	x	120	-	130	70	130	70	70	150	-	75
Grease Oil	a, b, cb, cl, e	100	x	-	75	x	100	-	-	-	70	-	-	-	-	-
Green Copperas*	w	Any	150	-	185	200	200	150	75	x	70	75	-	210	x	75
Greenland Spar*	al, fe	See Solvents														
Green Sulfate Liquor			120	150	150	150	150	150	-	110	-	-	-	-	-	-
Green Vitriol*	w	Any	150	150	185	200	200	150	75	x	70	75	-	210	x	75
Gypsum*	ho, am, h	See Solvents														
Halite*	a, gl, w	Any	150	185	185	200	160	150	75	75	70	x	100	120	75	75
Hartshorn*	w	Any	-	185	185	200	200	-	75	140	70	150	-	200	75	75
Heavy Spar*	Conc. H_2SO_4	See Solvents														
Hepar Calis*	h, w	Any	150	185	185	150	200	150	75	100	100	70	-	75	-	75
Heptyl Carbinol	a, cl, e	100	x	-	x	x	100	x	170	-	-	-	-	170	-	-
Hexachlorodiphenylmethane		100	x	x	x	x	x	x	75	75	-	75	-	75	-	-
Hexadecanoic Acid*	a, e	See Solvents														
Hexahydrobenzene	os	100	x	-	x	x	80	80	75	70	70	70	70	75	x	-
Hexahydropyridine	a, e, w	Any	x	-	x	-	x	-	-	-	-	-	-	-	-	-
Hexaldehyde		100	x	-	150	80	x	x	-	-	-	-	-	-	-	-
Hexamethylene	os	100	x	-	x	x	80	80	75	70	70	70	70	75	x	-
Hexanaphthene	os	100	x	-	x	x	80	80	75	70	70	70	70	75	x	-
Hexane	a, ac, e	100	x	-	x	80	120	120	-	75	-	75	-	75	-	-
Hexanedioic Acid	w	Any	80	80	x	x	x	-	-	-	-	-	-	-	-	-
Hexahol	a, e	100	x	-	x	x	120	100	-	-	-	-	-	140	-	-
Hexene		100	x	x	x	120	150	-	-	-	-	-	-	-	-	-
Hexone	os, w	Any	x	-	75	x	x	x	70	150	150	150	150	210	-	-
Hexyl Alcohol	a, e	100	80	-	80	100	120	100	-	-	-	-	-	140	-	-
Hydrated Lime	gl, h, w	Any	150	185	185	200	200	150	100	100	200	x	x	x	75	75
Hydraulic Oil		100	x	-	x	x	150	-	-	-	-	-	-	-	-	-
Hydrazine	a, w	Any	-	-	100	x	-	-	75	x	75	75	x	75	-	x
Hydrazinobenzene		Any	80	-	x	x	x	x	-	-	-	-	-	-	-	-
Hydrobromic Acid		100	100	-	150	x	x	150	150	x	x	x	x	210	x	75
Hydrochloric Acid	w	15	150	185	x	x	120	150	200	x	x	x	x	210	x	-
		38	150	185	x	x	x	80	200	x	x	x	x	210	x	75

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chlorobutyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Hydrocyanic Acid	a, e, w	20	150	-	150	x	x	150	120	-	70	70	x	210	-	-
		98	80	-	150	x	x	150	120	75	70	75	70	210	-	75
Hydrofluoric Acid	w	10	75	120	180	x	80	150	120	x	x	x	75	x	-	-
		20	x	120	180	x	x	100	120	x	x	x	75	x	-	-
		48	x	x	150	x	x	100	-	x	x	x	70	x	-	-
		75	x	x	75	x	x	70	x	x	x	x	x	x	x	70
(Anhydrous)			x	x	x	x	x	x	-	-	-	-	-	-	-	-
Hydrofluorosilicic Acid		10	100	185	185	150	150	150	75	x	x	x	70	x	-	75
(Hydrofluosilicic Acid)		50	80	185	185	80	80	150	75	x	x	x	70	x	-	-
Hydrogen**	a, e, w	Any	x	-	x	x	x	x	75	600	600	600	75	75	75	75
Hydrogen Bromide**	w	Any	100	-	150	x	x	150	150	x	x	x	x	210	x	75
Hydrogen Carboxylic Acid	a, e, w	Any	x	x	150	150	150	80	75	x	150	70	x	210	x	75
Hydrogen Chloride**	w	See Hydrochloric Acid														
Hydrogen Cyanide	a, e, w	Any	80	-	150	x	x	150	120	75	70	75	70	210	-	75
Hydrogen Dioxide	a, w	10	80	x	x	x	80	100	140	x	100	100	x	210	-	-
Hydrogen Fluoride	w	20	x	-	x	x	80	100	200	x	x	x	75	x	-	-
Hydrogen Peroxide	a, w	10	80	x	x	x	80	100	140	x	100	100	x	210	-	-
Hydrogen Sulfate		See Sulfuric Acid														
Hydrogen Sulfide**	a, w	Any	x	x	150	x	x	140	75	70	100	70	70	75	75	75
Hydroquinol*	a, e, w	Any	80	-	x	x	x	120	120	70	70	70	70	125	x	75
Hydroquinone*	a, e, w	Any	80	-	x	x	x	120	120	70	70	70	70	125	x	75
Hydrosilicfluoric Acid		See Fluosilicic Acid														
Hydrous Aluminum Oxide*	h, ho	See Solvents														
Hydroxyacetic Acid*	a, e, w	10	x	x	100	x	x	x	-	-	200	-	70	210	-	-
Hydroxlpropane Tricarboxylic Acid	a, e, w	Any	150	150	185	150	110	150	120	x	180	100	x	210	x	-
Hydroxybenzene*	a, cl, e, gl, ho, o, w, cb	Any	x	x	100	x	x	x	x	110	200	175	70	210	x	-
Hydroxyethylamine	a, cl, ct, w	Any	80	-	140	80	80	-	210	150	150	75	-	210	200	75
Hydroxysuccinic Acid*	a, e, w	Any	80	150	x	x	x	120	140	x	150	75	75	150	x	75
Hypnone*	os, w	Any	x	-	80	x	x	x	-	200	350	150	150	175	-	75
Hypo*	t, w	Any	150	185	185	200	200	150	150	x	70	-	70	210	-	-
Hypochlorous Acid		5	120	150	x	x	x	120	150	x	x	x	x	150	75	-
Icestone*	al, fe	See Solvents														
Iodine Pentafluoride		100	x	x	x	x	x	-	-	-	-	-	-	x	-	x
Iodoform*	a, cb, cl, e, gl	Any	x	x	x	x	-	-	-	-	-	-	-	-	-	-
IPA	a, e, w	Any	120	-	120	120	120	120	-	75	70	70	75	210	-	-
Iron Chloride*	a, gl, w	Any	150	185	185	80	200	150	200	x	x	x	x	210	x	75
Iron Dichloride*	a, w	Any	150	-	185	80	200	150	75	x	70	x	x	210	x	x
Iron Nitrate*	a, w	Any	150	185	185	200	200	150	100	x	70	x	-	210	-	-
Iron Perchloride*	a, gl, w	Any	150	185	185	80	200	150	200	x	x	x	x	210	x	75
Iron Persulfate*	w	Any	150	185	185	200	200	150	75	x	70	x	75	210	x	-
Iron Protochloride*	a, w	Any	150	-	185	80	200	150	75	x	70	x	x	210	x	x
Iron Sulfate*	w	Any	150	185	185	200	200	150	75	x	70	x	75	210	x	-
Iron Sesquichloride*	a, gl, w	Any	150	185	185	80	200	150	200	x	x	x	x	210	x	75
Iron Susquisulfate*	w	Any	150	185	185	200	200	150	75	x	70	x	75	210	x	-
Iron Tersulfate*	w	Any	150	185	185	200	200	150	75	x	70	x	75	210	x	-
Iron Trichloride*	a, gl, w	Any	150	185	185	80	200	150	200	x	x	x	x	210	x	75
Iron Vitriol*	w	Any	150	-	185	200	200	150	75	x	70	75	-	210	x	75
Isobutanol	a, e, w	Any	80	-	100	80	80	80	-	-	-	-	-	-	-	-
Isobutyl Alcohol	a, e, w	Any	80	-	100	80	80	80	-	-	-	-	-	-	-	-
Iso-Octane		100	x	-	x	80	120	-	-	-	-	-	-	-	-	-
Isopropanol	a, e, w	Any	80	-	185	120	120	80	-	75	70	70	75	210	-	-
Isopropyl Acetate	os, w	Any	x	- -	80	x	x	-	-	75	-	-	-	210	-	-
Isopropyl Alcohol	a, e, w	Any	120	-	120	120	120	120	-	75	70	70	75	210	-	-
Isopropyl Chloride	e, m, w	Any	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Isopropylcarbinol	a, e, w	Any	80	-	100	80	80	80	-	-	-	-	-	-	-	-
Isopropyl Ether	os, w	Any	80	-	x	x	80	-	-	-	-	-	-	-	-	-
Isopropyldieneacetone	a, e, w	Any	x	-	x	x	x	-	-	75	70	-	-	75	-	-
Isopropyltoluene	a, e, cl	100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Japanese Gelatin	aa, gl, w	Any	150	185	185	180	180	150	200	x	70	175	-	-	-	-
Jet Fuel																
Type A&AI: Kerosene			x	-	x	x	150	150	-	170	70	170	170	170	-	-
Type B: Gasoline-Kerosene			x	-	x	x	100	100	75	170	70	170	170	170	-	-
JP-1: Naphtha-Kerosene			x	-	x	x	120	150	-	-	-	-	-	-	-	-
JP-3: Gasoline-Kerosene			x	-	x	x	100	100	75	170	70	170	170	170	-	-
JP-4: Gasoline-Petroleum			x	-	x	x	100	100	75	170	70	170	170	170	-	-
JP-5&6: Kerosene			x	-	x	x	120	150	-	-	-	-	-	-	-	-
JPx			x	-	x	x	120	x	-	-	-	-	-	-	-	-
Kerosene			x	-	x	80	150	-	150	170	70	170	170	170	-	-
Ketohexamethylene	os	Any	x	-	x	x	x	x	75	x	70	70	70	75	-	-
Ketopropane	a, cl, e, o, w	Any	x	x	150	x	x	x	100	400	180	180	210	210	75	75
Kurrol's Salt		Any	150	150	185	200	200	150	-	x	70	x	-	210	-	-
Labarraque's Solution*	w	20	x	-	x	x	x	120	75	x	x	x	x	150	75	-

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Lactic Acid	a, e, gl, w	50	120	150	150	80	80	130	200	x	70	70	x	200	x	75
Lactol		100	x	x	x	x	100	-	-	-	-	-	-	-	-	-
Lacquer Solvents		Any	x	-	x	x	x	-	-	75	170	170	-	-	-	-
Lard Oil	a, b, cb, cl, e	100	x	-	75	80	100	-	-	-	70	-	-	-	-	-
Lauric Acid*	a, e	See Solvents														
Lavender Oil	a, cb, cl, ct, pe	100	x	x	x	x	100	-	-	-	-	-	-	-	-	-
Layor Caranga*	aa, gl, w	Any	150	185	185	180	180	150	200	x	70	175	-	-	-	-
Lead Acetate*	a, gl, h, w	Any	80	-	120	80	80	120	200	x	100	x	x	200	x	75
Lead Arsenate*	HNO_3	See Solvents														
Lead Nitrate*	a, w	Any	120	-	180	120	120	120	75	x	130	x	100	210	-	75
Lead Styphnate*	w	Any	120	175	185	180	120	120	-	-	-	-	-	-	-	-
Lead Sulfate*	h, w	Any	120	-	185	180	120	120	75	x	150	x	150	180	75	75
Lead Trinitroresorcinate*	w	Any	120	175	185	180	120	120	-	-	-	-	-	-	-	-
Leucogen*	w	Any	150	185	185	200	160	150	75	x	100	x	70	x	x	75
Lichenic Acid*	a, w	Any	80	-	-	-	x	-	-	75	-	-	-	-	-	-
Ligroin	os	100	x	x	x	80	130	-	-	-	-	-	-	-	-	-
Lime*	gl, h, w	Any	150	185	185	200	200	150	100	100	200	x	x	x	75	75
Lime Acetate*	a, w	Any	80	-	180	x	120	-	130	70	130	70	70	150	-	75
Lime Bleach*	a, w	Any	120	-	150	-	-	-	-	-	-	-	-	-	-	-
Lime Hydrate*	gl, h, w	Any	150	185	185	200	200	150	100	100	200	x	x	x	75	75
Limonene	a	100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Lime Saltpeter*	a, ac, w	Any	150	185	185	200	200	150	100	100	130	70	x	100	x	75
Limestone	h	See Solvents														
Linoil		100	x	x	x	-	x	-	-	-	-	-	-	-	-	-
Linoleic Acid	os	100	x	-	x	x	x	-	200	x	500	500	x	600	x	75
Linolenic Acid	os	100	x	80	150	x	80	80	200	-	70	70	-	-	-	-
Linolic Acid	os	100	x	-	x	x	x	-	200	x	500	500	x	600	x	75
Linseed Oil	a, cb, cl, e, tu, pe	100	x	-	150	180	180	130	200	75	70	70	-	200	-	-
Liquid Oxygen		100	x	x	x	x	x	x	-	-	-	-	-	-	-	-
Liquid Petroleum Gas		100	x	x	x	x	x	x	-	-	-	-	-	-	-	-
Liquid Rosin			x	-	x	x	150	150	200	100	400	x	-	600	-	-
Lubricating Oils			x	x	x	120	150	150	-	170	170	170	170	170	-	-
Lube Oils			x	x	x	120	150	150	-	170	170	170	170	170	-	-
Lye		Any	150	185	185	200	150	150	100	75	150	x	x	x	75	75
Lysol	a, w		150	-	150	150	150	-	-	-	-	-	-	-	-	-
Macassargum*	aa, gl, w	Any	150	185	185	180	180	150	200	x	70	175	-	-	-	-
Maddrell's Salt		Any	150	150	185	200	200	150	-	x	70	x	-	210	-	-
Magnesia Alba*	h	See Solvents														
Magnesium Bisulfite	w	Any	120	-	120	120	120	-	-	-	100	x	100	70	x	x
Magnesium Carbonate*	h	See Solvents							150							
Magnesium Chloride*	a, w	Any	150	185	185	200	200	130	200	70	70	x	x	140	x	75
Magnesium Hydrate*	am, h, w	Any	150	185	185	200	200	130	75	70	70	x	x	140	-	75
Magnesium Hydroxide*	am, h, w	Any	150	185	185	200	200	130	75	70	70	x	x	140	-	75
Magnesium Nitrate*	a, w	Any	150	185	185	200	200	150	75	70	70	70	-	210	-	-
Magnesium Sulfate*	w, a, gl	Any	150	185	185	200	200	150	200	110	150	110	140	210	x	70
Maize Oil	b, cb, cl, e	100	x	-	100	x	x	150	-	170	170	170	170	170	-	-
Maleic Acid*	a, b, w	25	80	150	x	x	x	120	200	x	70	70	-	210	-	-
Maleic Anhydride*	ac, cl, e, hc	See Solvents														
Maleinic Acid*	a, b, w	25	80	150	x	x	x	120	100	x	70	70	-	210	-	-
Malic Acid*	a, e, w	Any	80	150	x	x	150	120	140	x	150	75	75	150	x	75
Manganese Sulfate*	w	Any	150	150	185	200	200	150	75	-	-	-	-	200	x	-
Marble	h	See Solvents														
Marl*	h	See Solvents														
MEA (monoethanolamine)	a, cl, ct, w	Any	80	80	140	80	80	-	210	150	150	75	-	210	200	75
MEK	a, e, o, w	Any	x	x	100	x	x	x	x	150	150	150	150	210	170	-
Mercuric Chloride	a, e, gl, py, w	Any	150	185	150	x	150	150	200	x	x	x	x	200	x	-
Mercuric Cyanide*	a, w	Any	150	-	150	x	150	150	75	-	70	x	-	150	x	-
Mercurous Nitrate*	HNO_3, w	Any	150	-	150	80	80	150	70	-	140	x	x	210	-	-
Mercury		100	150	185	185	200	200	-	-	x	x	x	x	-	-	-
Mercury Bichloride*	a, e, gl, py, w	Any	150	185	150	x	150	150	75	x	x	x	x	200	x	-
Mercury Vapor**			x	-	x	x	x	x	-	-	-	-	-	-	-	-
Mesityl Oxide	a, e, w	Any	x	-	x	x	x	-	-	75	70	-	-	75	-	-
Methanal	a, e, w	40	80	x	150	80	80	150	100	x	100	150	70	210	x	-
Methane**		100	x	x	x	100	150	-	-	-	-	-	-	-	-	-
Methanol	a, e, w	Any	100	-	185	100	150	120	100	150	150	90	150	210	75	75
Methanecarboxylic Acid		See Acetic Acid														
Methyl Acetate	hc, w	Any	x	-	75	x	x	-	-	75	-	-	-	75	-	-
Methyl Acrylate	w	Any	x	-	x	x	x	-	-	75	-	75	-	75	-	-
Methyl Alcohol	a, e, w	Any	100	-	185	100	150	120	100	150	150	90	150	210	75	75
Methylbenzene	a, b, e	100	x	x	x	x	x	150	170	170	170	170	170	170	-	-
Methyl Bromide**		100	x	x	x	x	75	-	-	-	-	-	-	-	-	-
Methyl Butanol	a, e, w	Any	150	-	180	180	180	150	-	70	70	75	-	140	-	-
Methyl Butyl Ketone	a, e, w	Any	x	-	150	x	x	x	x	-	-	150	-	-	-	-
Methyl Chloride**	a, b, cl, ct, os, w	Any	x	-	80	x	x	x	75	x	100	x	-	210	-	70
Methylene Chloride	a, e	100	x	-	x	x	x	x	x	100	70	100	70	75	-	-

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Methylene Chlorobromide	os	100	x	x	x	x	x	x	-	150	150	x	70	210	-	75
Methylcyclopentane		100	x	x	x	x	x	-	-	-	-	-	-	-	-	-
Methyl Ether	os, w	100	x	-	x	x	150	-	-	-	-	-	-	-	-	-
Methylene Dichloride	a, e	100	x	-	x	x	x	x	-	100	70	100	70	75	-	-
Methyl Ethyl Ketone	a, e, o, w	Any	x	x	100	x	x	x	x	150	150	150	150	210	170	-
Methyl Formate	a, e, w	100	x	-	80	120	x	-	-	-	-	-	-	-	-	-
Methyl Hexyl Carbinol	a, cl, e	100	x	-	x	x	100	x	150	-	-	-	-	175	-	-
Methyl Isobutenyl Ketone	a, e, w	Any	x	-	x	x	x	-	-	75	70	-	-	75	-	-
Methyl Isobutyl Ketone	a, e, w	Any	x	-	75	x	x	x	70	150	150	150	150	210	-	-
Methyl Isopropyl Ketone	w, os	Any	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Methyl Merthacrylate	w	Any	x	-	x	x	x	x	-	x	70	70	-	75	-	-
Methyl Oleate	a, os	100	x	-	80	x	x	-	-	-	-	-	-	-	-	-
Methylphenol	a, e, gl, ho, w	Any	x	-	x	x	x	x	75	75	100	100	x	210	x	75
Methyl Polysiloxanes		100	x	-	x	x	180	-	-	-	-	-	-	-	-	-
Methylpropanol	a, e, w	Any	80	-	100	80	80	80	-	-	-	-	-	-	-	-
Methylpropylbenzene	a, cl, e	100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Methyl Salicylate	aa, e, w	Any	x	-	80	-	x	x	75	75	-	75	-	75	-	-
Milk Acid	a, e, gl, w	50	120	-	150	80	80	130	100	x	70	70	x	200	x	75
Milk of Magnesia*	am, h, w	Any	150	185	185	200	200	130	75	70	70	x	x	140	-	75
Milk, Whole			100	-	100	100	100	100	170	170	150	200	-	170	-	-
Mineral Oil		100	x	-	x	120	150	150	-	]10	70	170	110	170	-	-
Mineral Pitch			x	x	x	80	150	150	-	170	170	70	170	170	-	-
Mineral Spirits		100	x	x	x	x	x	x	75	75	70	75	-	75	x	-
Mineral Thinner		100	x	x	x	x	x	x	75	75	70	75	-	75	x	-
Mineral Turpentine*	a, b, e	See Solvents														
Mirabilite*	gl, w	Any	150	-	185	200	200	150	100	140	180	150	140	210	x	75
Molasses	w	Any	150	185	185	200	200	150	-	-	-	-	-	-	-	-
Molysite*	a, gl, w	Any	150	185	180	80	200	150	200	x	x	x	x	210	x	75
Monobromo Benzene		Any	x	-	x	x	x	x	-	-	-	-	-	100	-	-
Monobromotrifluoromethane**		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Monochloroacetic Acid*	a, e, w	10	x	x	150	x	x	x	200	-	70	-	-	-	-	-
Monochloro Benzene		Any	x	-	x	x	x	x	x	75	70	-	x	210	-	-
Monochlorodifluoromethane**		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Monochlorotrifluoromethane**		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Monoethanolamine	a, cl, ct, w	Any	80	80	140	80	80	-	210	150	150	75	-	210	200	75
Monomethylaniline	a, cl, e, w	100	x	-	75	x	x	-	-	-	-	-	-	-	-	-
Monomethylether		100	x	-	80	x	100	x	-	-	-	-	-	-	-	-
Monosodium Acid Methanearsenate		25	-	185	200	180	-	-	-	-	-	-	-	-	-	-
Monovinyl Acetate		100	x	-	-	x	x	-	-	-	-	-	-	-	-	-
Monsel's Salt*	w	Any	150	185	185	200	200	150	75	x	70	x	75	210	x	-
Morea Premic			150	-	150	-	-	-	-	-	-	-	-	-	-	-
Morrhua Oil	ae, a, cb, cl, e, pe	100	x	x	150	-	120	-	-	-	-	-	-	-	-	-
Motor Spirits		100	x	-	x	x	100	100	75	170	70	170	170	170	-	-
Muriatic Acid		See Hydrochloric Acid														
Mustard			x	-	-	-	-	-	-	-	-	-	-	-	-	-
Muthman's Liquid	a, e	100	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Myristic Acid*	a, e	See Solvents														
Naphtha		100	x	x	x	x	80	x	100	75	70	75	-	75	x	-
Naphthalene*	a, b, e	See Solvents														
Naphthenic Acid	hc, os, w	Any	x	-	x	-	80	-	-	130	200	130	-	210	-	-
Naphthylbenzene	a, b, e	100	x	x	x	x	x	150	170	170	170	170	170	170	-	-
Natural Gas**			x	x	x	100	120	x	-	170	170	170	170	170	-	-
Navee			-	-	-	-	70	-	-	-	-	170	-	-	-	-
Neatsfoot Oil	a, cl, e, k	100	x	-	80	x	150	-	-	-	-	-	-	-	-	-
Nickel Acetate*	a, w	Any	80	185	-	-	-	-	-	-	70	-	-	75	-	-
Nickel Chloride*	ho, w	Any	150	185	150	200	200	150	200	x	70	x	100	140	-	-
Nickel Nitrate*	a, w	Any	150	185	150	200	200	150	200	70	70	x	70	210	-	-
Nickel Salts*	a, w	Any	150	185	185	200	200	150	100	x	70	x	70	120	x	-
Nickel Sulfate*	a, w	Any	150	185	185	200	200	150	200	x	70	x	70	120	x	-
Nicotine Bentonite		Any	150	-	185	200	200	150	-	-	-	-	-	-	-	-
Nicotine Sulfate*	a, e, w	Any	150	-	185	200	200	150	-	-	70	70	-	75	-	-
Niter*	a, gl, w	Any	150	180	185	200	180	150	150	130	130	180	70	210	75	x
Niter Cake*	w	Any	150	185	185	200	160	150	100	x	150	x	70	200	x	75
Nitric Acid		10	x	-	100	80	x	150	125	x	200	70	x	400	x	x
		25	x	-	75	x	x	115	125	x	175	x	x	400	x	x
		40	x	-	x	x	x	100	80	x	140	x	x	400	x	x
Concentrated			x	-	x	x	x	x	x	x	70	70	x	210	x	-
Fuming			x	-	x	x	x	x	x	x	70	75	-	150	-	-
Nitrobenzene*	a, b, e, w	Any	x	-	80	x	x	x	75	170	150	150	70	210	-	-
Nitrocalcite*	a, ac, w	Any	150	185	185	200	200	150	100	100	130	70	x	100	x	75
Nitro Ethane	w	Any	80	-	80	x	x	80	-	75	75	75	-	75	-	-
Nitrogen**		100	150	185	185	200	200	-	-	-	-	-	-	-	-	-
Nitrogen Dioxide**	w	Any	See Nitric Acid													
Nitrogen Fertilizer Solution			150	185	150	150	150	150	-	-	-	-	-	-	-	-
Nitrogen Peroxide**	w	Any	See Nitric Acid													
Nitrogen Tetraoxide**			See Nitric Acid													

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chlorobutyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Nitrohydrochloric Acid		Conc.	x	x	x	x	x	x	-	x	x	x	-	75	-	-
Nitro Methane	w	Any	80	-	80	x	x	80	-	75	75	75	-	75	-	-
Nitromuriatic Acid			x	x	x	x	x	x	-	x	x	x	-	75	-	-
Nitropropane	w	Any	x	-	80	-	x	80	-	75	75	75	-	75	-	-
Nitroxanthic Acid*	a, b, cl, e, w	Any	80	-	80	120	100	x	75	x	70	x	x	210	x	-
Norge Niter*	a, ac, w	Any	150	185	185	200	200	150	100	100	130	70	x	100	x	75
Norway Saltpeter*	a, ho, w	Any	150	150	185	200	200	150	100	100	130	70	x	100	x	75
Norwegian Saltpeter*	a, ac, w	Any	150	185	185	200	200	150	100	100	130	70	x	100	x	75
NPN		100	-	-	120	-	-	120	-	-	-	-	-	-	-	-
Oakite Acid Materials (1)		See Solvents														
Oakite Alkaline Materials (1)		Any	150	185	185	200	150	150	100	75	75	-	-	x	-	x
Oakite OC 31 (1)			70	100	-	85	-	70	-	x	70	-	70	70	-	x
OC 32 (1)			70	100	-	85	-	70	-	x	x	-	x	70	-	x
OC 33 (1)			x	x	-	-	-	x	-	x	70	-	x	70	-	x
OC 34 (1)			x	x	-	x	-	x	-	x	70	-	70	x	-	x
OC 36 (1)			70	100	-	85	-	-	-	x	70	-	70	70	-	x
OC 84H (1)			70	100	-	85	-	-	-	x	x	-	x	70	-	70
OC 84M (1)			70	100	-	85	-	-	-	x	x	-	x	70	-	70
OC 85 (1)			x	x	-	x	-	-	-	x	70	-	70	70	-	x
OC 88 (1)			x	x	-	70	-	-	-	x	70	-	70	70	-	70
OC 131 (1)			70	100	-	85	-	-	-	x	70	-	70	70	-	x
O Chromicoat			x	-	-	x	-	-	-	x	70	-	-	x	-	x
Cryscoats 47, 87, 89, 89M			x	-	-	x	-	70	70	70	70	-	x	70	-	70
Cryscoat FH rinse			x	-	-	x	-	-	-	70	70	-	70	70	-	x
Cryscoat HC			x	-	-	x	-	-	-	x	70	-	x	70	-	x
Cryscoats LT & SW			x	-	-	x	-	-	-	x	70	-	x	x	-	x
O Drycid (1)			70	100	-	85	-	70	70	x	70	-	x	70	-	70
OFM 184 (1)			70	100	-	85	-	-	-	x	x	-	x	70	-	x
O Stripper SA			x	x	-	x	-	-	-	x	x	-	x	70	-	-
Oakite Solvent Materials			x	x	x	x	x	x	x	70	70	-	-	-	-	-
Octadecane	a, ac, e, ph	100	x	-	x	120	120	-	-	-	-	-	-	-	-	-
Octadecatrinoic Acid	os	100	x	80	150	x	80	80	200	-	70	70	-	-	-	-
Octadecenoic Acid	a, e, os	100	x	-	x	x	150	150	x	70	100	70	x	210	x	75
Octafluorocyclobutane		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
N-Octane	a, ac	100	x	-	x	120	150	-	-	-	-	-	-	-	-	-
Octyl Alcohol	a, cl, e	100	x	-	x	x	100	x	140	-	-	-	-	140	-	-
Oil of Bitter Almonds	a, e, w	Any	x	-	75	x	x	150	x	x	150	70	x	210	75	75
Oil of Mirbane*	a, b, e, w	Any	x	-	80	x	x	x	75	170	150	150	70	210	-	-
Oil of Vitriol		See Sulfuric Acid														
Oil, SAE		100	x	x	x	-	150	150	-	-	150	-	-	-	-	-
Oleic Acid	a, e, os	100	x	-	x	x	150	150	200	70	100	70	x	210	x	75
Olein	a, cl, ct, e	100	x	-	100	80	120	-	-	-	-	-	-	-	-	-
Oleum Spirits			x	-	x	x	x	x	x	70	70	-	75	400	x	70
Olive Oil	a, cb, cl, e	100	x	-	100	80	120	-	-	-	-	-	-	-	-	-
Orthoboric Acid*	w	Any	150	185	185	200	200	150	150	x	200	100	130	300	x	75
Ortho-dichlorobenzene		100	x	-	x	x	x	x	75	75	-	x	-	75	-	-
Ortho-hydroxybenzoic Acid*	a, ac, b, e, cu, w	Any	80	-	80	x	x	x	75	x	100	70	100	210	x	75
Oxalic Acid*	a, e, w	10	150	150	185	200	150	130	200	x	70	70	x	210	75	75
Oxygen**		100	x	-	100	100	100	100	-	-	-	-	-	-	-	-
Oxymethelene**	a, e, w	40	80	x	150	80	80	150	100	x	100	150	70	210	x	-
Ozone**			x	-	80	80	x	100	-	-	-	-	-	-	-	-
Painter's Naphtha		100	x	x	x	x	x	x	75	75	70	75	-	75	x	-
Palm Oil	a, cb, cl, e	100	x	-	x	x	150	-	-	-	-	-	-	-	-	-
Palmitic Acid*	a, e	See Solvents														
Palmitinic Acid*	a, e	See Solvents														
Palmitin*	cl, e	See Solvents														
Paper Alum*	w	Any	150	185	185	200	200	150	100	x	180	x	100	200	x	75
Paradihydroxybenzene*	a, e, w	Any	80	-	x	x	x	120	120	70	70	70	70	125	x	75
Paraform*	ho, w	Any	x	-	x	x	x	-	75	70	70	70	-	75	75	75
Paraformaldehyde*	ho, w	Any	x	-	x	x	x	-	75	70	70	70	-	75	75	75
Patent Alum*	w	Any	150	185	185	200	200	150	100	x	180	x	100	200	x	75
Peanut Oil	cb, cl, e, pe	100	x	x	x	x	150	-	-	-	-	-	-	-	-	-
Pear Alum*	w	Any	150	185	185	200	200	150	100	x	180	x	100	200	x	75
Pearl Ash*	w	Any	150	185	180	200	180	150	150	100	180	x	x	180	75	75
Pear Oil	a, e	100	x	-	x	x	x	x	75	75	70	70	-	210	-	75
Pentachlorodiphenyl			x	x	x	x	x	x	75	75	-	75	-	75	-	-
Pentachlorodiphenyl Ketone			x	x	x	x	x	x	75	75	-	75	-	75	-	-
Pentachlorodiphenyl Oxide			x	x	x	x	x	x	75	75	-	75	-	75	-	-
Pentachloroethylbenzene			x	x	x	x	x	x	75	75	-	75	-	75	-	-
Pentachlorophenylbenzoate			x	x	x	x	x	x	75	75	-	75	-	75	-	-
Pentamethylene Amine	a, e, w	Any	x	-	-	x	x	-	-	-	-	-	-	-	-	-
Pentasodium Triphosphate*	w	Any	x	-	-	x	x	-	-	-	-	-	-	-	-	-
Perchlorethylene	a, e, o, w	Any	x	-	x	x	x	x	-	120	120	100	70	75	-	-
Perchloric Acid	w	10	150	-	150	x	x	150	100	x	x	x	-	210	x	x
Perchloromethane	a, b, cl, e, n, o, w	Any	x	x	x	x	x	150	200	75	70	70	100	210	75	75

(1) Light-colored compounds recommended, but they may cause some cloudiness in the bleach.

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Permanent White*	Con. H_2SO_4	See Solvents														
Peroxide	a, w	10	80	x	x	x	80	100	120	x	100	100	x	210	-	-
		30	x	x	x	x	x	80	120	x	100	100	x	210	-	-
Peroxydol*	gl, w	Any	150	-	185	200	200	150	-	70	70	x	x	140	-	-
Peroxyhydrate	gl, w	Any	150	-	185	200	200	150	-	70	70	x	x	140	-	-
Petrol		100	x	-	x	x	100	100	75	170	70	170	170	170	-	-
Petroleum Oil			x	x	x	100	180	150	-	-	-	-	-	-	-	-
Petroleum Spirits		100	x	x	x	x	x	x	75	75	70	75	-	75	x	-
Petroleum Thinner		100	x	x	x	x	x	x	75	75	70	75	-	75	x	-
Phenetole		Any	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Phenol	a, cl, gl, ho	Any	x	-	100	x	x	x	200	110	200	175	70	210	x	-
Phenol Polysiloxane	o, w, cb, e	100	x	-	x	x	180	-	-	-	-	-	-	-	-	-
Phenol Trinitrate*	a, b, cl, e, w	Any	x	-	-	x	x	x	75	x	70	x	x	210	x	-
Phenylamine	a, b, e	100	x	x	75	x	x	150	x	70	70	100	75	210	75	75
Phenylbenzene		Any	x	-	x	x	x	x	-	-	-	-	-	-	-	-
Phenylcarbinol	a, cl, e, w	Any	x	-	185	x	x	-	-	75	100	100	100	210	x	75
Phenyl Chloride	os	100	x	x	x	x	x	x	175	150	150	150	150	210	75	-
Phenylethane	a, b, ct, e, w	Any	x	-	x	x	x	x	140	75	150	150	150	210	75	75
Phenyl Ether*	a, e	See Solvents														
Phenyl Ethyl Ether		Any	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Phenylformic Acid		Any	150	-	-	150	-	-	75	x	150	150	x	210	x	75
Phenyl Hydrazine		Any	80	-	x	x	x	x	-	-	-	-	-	-	-	-
Phenylic Acid*	a, cb., cl, e, gl, ho, o, w	Any	x	-	100	x	x	x	x	110	200	175	70	210	x	-
Phenylmethane	a, b, e	100	x	x	x	x	x	150	170	170	170	170	170	170	-	-
Phenyl Methyl Ketone	os, w	Any	x	-	80	x	x	x	-	200	350	150	150	175	-	75
Phenylsulfonic Acid*	a, w	10	-	-	70	-	-	140	-	x	120	x	70	210	-	-
Phorone		100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Phosphate Esters		Any	x	-	120	x	x	-	-	-	-	-	-	-	-	-
Phosphoric Acid		50	150	185	185	180	80	150	200	x	130	x	200	300	x	75
		85	150	-	185	150	x	140	200	x	-	x	70	210	x	75
		106	x	-	120	-	-	-	200	x	-	x	70	400	x	75
Phospholeum		106	x	x	120	x	-	-	200	x	-	x	70	400	x	75
Phosphoric Anydride*	w	See Phosphoric Acid														
Pickle Alum*	w	Any	150	185	185	200	200	150	100	x	180	x	100	200	x	75
Picric Acid*	a, b., cl, e, w	Any	80	-	80	120	100	x	75	x	70	x	x	210	x	-
Picronitric Acid*	ab, cl, e, w	Any	x	-	-	x	x	x	75	x	70	x	x	210	x	-
Pimelic Ketone	os	100	x	-	x	x	x	x	75	x	70	70	70	75	-	-
Pinene		100	x	-	-	x	75	-	-	-	-	-	-	-	-	-
Pine Oil (150, 220, 230, & NFXI)			x	-	-	x	150	-	-	-	150	-	-	-	-	-
Piperidine	a, e, w	Any	x	-	-	-	x	-	-	-	-	-	-	-	-	-
Plating Solutions																
Antimony			130	180	185	-	-	-	-	-	-	-	-	-	-	-
Arsenic			100	-	-	-	-	-	-	-	-	-	-	-	-	-
Brass			100	-	185	-	-	150	-	-	-	-	-	-	-	-
Cadmium			150	-	150	150	150	150	-	-	-	-	-	-	-	-
Chrome			x	-	x	x	x	120	-	-	-	-	-	-	-	-
Cobalt			150	-	150	150	150	150	-	-	-	-	-	-	-	-
Copper			100	-	180	-	-	140	-	-	-	-	-	-	-	-
Gold			100	x	180	-	-	150	-	-	-	-	-	-	-	-
Iron			100	-	-	-	180	150	-	-	-	-	-	-	-	-
Lead			150	-	150	150	150	150	-	-	-	-	-	-	-	-
Nickel			100	-	-	-	-	150	-	-	-	-	-	-	-	-
Platinum			-	-	-	200	-	-	-	-	-	-	-	-	-	-
Silver			100	-	150	-	-	150	-	-	-	-	-	-	-	-
Tin			-	150	150	-	-	150	-	-	-	-	-	-	-	-
Zinc			100	-	150	-	-	150	-	-	-	-	-	-	-	-
Zinc on Aluminum			-	-	-	-	-	150	-	-	-	-	-	-	-	-
Polyformaldehyde*	ho, w	Any	x	-	x	x	x	-	75	70	70	70	-	75	75	75
Polyoxymethylene*	ho, w	Any	x	-	x	x	x	-	75	70	70	70	-	75	75	75
Potash*	w	Any	150	185	180	200	180	150	150	100	180	x	x	180	75	75
Potash Alum*	w	Any	150	185	185	200	180	150	200	x	150	70	100	200	180	75
Potassa*	a, e, gl, w	Any	150	185	185	200	150	150	100	75	130	x	x	x	75	75
Potassium Acetate*	a, w	Any	120	175	150	-	120	150	75	75	100	x	-	180	75	75
Potassium Alum*	w	Any	150	185	185	200	180	150	200	x	150	70	100	200	180	75
Potassium Carbonate*	w	Any	150	185	180	200	180	150	150	100	180	x	x	180	75	75
Potassium Chloride*	a, w	Any	150	185	185	150	150	150	200	70	150	70	70	210	x	70
Potassium Cupro Cyanide*	w	Any	150	-	150	-	-	150	-	100	70	x	x	75	-	-
Potassium Cyanide*	a, gl, w	Any	150	-	150	150	150	150	120	70	100	x	x	100	75	75
Potassium Di (Bi) Chromate*	w	Any	x	x	150	120	150	150	200	130	150	140	130	180	x	x
Potassium Hydrate*	a, e, gl, w	Any	150	185	185	200	150	150	100	75	130	x	x	x	75	75
Potassium Hydroxide	a, e, gl, w	Any	150	185	185	200	150	150	100	75	130	x	x	x	75	75
Potassium Muriate*	a, w	Any	150	185	185	150	150	150	75	70	150	70	70	210	x	70
Potassium Nitrate*	a, gl, w	Any	150	180	185	200	180	150	200	130	130	180	70	210	75	x

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Potassium Oxide	w	Any	150	185	185	200	150	150	100	75	130	x	x	x	75	75
Potassium Permanganate*	w	Any	x	185	130	x	150	150	200	75	100	100	x	130	75	x
Potassium Sulfate*	w	Any	150	185	185	200	180	150	200	70	100	100	70	130	75	75
Potassium Sulfite*	a, w	Any	150	185	180	150	150	140	-	-	100	-	-	120	-	-
Potato Oil	a, e, w	Any	150	-	180	180	180	150	-	70	70	75	-	140	-	-
Potato Spirit	a, e, w	Any	150	-	180	180	180	150	-	70	70	75	-	140	-	-
Producer Gas**		100	x	x	x	120	200	-	-	-	-	-	-	-	-	-
Propane**			x	-	x	100	120	x	-	75	75	75	75	75	-	-
Propanol	a, e, w	Any	120	-	120	120	120	120	-	75	70	70	75	210	-	-
Propanone	a, cl, e, o, w	Any	x	x	150	x	x	x	100	400	180	180	210	210	75	75
Propene**			x	-	x	x	x	-	-	75	75	75	75	75	-	-
Propenenitrile	os, w	Any	80	80	x	x	x	-	-	-	-	-	-	-	-	-
Propyl Acetate	a, hc, k, o	100	x	-	80	x	x	-	-	-	-	-	-	75	-	-
Propylacetone	a, e, w	Any	x	-	150	x	x	x	-	-	-	150	-	-	-	-
Propyl Alcohol	a, e, w	Any	120	-	120	120	120	120	-	-	-	70	-	75	-	-
Propylene**			x	-	x	x	x	-	-	75	75	75	75	75	-	-
Propylformic Acid	a, e, w	Any	x	x	x	x	-	-	75	x	200	70	x	210	x	x
Propyl Nitrate		100	-	-	120	-	-	120	-	-	-	-	-	-	-	-
Protochloride*	a, w	Any	150	-	185	80	-	-	-	-	-	-	-	-	-	-
Prussic Acid	a, e, w	Any	80	-	150	x	x	150	120	75	70	75	70	210	-	75
Purple Salt*	w	Any	x	185	130	x	150	150	-	75	100	100	x	130	75	x
Pyridine	a, b, e, w	Any	x	-	100	x	x	-	x	125	100	100	100	210	75	75
Pyroacetic Ether	a, cl, e, o, w	Any	x	x	150	x	x	x	100	400	180	180	210	210	75	75
Pyroligneous Acid	a, w	Any	x	-	100	x	x	-	75	x	70	70	-	140	-	-
Pyromucic Aldehyde	a, b, e	100	x	-	185	x	x	x	x	100	140	100	100	210	75	-
Pyrrole	a, e, h	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Quinol*	a, e, w	Any	80	-	x	x	x	120	120	70	70	70	70	125	x	75
Rapeseed Oil	a, cb, cl	100	x	x	185	120	150	-	-	-	-	-	-	-	-	-
Raw Linseed Oil	a, cb, cl, e, pe	100	x	-	150	180	180	130	75	75	70	70	-	200	-	-
Red Oil	a, e, os	100	x	-	x	x	150	150	x	70	100	70	x	210	x	75
Red Potassium Chromate*	w	Any	x	x	150	x	150	150	75	130	150	140	130	180	x	x
Refined Linseed Oil	a, cb, cl, e, tu, pe	100	x	-	150	180	180	130	75	75	70	70	-	200	-	-
Ricinus Oil	a, b, cb, cl, e	100	80	-	150	120	150	-	-	110	170	200	170	170	-	-
Rock Salt*	a, gl, w	Any	150	185	185	200	160	150	75	75	70	x	100	120	75	75
Saccharose Solutions		Any	120	-	120	120	120	-	-	-	150	70	130	150	75	75
Saccharum Solutions		Any	120	-	120	120	120	-	-	-	150	70	130	150	75	75
Salammoniac*	a, w, gl	Any	150	185	185	200	200	150	200	x	100	x	x	210	x	75
Sal Chalybis*	w	Any	150	-	185	200	200	150	75	x	70	75	-	210	x	75
Salicylic Acid*	a, ac, b, e, tu, w	Any	80	-	80	x	x	x	75	x	100	70	100	210	x	75
Sal Soda*	w	Any	150	185	185	200	200	-	70	120	100	x	x	140	75	75
Salt Cake*	gl, w	Any	150	-	185	200	200	150	100	140	180	150	140	210	x	75
Salt of Lemery*	w	Any	150	185	185	200	180	150	75	70	100	100	75	130	75	75
Salt of Tartar*	w	Any	150	185	180	200	180	150	150	100	180	x	x	180	75	75
Saltpeter*	a, gl, w	Any	150	180	185	200	180	150	150	130	130	180	70	210	75	x
Salt Water			150	185	185	200	180	150	75	75	70	x	100	130	75	75
Sand Acid	w	50	80	185	x	80	80	150	75	x	70	x	70	x	-	-
Sea Salt*	a, gl, w	Any	150	185	185	200	180	150	75	75	70	x	100	130	75	75
Seed Oil	a, b, cb, cl,e	100	x	x	100	150	150	140	-	170	170	170	170	170	-	-
Separan NP-10	a, ac, w		150	-	-	-	-	-	-	-	-	-	-	-	-	-
Sewage			x	-	150	180	180	150	200	x	70	110	-	-	-	-
Silicate Esters		Any	x	-	150	x	180	-	-	-	-	-	-	-	-	-
Silicofluoric Acid	w	50	80	185	x	80	80	150	75	x	70	x	70	x	-	-
Silicone Grease		100	80	-	100	120	180	-	-	-	-	-	-	-	-	-
Silicone Oils		100	80	-	100	120	180	-	-	-	-	-	-	-	-	-
Silver Nitrate*	a, e, gl, w	Any	150	-	150	200	180	150	200	x	130	x	x	210	-	-
Skydrol		100	x	-	130	x	x	-	-	-	-	-	-	-	-	-
Slaked Lime*	gl, h, w	Any	150	185	185	200	200	150	100	100	200	[illegible]	x	x	75	75
Soap Solutions			150	185	150	180	180	-	-	170	70	70	170	170	-	-
Soda*	w	Any	150	185	185	200	200	-	70	120	100	x	x	140	75	75
Soda Alum*	w	Any	150	-	185	200	200	150	100	x	200	x	75	75	-	-
Soda Ash	w	Any	150	185	185	200	200	-	70	120	100	x	x	140	75	75
Soda Niter*	a, gl, w	Any	150	180	185	200	150	150	100	130	170	75	x	210	75	75
Soda Saltpeter*	a, gl, w	Any	150	180	185	200	150	150	100	130	170	75	x	210	75	75
Sodium Acetate*	a, e, w	Any	150	185	185	120	150	-	-	-	-	-	-	-	-	-
Sodium Acid Carbonate*	w	Any	150	185	185	200	200	150	75	100	150	x	-	150	-	-
Sodium Acid Sulfate*	w	Any	150	185	185	200	160	150	75	100	150	x	-	150	-	-
Sodium Acid Sulfite*	w	Any	150	185	185	200	160	150	75	x	100	x	70	x	x	75
Sodium Alumino Silicate*		See Solvents														
Sodium Aluminum Fluoride*	al, fe	See Solvents														
Sodium Aluminum Sulfate*	w	Any	150	-	185	200	200	150	100	x	200	x	75	75	-	-

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Sodium Bicarbonate*	w	Any	150	185	185	200	200	150	75	100	150	x	-	150	-	-
Sodium Bisulfate*	w	Any	150	185	185	200	160	150	200	100	150	x	-	150	-	-
Sodium Bisulfite*	w	Any	150	185	185	200	160	150	75	x	100	x	70	x	x	75
Sodium Borate*	w	Any	150	-	185	200	180	150	-	-	150	-	-	75	-	-
Sodium Carbonate*	w	Any	150	185	185	200	200	-	100	120	100	x	x	140	75	75
Sodium Chloride*	a, gl, w	Any	150	185	185	200	160	150	200	75	70	x	100	130	75	75
Sodium Cyanide*	a, w	Any	150	185	150	150	160	150	200	100	100	x	x	210	75	70
Sodium Dioxide*	w	Any	150	-	185	200	200	120	180	75	100	100	x	140	-	-
Sodium Disulfite*		Any	100	150	150	160	160	100	-	-	70	-	70	210	-	-
Sodium Fluoaluminate*	al, fe	See Solvents														
Sodium Hexametaphosphate*	w	Any	150	150	185	150	150	150	170	-	180	100	-	-	-	-
Sodium Hydrate	a, gl, w	Any	150	185	185	200	150	150	100	75	130	x	x	x	75	75
Sodium Hydroxide	a, gl, w	Any	150	185	185	200	150	150	100	75	130	x	x	x	75	75
Sodium Hypochlorite*(1)	w	5	x	120(2)	120	x	x	120	75	x	x	x	x	150	75	-
	w	20	x	120	80	x	x	120	175	x	x	x	x	150	75	-
Sodium Hyposulfite*	t, w	Any	150	185	185	200	200	150	-	x	70	-	70	210	-	-
Sodium Metaborate Peroxy-hydrate*	gl, w	Any	150	-	185	200	200	150	-	100	100	x	x	140	-	-
Sodium Metaphosphate		Any	150	185	185	200	200	150	-	x	70	x	-	210	-	-
Sodium Nitrate*	a, gl, w	Any	150	180	185	200	150	150	200	130	170	75	x	210	75	75
Sodium Perborate*	gl, w	Any	150	-	185	200	200	150	-	100	100	x	x	140	-	-
Sodium Peroxide*	w	Any	150	-	185	200	200	120	-	75	100	100	x	140	-	-
Sodium Phosphate*	a, w	Any	150	185	185	200	200	150	-	150	150	x	150	210	-	-
Sodium Pyroborate*	gl, w	Any	150	-	185	200	180	150	-	-	150	-	-	75	-	-
Sodium Sesquicarbonate*	w	Any	150	185	185	200	200	-	70	120	100	x	x	140	75	75
Sodium Silicate Sulfate		Any	150	-	185	200	200	-	200	170	170	x	x	-	-	-
Sodium Stannic Chloride	a, cb, t, w	Any	150	-	150	x	150	150	75	x	x	x	x	210	-	-
Sodium Sulfate*	gl, w	Any	150	-	150	200	200	150	200	140	180	150	140	210	x	75
Sodium Sulfate Decahydrate*	gl, w	Any	150	-	185	200	200	150	100	140	180	150	140	210	x	75
Sodium Subsulfite*	t, w	Any	150	185	185	200	200	150	-	x	70	-	70	210	-	-
Sodium Sulfite*	a, w	Any	150	185	185	200	200	150	100	70	150	70	70	x	75	75
Sodium Superoxide*	w	Any	150	-	185	200	200	120	-	75	100	100	x	140	-	-
Sodium Tetraborate*	w, gl	Any	150	-	185	200	180	150	-	-	150	-	-	75	-	-
Sodium Thiosulfate*	t, w	Any	150	185	185	200	200	150	-	x	70	-	70	210	-	-
Sodium Triphosphate*	w	Any	150	185	185	200	200	-	-	100	120	x	x	210	-	-
Sodium Tripolyphosphate*	w	Any	150	185	185	200	200	-	-	100	120	x	x	210	-	-
Soya Oil	a, cb, cl, e	100	x	-	x	80	120	-	-	110	170	170	-	-	-	-
Soybean Oil	a, cb, cl, e	100	x	-	120	80	120	-	-	110	170	170	-	-	-	-
Spirits of Turpentine	a, aa, cl, e	100	x	x	x	x	150	x	75	70	70	70	70	210	x	75
Spirits of Wine	a, cl, e	100	150	-	120	150	150	150	170	-	180	100	-	-	-	-
Stannic Chloride	a, cb, t, w,	Any	150	-	150	x	150	150	200	x	x	x	x	210	-	-
Stannous Chloride*	a, ho, ta, w	Any	150	-	150	x	150	150	200	x	150	x	x	210	-	-
Starch Syrup	a, gl, w	Any	120	-	185	120	120	150	-	170	170	170	170	170	-	-
Stearic Acid*	a, cb, cl, ct, e, w	Any	x	-	75	80	200	150	75	120	150	150	x	450	x	75
Stoddard's Solvent		100	x	-	x	x	80	x	-	-	-	-	-	-	-	-
STPP*	w	Any	x	-	-	x	x	-	-	-	-	-	-	-	-	-
Stripper SA			x	x	-	x	-	-	-	x	x	-	x	70	-	x
Styrene	a, e		x	-	x	x	x	x	-	-	70	75	-	75	-	-
Sublimed White Lead*	h, w	Any	120	-	185	180	120	120	75	x	150	x	150	180	75	75
Sucrose Solution		Any	120	-	120	120	120	-	-	-	150	70	130	150	75	75
Sugar of Lead*	a, gl, h, w	Any	80	-	120	80	80	120	75	x	100	x	x	200	x	75
Sulfite Liquors		Any	120	-	120	120	120	-	-	x	100	x	100	170	x	x
Sulfamic Acid		Any	150	-	150	150	-	-	-	-	-	-	-	-	-	-
Sulfur*	a, b, cb, ct, e	See Solvents														
Sulfurated Lime*	h, w	Any	150	185	185	150	200	150	75	100	100	70	-	75	-	75
Sulfur Chloride	a, b, cb, e		x	-	x	x	x	-	100	x	x	x	70	150	-	x
Sulfur Dioxide**	a, e, w	Any	x	150	185	x	x	-	75	x	170	x	150	150	x	75
Sulfuretted Hydrogen**	a, w	Any	x	x	150	x	x	140	75	70	100	70	70	75	75	75
Sulfur Hexafluoride**	a, e, w	Any	x	-	80	x	x	-	-	75	-	-	-	-	-	-
Sulfur Monochloride	a, b, cb, e		x	-	x	x	x	-	100	x	x	x	70	150	-	x
Sulfur Subchloride	a, b, cb, e		x	-	x	x	x	-	100	x	x	x	70	150	-	x
Sulfuric Acid		10	150	185	185	180	150	150	170	x	70	x	200	400	x	70
		30	150	185	185	170	100	150	170	x	x	x	200	400	x	70
		50	80	150	150	80	80	150	170	x	x	x	200	400	x	70
		75	x	x	100	x	x	80	x	70	70	x	170	400	x	70
		95	x	x	x	x	x	x	x	70	70	x	75	400	x	70
Sulfuric Ether	a, b, cl, o, n, w	Any	x	x	x	x	120	x	x	70	70	70	70	150	75	75
Sulfurous Acid		10	x	150	150	x	x	130	75	x	70	70	70	210	x	-
		75	x	-	100	x	x	x	75	x	70	70	70	210	x	-
Sulfurous Acid Anhydride**	a, e, w	Any	x	150	x	x	x	-	75	x	170	x	150	150	x	75
Sulfurous Oxychloride			x	-	x	x	x	x	-	x	-	x	120	210	x	-

(1)Light colored compounds recommended, but they may cause some cloudiness in the bleach.
(2)Use 26666 compound for storage and Hard Rubber for manufacturing processes of Sodium Hypochlorite.

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Sulfur Trioxide*		100	-	-	-	x	x	-	-	-	-	-	-	-	-	-
Superphosphoric Acid		106	-	-	160	-	-	-	200	x	-	x	70	400	x	75
Sweet Oil	a, cb, cl, e	100	x	-	100	80	120	-	-	-	-	-	-	-	-	-
Sweet Birch Oil	aa, e, w	Any	x	-	80	-	x	x	75	75	-	75	-	75	-	-
Table Salt*	a, w, gl	Any	150	185	185	150	160	150	75	75	70	x	100	130	75	75
Tallol			x	-	x	x	150	150	200	100	400	x	-	600	-	-
Tall Oil			x	-	x	x	150	150	200	100	400	x	-	600	-	-
Tannic Acid*	a, ac, w	Any	100	150	185	100	x	150	75	x	180	x	x	210	x	70
Tannin*	a, ac, w	Any	100	150	185	x	x	150	75	x	180	x	x	210	x	70
Tanning Solutions			100	150	150	160	160	100	-	-	70	-	70	210	-	-
Tar, Bituminous*	b, cb	See Solvents														
Tar Camphor*	a, b, e	See Solvents														
Tartaric Acid*	a, e, w	Any	150	185	185	100	150	150	75	x	150	70	x	175	75	70
TCA*	a, e, w	Any	x	-	x	x	x	x	-	x	x	x	x	210	-	-
TCP	os	100	80	-	185	x	x	x	-	75	150	x	-	75	-	-
TEA	a, cl, w	100	80	-	150	x	120	80	75	75	75	70	-	210	75	-
Terra Alba*	gl, ho	See Solvents														
Terra Ponderosa*	Con. H_2SO_4	See Solvents														
Terpineol	a, gl, mo, w	Any	x	-	x	x	x	-	-	-	-	75	-	75	-	-
Tertiary Butyl Alcohol*	a, e, w	Any	75	-	75	100	120	-	-	-	-	-	-	-	-	-
Tertiary Butyl Catechol		Any	x	-	80	80	x	x	-	-	-	-	-	-	-	-
Tertiary Butyl Mercaptan		Any	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Tetrabromoethane	a, e	100	-	-	x	x	x	x	-	-	-	-	-	-	-	-
Tetrabromomethane*	a, cl, e, w	Any	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Tetrabutyl Titanate	os	100	75	-	75	100	120	-	-	-	-	-	-	-	-	-
Tetrachloridifluoroethane		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Tetrachlorodifluoromethane		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Tetrachloroethane	a, e	100	-	-	x	x	x	x	75	75	-	x	75	75	-	-
Tetrachloroethylene	a, e, o	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Tetrachloromethane	a, b, cl, e, n, o, w	100	x	x	x	x	x	150	200	75	70	70	100	210	75	75
Tetradeconoic Acid*	a, e	See Solvents														
Tetra Ethyl Lead	os		x	-	x	-	120	80	-	-	-	-	-	-	-	-
Tetraethyl Orthosilcate	a	100	x	-	180	180	180	150	-	75	-	-	-	210	-	-
Tetrafluoromethane		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Tetrahydrofuran	os, w	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Tetrahydronaphthalene	os	100	x	-	x	x	x	-	-	-	-	75	-	75	-	-
Tetralin	os	100	x	-	x	x	x	-	-	-	-	75	-	75	-	-
Trimethyl Pentane		100	x	-	x	80	120	-	-	-	-	-	-	-	-	-
Tetrol	a, e	100	x	-	x	x	x	-	-	-	-	-	-	-	-	-
Thenardite*	gl, w	Any	150	-	185	200	200	150	100	140	180	150	140	210	x	75
Thionyl Chloride			x	-	x	x	x	x	-	x	-	x	120	210	x	-
Tincal*	w	Any	150	-	185	200	180	150	-	-	150	-	-	75	-	-
Tin Chloride	a, cb, t, w	Any	150	-	150	x	150	150	75	x	x	x	x	210	-	-
Tin Crystals*	a, ho, ta, w	Any	150	-	150	x	150	150	120	x	150	x	x	210	-	-
Tin Dichloride*	a, ho, ta, w	Any	150	-	150	x	150	150	120	x	150	x	x	210	-	-
Tin Protochloride*	a, ho, ta, w	Any	150	-	150	x	150	150	120	x	150	x	x	210	-	-
Tin Salt*	a, ho, ta, w	Any	150	-	150	x	150	150	120	x	150	x	x	210	-	-
Tin Tetrachloride	a, cb, t, w	Any	150	-	150	x	150	150	75	x	x	x	x	210	-	-
Titanium Tetrachloride	HCl, w	100	x	x	x	x	100	-	-	-	-	-	-	-	-	-
Toluene	a, b, e	100	x	x	x	x	x	70	150	150	150	150	150	150	-	-
Transformer Oil		100	x	x	x	120	150	x	75	75	-	75	-	75	-	-
Transmission Fluid		100	x	x	x	100	100	x	-	-	-	-	-	-	-	-
Travertine*	h	See Solvents														
Triacetin	a, e, os, w	Any	x	-	80	80	80	x	-	-	-	70	-	75	-	-
Tributoxy Ethyl Phosphate	os	100	80	-	120	x	x	x	-	-	-	-	-	-	-	-
Tributyl Phosphate		100	75	-	75	x	x	x	-	75	-	-	-	130	-	-
Trichloroacetic Acid*	a, e, w	Any	x	-	x	x	x	x	-	x	x	x	x	210	-	-
Trichlorobenzene	a, e, es, os, o		x	x	x	x	x	x	75	85	-	75	-	75	-	-
Trichloroethane	a, e, es, os, o		x	-	x	x	x	x	-	75	-	-	-	75	-	-
Trichloroethylene	a, e, es, os, o		x	x	x	x	x	x	75	x	100	120	x	210	-	-
Trichloromethane	a, b, e, n, o, w	Any	x	x	x	x	x	x	x	x	130	130	130	210	75	75
Trichloromonofluoromethane		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Trichlorotrifluoroethane		100	x	-	x	x	x	x	-	x	75	70	100	75	-	-
Tricresyl Phosphate	os	100	80	-	185	x	x	x	-	75	150	x	-	75	-	-
Triethanol Amine	a, cl, w	Any	80	-	150	120	120	80	75	75	75	70	-	210	75	-
Triethyl Aluminum	hc	100	x	-	-	x	x	-	-	-	-	-	-	-	-	-
Triethyl Borane	os	100	x	-	-	x	x	-	-	-	-	-	-	-	-	-
Trifluorovinyl Chloride	a, b, ke		x	-	x	-	x	x	-	-	-	-	-	-	-	-
Trihydroxybenzoic Acid*	a, e, gl, w	Any	150	-	150	x	x	150	-	-	180	-	-	-	-	-
Trihydroxyethyl Amine	a, cl, w	Any	80	-	150	x	120	80	75	75	75	70	-	210	75	-

(continued)

TABLE 7.4: RUBBER, RESIN, STEEL, ALUMINUM, LEAD, GLASS, CONCRETE AND WOOD LINING MATERIALS—GATES RUBBER (continued)

CHEMICAL RESISTANCE FOR LINING MATERIALS	Solvents	Concentration	Soft Natural Rubber	Hard Natural Rubber	Chloro-butyl	Neoprene	Nitrile	PVC	Fiberglass Resins	Mild Steel	316 Stainless	Aluminum	Lead	Glass	Concrete	Wood
Trinitrophenol*	a, b, cl, e, w	Any	x	-	-	x	x	x	75	x	70	x	x	210	x	-
Trinitrotoluene	a, e		x	x	x	100	x	-	-	-	-	-	-	-	-	-
Trioctyl Phosphate	a, ac, e	100	x	x	100	x	x	-	-	-	-	-	-	-	-	-
Triolein	a, cl, e, ct	100	x	-	100	80	120	-	-	-	-	-	-	-	-	-
Tripalmitin*	cl, e	See Solvents														
Tripolyphosphate*	w	Any	x	-	-	x	x	-	-	-	-	-	-	-	-	-
Trisodium Phosphate		Any	150	185	185	200	200	150	-	100	120	x	x	210	-	-
Tritolylphosphate	os	100	80	-	185	x	x	x	-	75	150	x	-	75	-	-
Tung Oil	e, cb, cl, o	100	x	-	x	120	120	-	-	110	150	170	-	-	-	-
Turpentine	a, aa, cl, e	100	x	x	x	x	150	x	75	70	70	70	70	210	x	75
Turpentine Substitute		100	x	x	x	x	x	x	75	75	70	75	-	75	x	-
Turps	a, aa, cl, e	100	x	x	x	x	150	x	75	70	70	70	70	210	x	75
Urea*	a, b, e, w	Any	150	185	150	150	150	150	100	70	180	180	-	200	-	-
Varnish		100	x	x	x	x	150	-	-	-	-	-	-	-	-	-
Vegetable Oils			x	x	100	x	150	-	-	170	170	170	170	170	-	-
Versilube, F44 & F50		100	80	-	100	120	150	-	-	-	-	-	-	-	-	-
Vinegar	a, e, gl, w	8	150	150	150	150	x	x	200	75	180	180	x	400	x	75
Vinegar Naphtha	a, cl, e, w	Any	x	-	100	x	x	x	75	75	100	130	70	210	x	75
Vinegar Salts*	a, w	Any	80	-	180	x	120	-	130	70	130	70	70	150	-	75
Vinyl Chloride**	a, e	Any	x	x	x	x	x	-	-	-	-	-	-	-	-	-
Vinyl Cyanide	os, w	Any	80	80	x	x	x	-	-	-	-	-	-	-	-	-
Vinyl Trichloride	a, e, ke, es	100	x	-	x	x	x	x	-	75	-	-	-	75	-	-
VM & P Naphtha		100	x	x	x	x	x	x	75	75	70	75	-	75	x	-
Water		Any	150	185	185	200	150	150	-	70	75	75	75	75	75	75
Waterproofing Salt	w	Any	150	185	120	120	120	-	75	x	150	75	75	210	x	75
Whiskey		100	150	-	150	150	150	150	-	70	x	-	-	-	-	-
White Caustic*	a, gl, w	Any	150	185	185	200	150	150	100	75	130	x	x	x	75	75
White Copperas*	gl, w	Any	150	185	150	150	150	150	100	x	200	x	170	210	x	75
White Lead Sulfate*	h, w	Any	120	-	185	180	120	120	75	x	150	x	150	180	75	75
White Vitriol*	gl, w	Any	150	185	150	150	150	150	100	x	200	x	170	210	x	75
Whiting*	h	See Solvents														
Wine		100	150	-	150	150	150	150	-	x	70	x	-	-	-	-
Wintergreen Oil	e, aa, w	Any	x	-	80	-	x	x	75	75	-	75	-	75	-	-
Wood Alcohol	a, e, w	Any	100	-	185	100	150	120	100	150	150	90	150	210	75	75
Wood Oil	e, cb, cl, o	100	x	-	x	120	120	-	-	110	150	170	-	-	-	-
Wood Tar	a, e, o	100	x	-	x	x	x	-	-	75	150	70	x	210	x	75
Wood Vinegar	a, w	Any	-	-	100	x	x	-	75	x	70	70	-	140	-	-
Xylene	a, e	100	x	x	x	x	x	70	x	150	150	75	-	75	x	-
Xylidine	a, e	100	x	-	100	x	x	x	-	-	-	-	-	100	-	-
Zeolite*	w	Any	80	-	100	120	150	-	-	-	-	-	-	-	-	-
Zinc Acetate*	a, w	Any	150	-	150	x	x	150	-	-	-	-	-	-	-	-
Zinc Chloride*	a, e, gl, w	Any	150	185	185	150	150	150	100	x	100	x	75	210	x	x
Zinc Sulfate*	gl, w	Any	150	185	150	150	150	150	100	x	200	x	170	210	x	75
Zinc Vitriol	gl, w	Any	150	185	150	150	150	150	100	x	200	x	170	210	x	75

TABLE 7.5: IRON, BRONZE, STEEL, SYNTHETIC RESIN AND RUBBER PUMP MATERIALS—ITT JABSCO

Chemical Resistance Table*

KEY TO SYMBOLS:

A Satisfactory.
C May be suitable dependent on concentration and temperature. Contact factory for Engineering Assistance.
N Not recommended.
□ Blank: Information lacking at time of printing. Contact factory.

Chemical	Formula	BODIES, SHAFTS, etc.						IMPELLERS		
		CAST IRON	BRONZE	316 STAINLESS	PHENOLIC	EPOXY	PVC	NEOPRENE	NITRILE (-37)	VITON (-59)
Acetaldehyde	CH_3CHO	C	A	A	A	A	N	N		C
Acetamide	CH_3CONH_2	N	N	N	N	A				A
Acetate Solv. (Crude)		N	N	A	N	A		N		N
Acetate Solv. (Pure)		A	A	A	A	A		C		N
Acetic Acid, Glacial[12]	CH_3COOH	N	C	A	N	C	A	N	N	N
" 10%		N	C	A	C	A	A	N	C	N
" 25%		N	C	A	C	A	A	N	N	
" 50%		N	C	A	C	C	A	N	N	N
" Pure		N	C	A	C	C	N	N	C	
" Vapor		C	C	A	C	C		N	C	N
Acetic Anhydride[12]	$(CH_3CO)_2O$	C	C	A	A	A	N	C	C	N
Acetone	$CH_3{\cdot}CO{\cdot}CH_3$	A	A	A	A	N	N	N	N	N
Acetylene	$HC{\cdot}CH$	A	N	A	A	A	A	C	A	
Acetylene Tetrabromide	$(CHBr_2)_2$	N	N	A	N	N				A
Acetylsalicylic Acid (Aspirin)	$CH_3CO{\cdot}O{\cdot}C_6H_4COOH$	N	N	A	N	A		N		
Acrylonitrile	$CH_2{=}CHCN$	C	C	C	N	A		N		N
Adhesive (PVA)		A	A	A		A		A		
" Bordon Chem. Co.						A		C	N	N
" Findley						A		A	A	A
" Pacific Soap						A		N	N	N
Alcohol, Amyl	$C_4H_9CH_2OH$	A	A	A	A	A		A	A	N
" Benzyl	$C_6H_5CH_2OH$	A	A	A	A	A		C		A
" Butyl	$C_3H_7CH_2OH$	N	A	A	N	A	A	A	A	A
" Diacetone	$(CH_3)_2COHCH_2COCH_3$	A	A	A	A	A		A	C	A
" Ethyl	CH_3CH_2OH	A	A	A	A	A	A	A	C	C
" Hexyl	$C_5H_{11}CH_2OH$	A	A	A	A	A		A		A
" Isobutyl	C_3H_7CH	C	A	A	C	A				A
" Isopropyl	$C_2H_5CH_2OH$	C	A	A	A	A		A	C	A
" Methyl	CH_3OH	A	A	A	A	A	A	C	N	N
" Octyl	$CH_7H_{15}CH_2OH$	A	A	A	A	A		A	A	A
" Propyl	$C_2H_5CH_2OH$	C	A	A	C	A	A			A
Aluminum Etch		N	N	N	N	N		A	A	A
Aluminum Chloride[2, 12]	$AlCl_3$	N	C	N	N	A	A	A	A	A
" Hydroxide[3]	$Al(OH)_3$	A	C	A	N	A	A	A	A	
" Oxide	AlO_3	N	N	A	N	A		A	A	A
" Sulfate[12]	$Al(SO_4)_3$	N	C	N	A	A	A	A	A	
Amines	$R{-}NH_2$	N	N	A	N	A		N	C	N
Ammonia, Anhydrous Liquid	NH_3	A	N	A	A	A	N	A	C	N
" Liquors	$NH_4OH{\cdot}H_2O$	A	N	A	A	A		A		N
" Nitrate	NH_4NO_3	A	N	A	A	A		C	A	
Ammonium Bicarbonate	NH_4HCO_3	C	N	A	N	A		A	A	
" Bifluoride[5]	$HH_4F{\cdot}HF$	N	N	A	A	A	A	A	A	A
" Carbonate	$(NH_4)_2CO_3$	A	N	A	N	A	A	A	A	
" Casenite[6]				A	N	A		A		
" Chloride[12]	NH_4Cl	N	N	N	A	A	A	A	N	N
" Hydroxide[12]	NH_4OH	A	A	A	A	A	A	A	C	A
" Nitrate	NH_4NO_3	A	N	A	N	A		A	A	A
" " 50%		A	N	A	N	A		A	A	A
" Oxalate	$NH_4C_2O_4$	N	N	A	N	A	A			
" Persulfate	$(NH_4)_2S_2O_8$	N	N	A	C	A	A	N	C	A
Ammonium Persulfate 40%		N	N	A	C	A	A	A	A	A
" Phosphate, Dibasic	$(NH_4)_2HPO_4$	C	C	C	A	A		A	A	
" " Monobasic	$(NH_4)H_2PO_4$	N	N	C	A	A		A	A	
" " Tribasic	$(NH_4)_3H_2PO_4$	A	C	A	A	A		C	A	
" Sulfate[12]	$(NH_4)_2SO_4$	C	N	C	A	A	A	A	A	
Ammonium Thio-Sulfate	$(NH_4)_2S_2O_3$	N	N	A	A	A		A	A	
Amyl Acetate	$CH_3COO(CH_2)_4CH_3$	C	C	A	N	A	N	N	N	N
Aniline Dyes[15]	$R{-}C_6H_4NH_2$	C	C	A	N	A		C	C	C
" Oil	$C_6H_5NH_2$	A	A	A	N	A		N	N	C
Anise Oil	$C_{10}H_{12}O_2$ (mixture)	N	N	A	A	A		C		
Anti-Freeze (by trade name)										
Dowgard, Hubbard Hall, Peak, Perma-Sta, Permaguard, Pyro Perm., Sears, Shellzone, Smith-Blue Cold, Texaco P.T., Telar, Wilco, Zerex.		A	A	A	A	A	A	A	A	A
" Prestone		A	A	A	A	A		N	A	C
" Pyro Super		A	A	A	A	A		N	A	
" Valvolene		A	A	A	A	A		C	C	
Aromatic Hydrocarbons (Consult Factory)		A	C	C	A	A	N	N	N	A
Arsenic Acid	H_3ASO_4	N	N	A	C	A	A	A	A	
Asphalt		A	A	A	N	A		C	C	
Asphalt Topping		A	A	A	N	A		A	C	C
ASTM #1 Oil		A	A	A	N	A		C	A	A
ASTM #3 Oil		A	A	A	A	A		C	A	A
Barbeque Sauce		N	N	A	N	A		A	A	
Barium Chloride[12]		C	C	A	A	A	A	A	A	
" Hydroxide	BaOH	A	A	A	A	A		A	A	
" Nitrate	$BaNO_3$	A	N	A	N	A		A		
Bay Oil		N	N	A	A	A		C		A
Beef Extract		N	N	A	N	A		A	A	A
Beer		N	A	A	A	A	A	A		
Beet Sugar Liquors		A	A	A	A	A	A	A	A	
Benzaldehyde	C_6H_5CHO	A	A	A	N	A		N		C
Benzene	C_6H_6	A	A	A	A	A	N	N	N	N
" Sulfonic Acid[8]	$C_6H_5SO_3H$	N	N	C	N	A		A		
Benzine	(Mixture)	A	A	A	N	A		N		A
Benzoic Acid	C_6H_5COOH	N	N	A	C	A	A	C		
Benzol	(See Benzene)	A	A	A	A	A		N	N	N
Benzoyl Peroxide	$(C_6H_5CO)_2O_2$	N	N	A	N	N		A		
Beta Carotene		N	N	A	N	A		N	A	A
Benzyl Chloride	$C_6H_5CH_2Cl$	N	N	N	N	A		N		C
Bone Oil		A	A	A	N	A			A	
Borax	$NA_2B_4O_7$	A	A	A	N	A	A	C	C	
Boric Acid	H_3BO_3	N	A	A	A	A	A	A	A	A
Boron Fuels (H.E.F.)		N	N	A	N	N	N			C
Brake Fluid (by trade name)										
" Dupont		A	A	A	N	A		A	N	
" Union Oil		A	A	A	N	A		A	N	
Brewery Slop		A	A	A	A	A		A	A	A
Brine (Saturated)		N	A	A	A	A		A	A	A
Bromine, Anhydrous Liq. Br.		N	N	N	N			N	N	A

KEY TO FOOTNOTES:

2. To 25% concentration—150° F. Titanium shaft
3. To 25% concentration
5. Use Hastelloy "B" shaft
6. Slow speed
8. 10% at 85° F.
12. Titanium shaft
15. To 10% concentration—100° F.

*Data contained in the table is based on results of tests taken at ambient temperatures unless otherwise noted.

(continued)

TABLE 7.5: IRON, BRONZE, STEEL, SYNTHETIC RESIN AND RUBBER PUMP MATERIALS—ITT JABSCO (continued)

	BODIES, SHAFTS, etc.						IMPELLERS		
	CAST IRON	BRONZE	316 STAINLESS	PHENOLIC	EPOXY	PVC	NEOPRENE	NITRILE (-37)	VITON (-59)
Butane $CH_3(CH_2)_2CH_3$	A	A	A	N	A		A		
Butanol (see Butyl Alcohol)	N	A	A	N	A	A	A	A	A
Butter	N	N	A	N	A		C	A	A
Buttermilk	N	N	A	N	A		A	A	A
Butyl Acetate $CH_3COO(CH_2)_3CH_3$	A	A	A	N	A		N		N
Butyraldehyde $CH_3(CH_2)_2CHO$	A	N	N	N	A		N		
Butyric Acid $CH_3(CH_2)_2COOH$	N	A	A	N	A		N	C	
Calcium Bisulfate $Ca(HSO_4)_2$	N	C	A	N	A		A		
Calcium Chloride[12] $CaCl_2$	C	A	A	A	A		A	A	
" Hydroxide $Ca(OH)_2$	A	N	A	N	A		A	A	
Calcium Hypochlorite[10 12] $Ca(ClO)_2$	N	N	C	A	A		C	C	
" Sulfate[5] $CaSO_4$	A	A	A	N	A	A	C		
Calgon[11] $(NaPO_3)_6$	N	C	A	N	A		A	A	A
Cane Sugar Liquors	A	A	A	A	A	A	A	A	
Carbolic Acid (Phenol) C_6H_5OH	N	A	A	N	A		C		
Carbon Dioxide CO_2	N	A	A	A	A	A	A		
" Disulfide CS_2	A	N	A	A	A	A	N	N	A
" Monoxide CO	N	C	A	A	A	A	A		
" Tetrachloride CCl_4	C	A	A	A	A	A	N	N	A
Carbonic Acid H_2CO_3	N	A	A	A	A	A	A	N	
Castor Oil	A	A	A	N	A	A	A	A	
Catsup	N	C	A	N	A	A	C	A	A
Cellulube "200"	A	A	A	N	A		N	N	A
" "550"	A	A	A	N	A		N	C	A
"Charsol" Liquid Smoke	N	N	A	N	A		A	N	N
Chlorinated Glue	N	A	A	N	A		N	N	A
Chlorinated Lime $Ca(ClO)_2$	N	N	A	N	A		C	C	
Chlorinated Trisodium Phosphate 4 oz./Gal.	N	N	A	C	A		A	A	A
Chlorine, Anhydrous Liquid[12] Cl_2	C	N	N	N		N	C	C	A
Chlorinated Hydrocarbon	A	A	N	N	A	N	N	N	N
Chloro-Acetone C_3H_5ClO	N	N	A	N	N		C		
Chloroacetic Acid[12] $C_2H_3lO_2$	N	N	N	N	N	A	A		
Chlorobenzene (Mono) C_6H_5Cl	N	A	A	N	A		N		N
Chloro Bromomethane $ClCH_2Br$	N	N	A	N	N				N
Chlorobutadiene $CH_2CHCClCH_2$	N	N	A	N	A				A
Chloroform $CHCl_3$	N	N	A	A	A	N	N	N	A
Chloro Sulfonic Acid $HClO_3S$	N	N	N	N	N	A	N		N
Chlorothene (Trichlorethane) or Methol Chloroform	N	N	A	N	N		N	N	C
Chlorox (Bleach)	N	A	A	N	A	A	A	C	C
Chocolate Syrup	N	N	A	N	A		A		
Chromic Acid, Cold[12] H_2CrO_4	N	N	C	C	C		N	N	A
" 50%[12]	N	N	C	C	C	N	N	N	A
Cider	N	A	A	N	A	A	A		
Cinnamon Oil	N	N	A	A	A		C		
Citric Acid $C_6H_8O_7 \cdot H_2O$	N	C	A	A	A	A	A	C	
Citric Oils	N	N	A	N	A		N		A
Citroflex					A		N	N	
Citrus Pectin Liquor			A		A		A	A	C
Cleaning Solution (Food Grade Acid)	A	N	A	N	A		A	A	A
Clove Oil	N	N	A	A	A		C		
Cocoanut Oil (Amb. Temp.)	A	A	A	A	A		N	A	A
Cod Liver Oil	N	N	A	A	A		N	A	A
Copper Chloride[12] $CuCl_2 \cdot 2H_2O$	N	N	N	N	A	A	C	A	
" Cyanide $Cu(CN)_2$	N	C	A	A	A	A	A		
" Floborate $CuBF_6 \cdot 4H_2O$	N	N	N	A	A	A	A		
" Sulfate $CuSO_4 \cdot 5H_2O$	N	C	A	A	A	A	A	A	
Corn Oil	A	C	A	A	A	A	C	A	A
Cotton Seed Oil	A	A	A	A	A	A	C	A	A
Cream	N	N	A	A	A		C	A	A
Creosote Oil	A	A	A	N	A		N		C
Cresols $C_6H_4OH \cdot CH_3$	C	C	A	N	A		N	C	C
Cresylic Acid	C	C	A	N	A		N	C	C
Cutting Oil (Water Soluble)	A	A	A	A	A		N	C	A
" (Sulfur Base)	A	A	A	C	A		C	A	
Cyanic Acid HOCN	N	N	A	N	A		C	C	
Cyclo Hexane C_6H_{12}	A	N	A	N	A		N	N	A
Darex A.E.A.							N	C	
Degerm, Deodorants (by trade name)									
Blue Chip	N	A	A	A	A		A	A	
Flushex H7BD (50%)	N	A	A	A	A		N	A	
" (100%)	N	A	A	A	A		C	C	
Monogram DG19	N	A	A	A	A		A	A	
Air Fresh (3 oz./Gal. H_2O)	N	A	A	A	A		C	A	
" (50%)	N	A	A	A	A		N	N	
Blue Jet (50%)	N	A	A	A	A		C	A	
" (100%)	N	A	A	A	A		N	C	
B & B L-55	N	A	A	A	A		N	N	
" L-55 #101	N	A	A	A	A		A	A	
" " #102	N	A	A	A	A		A	A	
" " #103	N	A	A	A	A		A	A	
" " #104	N	A	A	A	A		A	N	
Degreaser (Menasco)					A		A	N	A
Detergents		A	A		A	A	A	A	
Developing Solution Copy Mach	N	N	A	N	A		A	A	A
Dibenzyl Ether $(C_6H_5CH_2)_2O$	N	N	A	N	A		N		
Dibutyl Ether $CH_3(CH_2)_3O(CH_2)_3CH_3$	N	N	A	N	A		N		
Dibromochloropropane $BrCH_2CHClBr$	N	N	A	N					A
Dehydratine 80							C	A	A
Diesel Fuels (by trade name)									
Chevron	A	A	A		A	A	N	C	A
Mobil—Special #1	A	A	A		A	A	N	C	A
" Amber #2	A	A	A		A	A	N	C	A
Shell—Premium	A	A	A		A	A	N	C	A
Standard Oil	A	A	A		A	A	N	C	A
Texaco 448	A	A	A		A	A	N	C	A
" Fuel Chief	A	A	A		A	A	N	C	A
Diester Syn. Lub. Oil	A	A	A		A				A
Diethylene Glycol $O(CH_2CH_2OH)_2$	A	A	A		A		A	A	
Diethyl Sebacate $[(CH_2)_4COOC_2H_5]_2$					A		N		
Di-Isopropyl Ketone $(CH_3)_2CHCOCH(CH_3)_2$			A		A		N	N	N
Dinitro Toluene $(NO_2)_2C_6H_3CH_3$			A		A				N
Dioctyl Sebacate					A		N		C
Diphenyl Oxide $(C_6H_5)_2O$	A	A	A		A				A
Disinfectant Deodorant		A	A	A	A		C	A	A

KEY TO FOOTNOTES:

5. Use Hastelloy "B" shaft
10. Chlorinated lime
11. Sodium Hexametaphosphate
12. Titanium shaft

All impeller compounds normally ok when concentration is 1 part oil to 50 parts water.

(continued)

TABLE 7.5: IRON, BRONZE, STEEL, SYNTHETIC RESIN AND RUBBER PUMP MATERIALS—ITT JABSCO (continued)

		BODIES, SHAFTS, etc.						IMPELLERS		
		CAST IRON	BRONZE	316 STAINLESS	PHENOLIC	EPOXY	PVC	NEOPRENE	NITRILE (-37)	VITON (-59)
Distillery Wort		C	A	A	A	A		A		
Drinox (Morton Chem. Co.)								N	N	N
Dyes, Abrasive								N	N	C
Dyes—Water Base				A		A		A		
Elixis (Central Pharm. Co.)								A	A	A
Epichlorohydrin	OCH_2CHCH_2Cl					A		N		N
Ethanolamine	$H_2N{\bullet}CH_2CH_2{\bullet}OH$				A	A		C	A	
Ether Compounds		C	A	A	N	A		N	N	N
Ethyl Acetate	$CH_3COO{\bullet}C_2H_5$	A	A	A	A	A	N	N	N	N
" Acrylate	$CH_2CHCOOC_2H_5$					A	N			N
" Chloride	CH_3CH_2Cl	C	A	A	N	A		C	A	
" Ether	$C_2H_5OC_2H_5$	C	A	A	A	A		N		N
Ethylene Dichloride	$CH_2Cl{\bullet}CH_2{\bullet}Cl$	A	C	A	N	A	N	N	N	A
" Glycol	$HOCH_2{\bullet}CH_2OH$	A	A	A	A	A	A	A	A	A
Ethylene Oxide	$(CH_2)_2O$	N	A	A	N	A	N	N		N
Fatty Acids		C	C	A	N	A	A	N	C	N
Ferric Chloride[12]	$FeCL_3$	N	N	N	A	A	A	A	C	
" Nitrate	$FeNC_3$			A		A	A	A		
" Oxide	FeO_3					A		C		
" Sulfate	$FeSO_4$	N	N	C	N	A	A	A	A	
Ferrous Chloride	$FeCl_2$	N	C	N	A	A	A	A	A	
" Sulfate	$FeSO_3$	N	N	A		A	A	A	A	
Fish Batter		N	N	A	N	A	A	A	A	
Fluoboric Acid[14]	HBF_4	N	N	C	A	A	A	A	A	
Fluosilicic Acid[15] (PVC 25%)	H_2SiF_6	N	N	A		A	C	A	A	
Formaldehyde	$HCHO$	C	A	A		A	A	N	A	A
Formic Acid[5]	$HCOOH$	N	C	C	C	A	C	C	N	C
Freon II (MF)[16]	CCl_3F	C	A	C		A	C	N	N	N
" 12, Wet		A	A	N		A	C	C	C	C
" 22	$CClF_2$	C	A	C		A	N	C	C	N
" 113 (TF)[16]	$C_2Cl_3F_3$		A			A	A	N	C	A
Fruit Juice		N	C	A	N	A	A	A	A	A
Furan Resin			A	A	A			A	N	A
Furfural	C_4H_3OCHO	A	A	A	N	A		N	N	C
Gasoline		A	A	A	A	A	C	N	N	A
Gelatin[5]		N	A	A	N	A		A	A	
Ginger Oil		N	N	A	A	A		A		A
Glucose	$C_6H_{12}O_6$	A	A	A	A	A	A	A	A	
Glue (by trade name)										
Arabol			A			A		N	N	N
Cohoes		A	A	A		A		A	A	
Emhart		A	A	A		A		C	A	
Lavoris				A		A		N		
Poly Vinyl (70%)		A	A	A		A		A		
Glycerine	$C_3H_8O_3$	A	A	A	A	A	A	A	A	A
Glycolic Acid (70%)	$HOCH_2COOH$					A		A	A	A

		BODIES, SHAFTS, etc.						IMPELLERS		
		CAST IRON	BRONZE	316 STAINLESS	PHENOLIC	EPOXY	PVC	NEOPRENE	NITRILE (-37)	VITON (-59)
Gold Monocyanide	$AuCN$	N	N	A	A	A		A		
Grapefruit Oil		N	N	A	A	A		N	N	
Grape Juice		N	C	A	A	A		A	A	
Grease		A	A	A	N	A		N	N	A
Heptane	$CH_3(CH_2)_5CH_3$	A	A	A	N	A	A	N	A	
Hair Solution (by trade name)										
Breck						A		C	A	A
Clairol				A		A		A		
Duart						A		A	A	
Mentos						A		A	A	A
Reaken						A		A	A	A
Hexane	$CH_3(CH_2)_4CH_3$	A	A	A	N	A	C	N	A	A
High Energy Fuels								N	C	A
Honey		A	A	A	N	A	A	A		
Horse Radish						A		A	N	
Hydraulic Fluid										
" Skydrol 700		A	A	A	N	A		N	N	A
" Petroleum Base		A	A	A	N	A		N	A	A
Hydraulic Oil		A	A	A	N	A		N	C	A
Hydratite Liquid			A			A		A	A	A
Hydrazine (Water Base)	$NH_2{\bullet}NH_2 + H_2O$	C	N	A	A	A		A		
" (Alcohol Base)	$NH_2{\bullet}NH_2 + CH_3OH$	C	N	A	A	A		A		
Hydrobromic Acid[5,17]	HBr	N	N	N	N	C	C	C	C	
Hydrochloric Acid (20%)[18]	HCl	N	C	N	A	A	A	A	C	A
" (37%)[5]		N	N	N	C	A	C	C	C	C
Hydrocyanic Acid (Prussic Acid)	HCN	N	N	A	N	A	A	A	A	
Hydrofluoric Acid (20%)[5]	$HF{\bullet}H_2O$	N	N	N	N		C	C	C	A
" (48%)		N	N	N	N		C	C		C
" (75%)		N	N	N	N		C	N		C
Hydrofluosilicic Acid (20%)	H_2SiF_6	N	A	N	N	A	C	C	A	
Hydrogen Peroxide	H_2O_2	N	N	C	N	A	A	N	A	
" Sulfide	H_2S	N	N	C	N	A	A	N	C	
Hydroxyacetic Acid (70%)			N			A		A	A	A
*Hypo		C	N	A	A	A	A	A	A	
Ink[21]		N	N	C		A		A	A	A
Iodine	I_2	N	N	N		A	N	N	A	A
Isotane						A		N	A	A
Iso-Propyl Alcohol	$CH_3CH_2CH_2OH$	C	A	A	A	A		A	C	A
Jet Fuel (JP-4)		A	A	A	N	A	A	N	A	A
Kerosene		A	A	A	A	A	A	N	C	A
Kerosene & Naphtha		A	A	A	A	A		N	C	A
Ketchup		N	C	A	N	A	A	C	A	A
Ketones				A	A	C	N	N	N	N
Lacquers		C	A	A	A	A		N	N	N

KEY TO FOOTNOTES:

5. Use Hastelloy "B" shaft
6. Slow speed
12. Titanium shaft
14. To 40% concentration 150° F.—Hastelloy "B" shaft
15. To 10% concentration—100° F.

*Hypo—See sodium thio sulfate

16. Use Polyurethane Impeller
17. To 40% concentration
18. To 20% concentration. Use Hastelloy "B" shaft (muriatic acid)
21. Water soluble

(continued)

TABLE 7.5: IRON, BRONZE, STEEL, SYNTHETIC RESIN AND RUBBER PUMP MATERIALS—ITT JABSCO (continued)

	BODIES, SHAFTS, etc.						IMPELLERS		
	CAST IRON	BRONZE	316 STAINLESS	PHENOLIC	EPOXY	PVC	NEOPRENE	NITRILE (-37)	VITON (-59)
Lactic Acid $CH_3CHOHCOOH$	N	C	A	N	A	A	C	C	A
Lard	A	A	A	N	A	A	C	A	
Larvacide (Trichloro Nitro Methane) (Chloropicrin) CCl_3NO_2	A	N	A	N	A		N	N	N
Latex[22]		A	A	N	A		A	A	
Lead Sulfamate					A		A		
Lemon Oil			A	A	A		C		A
Lignin Liquor		A	A		A		A	A	A
Lime CaO	A	A	A	N	A		A	A	
Lindol									C
Linseed Oil	A	A	A	N	A	A	N	A	
Lithium Bromide $LiBr\cdot H_2O$	A					A	N	A	A
Lubricants (by trade name)									
Crown—Heavy Duty	A	A	A	A	A		N	N	N
" Multi Purpose	A	A	A	A	A		N	N	C
Lubrico—M6	A	A	A	A	A		C	A	A
Marfak—2HD	A	A	A	A	A		A	A	A
Orange	A	A	A	A	A		A	A	
Magnesium Chloride[12] $MgCl_2\cdot 6H_2O$	N	C	A	A	A	A	A	A	
" Hydroxide $Mg(OH)_2$	A	A	A	N	A	A	A	A	C
" Nitrate $Mg(NO_3)_2\cdot 2H_2O$	N	N	A	A	A	A	A		
" Oxide MgO	A	A	A	N	A		A	A	C
" Sulfate $MgSO_4\cdot 7H_2O$	A	C	A	A	A	A	A	A	C
Manganese Nitrate $Mn(NO_3)_2\cdot 6H_2O$					A	A	A	A	C
Mash		A	A		A		A		
Mayonnaise	N	N	A		A		A	C	A
Melamine[5] $N\cdot C(NH_2)N\cdot C(NH_2)N\cdot C(NH_2)$	N	N	N	N	A		N	C	
Mercury[6] Hg	A	N	A	N	A	A	C	A	
Methanol (Methyl Alcohol)	A	A	A	A	A	A	C	N	N
" (100%)									
" (50%)	N	N	A	A	A		A	N	N
Mercuric Chloride[12] $HgCl_2$	N	N	N	A	A		C	A	
Methyl Acrylate $CH\cdot CHOOCH_3$					A				N
" Butyl Ketone $CH_3CO(CH_2)_3CH_3$			A		C				N
" Cellosolve $CH_3OCH_2CH_2OH$			A		C		N		
" Chloride CH_3Cl	A	C	A		A		N	C	
" Cyclopentane C_6H_{12}			A		A		N		
" Ethyl Ketone $CH_3CO\cdot CH_2CH_3$			A	A	C		N	N	N
" Isobutyl Ketone $CH_3COCH(CH_3)CH_2CH_3$			A	A	C		N	N	N
" Isopropyl Ketone $CH_3C\cdot NOHCH(CH_3)_2$			A	A	C		N	N	N
" Methacrylate $CH_2C(CH_3)COCH_3$					A		A	A	A
Methylene Bromide $BrCH_2$	A		A		A	C	N		C
" Chloride CH_2Cl_2	A		C		A	N	N	N	N
" Dichloride CH_2Cl_2			A		A				C
Milk	N	C	A	A	A	A	A	A	A
Mineral Oil	A	A	A	A	A	A	C	A	A
Molasses	A	A	A	A	A	A	A	A	
Mono Chlorobenzene C_6H_5Cl					A				C
" Methylether $(CH_3)_2O$					A				A
" Vinyl Acetylene $CH\cdot CCH\cdot CH_2$					A				A
* Multi-Circuit Etch	N	N	N	N	A				A
Mustard	N	A	A	N	A		A	C	N
N—Butyl Acetate $CH_3COO(CH_2)_3CH_3$	A	A	A	N	A		N		N
N—Butyl Ether $CH_3(CH_2)_3O(CH_2)_3CH_3$	C	A	A	N	A		N		
N—Capronitrile $CH_3(CH_2)_4CN$			A		A		N		
N—Heptane $CH_3(CH_2)_5CH_3$	A	A	A	N	A				
N—Hexane $CH_3(CH_2)_4CH_3$	A	A	A	N	A		N		A
N—Pentane $CH_3(CH_2)_3CH_3$	A	A	A	N	A		N		
N—Propyl Acetate $CH_3COOCH(CH_3)_2$	A	A	A	N	A		N		N
N—Propyl Alcohol $CH_3(CH_2)_2OH$	A	A	A	A	A				A
Naphtha (mixture)	A	A	A	A	A	A	N		A
Naphthalene $C_{10}H_8$	A	C	A	A	A	N	N	N	
Nickel Chloride[12] $NiCl_2$	N	N	C	A	A	A	C	A	
Nickel Sulfate $NiSO_4$	N	C	C	C	A		C	A	
Nitric Acid (dilute)[12] HNO_3	N	N	C	N	A				A
" 60%	N	N	A	N	A	A	N	N	C
" 90%	N	N	A	N	N		N	N	C
" Crude	N	N	N	N	N		N	N	C
" Red Fuming	N	N	N	N	N		N	N	N
Nitrobenzene $C_6H_5NO_2$	C	C	A	N	A	N	N	N	N
Nitropropane $CH_3(CH_2)_2NO_2$			A		A				N
O—Chloro-Phenol ClC_6H_4OH				N	A		N		
O—Dichlorobenzene $C_6H_4Cl_2$			A	N	A		N		C
Oil									
" Aniline	A	A	A	N	A		N	N	C
" Anise			A	A	A		C		
" ASTM #1	A	A	A	A	A	A	C	A	A
" ASTM #3	A	A	A	A	A	A	C	A	A
" Bay			A	A	A		C		A
" Bone	A	A	A		A			A	
" Castor	A	A	A		A		A	A	
" Chevron CP11X	A	A	A	A	A		C	A	A
" Cinnamon			A	A	A		C		
" Citric	N	N	A		A		N		A
" Clove			A	A	A		C	A	
" Coconut	A	A	A	A	A		N	A	A
" " 180°F	A	A	A		A	N	N	C	N
" Cod Liver			A	A	A		N	A	A
" Corn	A	C	A		A		C	A	A
" Cotton Seed	A	A	A	A	A		C	A	A
" Creosote	A		A		A				C
" Diester Syn. Lub.	A	A	A	A	A				A
" Dromus "A"	A	A	A	A	A			C	
" " "C"	A	A	A	A	A			A	

KEY TO FOOTNOTES:

5. Use Hastelloy "B" shaft
6. Slow speed
12. Titanium shaft
22. Water soluble—slow speed

* Muriatic Acid—See Hydrochloric Acid 20%.

(continued)

TABLE 7.5: IRON, BRONZE, STEEL, SYNTHETIC RESIN AND RUBBER PUMP MATERIALS—ITT JABSCO (continued)

	BODIES, SHAFTS, etc.					IMPELLERS			
	CAST IRON	BRONZE	316 STAINLESS	PHENOLIC	EPOXY	PVC	NEOPRENE	NITRILE (-37)	VITON (-59)
Oil, Ginger			A	A	A		A		A
" Hydraulic	A	A	A	A	A			C	A
" Lemon			A	A	A		C	N	A
" Linseed	A	A	A		A		N	A	
" Mineral	A	A	A	A	A		A	A	
" Olive	A	A	A		A		C	A	A
" Orange			A		A		C	A	A
" Pale	A	A	A		A		N		
" Palm	A	A	A		A		C	A	A
" Peanut	A	A	A		A		N	A	A
" Pella	A	A	A		A		N	A	A
" Peppermint			A		A		N	N	A
" Pine	C	N	A	C	A		N	N	A
" Rape Seed	A	A	A		A		C		A
" Red (Oleic Acid)	C	C	A		A		N	A	A
" Rose			A	A	A		C		A
" Royal Triton	A	A	A	A	A		A	A	A
" Sesame Seed	A	A	A		A		C	A	A
" Shell Dieselene	A	A	A	A	A		N	A	A
" Silicone	A	A	A	A	A		A	A	A
" Soybean	A	A	A	N	A		N	A	A
" Sperm	A	A	A		A		N	A	A
" Sulfur Base, Cutting	A	N	A		A		C	A	
" Tanning			A		A		N	A	A
" Turbine	A	A	A	A			A	A	A
" Tung			A		A		C		
" Vegetable	A	A	A	A	A		C	A	A
†" Water Soluble, Cutting (conc.)	A	A	A	A	A		N	C	A
Oil of Birchwood					A		N		A
Olive Oil (mixture)	A	A	A		A		C	A	A
Orange Oil (mixture)			A		A		C	A	A
Oxalic Acid, Cold[12] [5] $(COOH)_2$	C	A	A		A	A	A	N	
Paint	A	C	A	N	N			C	C
Palm Oil	A	A	A		A		C	A	A
Paraplex G62					A	N	N	A	
Peanut Oil	A	A	A		A		N	A	A
Peppermint Oil			A		A		N	N	A
Perchloro Ethylene $(CCl_2)_2$	A	N	A		N		N	N	A
Petrolatum Prod. (by trade)									
" Amber (6S2010)					A		A	A	A
" Amber (6S2001)					A		A	A	A
" Lily White					A		A	A	A
" Snow White					A		A	A	A
Phenol (Carbolic Acid) C_6H_5OH	N	C	A	N	A	A	C	N	C
Phenyl Compounds C_6H_5-			A	N	A		N		C
Phosphoric Acid, Crude[5] H_3PO_4	N	N	C	N	A		C	C	A
" 0/45%	N	C	A	N	A	A	A	A	A
" 45%/Pure[5]	N	N	C	N	A	A	C	A	A

	BODIES, SHAFTS, etc.					IMPELLERS			
	CAST IRON	BRONZE	316 STAINLESS	PHENOLIC	EPOXY	PVC	NEOPRENE	NITRILE (-37)	VITON (-59)
Photographic Developer	N	N	A	A	A	C	A		A
Pickling Acid, Crude	N	N	N	N	A		N		C
Picric Acid, Molten $(NO_2)_3C_6H_2OH$	A	N	A	N	A		C	C	
Pine Oil	C	N	A	C	A		N	N	A
Pipe Line Cleaner, Davan Industries	A	A	A		A		A	A	A
Plasticizer				A		N	C	N	A
Plasticol							N	N	A
Plating Solutions:									
Antimony Plating			A	A	A		A		
Arsenic Plating			A	A	A		A		
Regular Brass Bath[5]				A	A	A	A		
High Speed Brass Bath			A	A	A			A	
Copper-Cadmium Bronze Bath			A	A	A		A		
Copper-Tin Bronze Bath			A	A	A			A	
Copper-Zinc Bronze Bath			A	A	A		A		
Cyanide Bath[5]					A	A	A		
Fluoborate Bath[5]				A	A		A		
Chromic-Sulfuric Bath[12]					C				A
Fluosilicate Bath[12]					C				A
Fluoride Bath[12]					C				A
Black Chrome Bath[12]					C			C	C
Barrel Chrome Bath[12]					C				A
Copper Sulfate Baths[5]					A	A		A	A
Copper Fluoborate Baths[5]				A	A		A		
Copper Strike Bath			A	A	A		A		
Rochelle & Potassium Salt Baths			A		A	A	A		
Rochelle & Sodium Salt Baths[5]					A		A		
Barrel Copper Bath			A		A			A	
Gold Plating (Teflon Face Seal)			A	A	A	A	A		
Indium Cyanide Plating			A	A	A	A		A	
Chloride Bath[12]				A	A		A		
Ferrous Sulfate Bath			A	A	A		A		
Ferrous Ammonium Sulfate Bath[5] [12]				A	A		A		
Sulfate-Chloride Bath[12]				A	A		A		
Fluoborate Bath[5]					A		A		
Lead Fluoborate Plating[5]				A	A	A	A		
Nickel Fluoborate Bath[5]				A	A	A	A		
All other Nickel Baths[12]					A			A	
Silver Plating			A	A	A	A	A		
Tin-Fluoborate Plating[5]				A	A	A	A		
Tin-Nickel Plating[5]					A	A		A	
Acid Sulfate Bath[5]				A	A		A	A	
Acid Fluoborate Bath[5]				A	A	A	A		
Alkaline Zincate Bath[5]					A			A	
Cyanide Bath[5]				A	A		A		
Potash K_2CO_3	C	N	A	C	A	C	N	A	
Potassium Bicarbonate $KHCO_3$	A	N	A	A	A	A	A		
" Carbonate (Potash) K_2CO_3	A	N	A	A	A	C	A	A	
" Chloride[15] KCl	A	N	A	A	A	A	A	A	

KEY TO FOOTNOTES:

5. Use Hastelloy "B" shaft
12. Titanium shaft
15. To 10% concentration—100° F.

†All impeller compounds are normally ok when concentration is 1 part oil to 50 parts water.

(continued)

TABLE 7.5: IRON, BRONZE, STEEL, SYNTHETIC RESIN AND RUBBER PUMP MATERIALS—ITT JABSCO (continued)

	BODIES, SHAFTS, etc.						IMPELLERS		
	CAST IRON	BRONZE	316 STAINLESS	PHENOLIC	EPOXY	PVC	NEOPRENE	NITRILE (-37)	VITON (-59)
Potassium Chromate K_2CrO_4	A	A	A	N	C		A	A	
" Cyanide KCN	A	N	A	N	A		A	A	
" Dichromate $K_2Cr_2O_4$	A	A	A	N	C	A	A		
" Hydroxide (Caustic Potash) KOH	C	N	A	C	A	A	N	A	
" Permanganate $KMnO_4$	A	C	A	A	C	C	A	C	C
" Phosphate, Mono K_3PO_4	N	C	A	A	A		A	A	
" Sulfate[5] K_2SO_4	A	C	A	A	A		A	A	
Proprionic Acid							N	N	N
Propyl Nitrate $CH_3(CH_2)_2NO_3$					A				N
Propylene Glycol $CH_2OHCHOHCH_3$	A	A	A	A	A		C	A	
Pydrauls	A	A	A	N	A		N	N	A
Pyridine C_5H_5N	A	N	C	N	A		N		N
Quaternary Ammonium Germacide	N	N	A	A	A		A	A	
Rape Seed Oil	A	A	A		A		C		A
Red Oil (Oleic Acid)	C	C	A		A		N	A	A
Resin Solvent (7073)			A		A		N	N	
Rose Oil			A	A	A		C		A
Rum			A	A	A	A	A		
Rust Inhibitors (by trade name)									
Aidco #29 & #44, Caterpillar, Du DuPont #7, Mac's #13, Permatex, Wilco.	A	A	A	A	A		A	A	A
Chevron, Drew Ameroid, Rust Rout, Union, V.O.	A	A	A	A	A		N	A	A
Lazy Way	N		A	A	A		A	A	A
Aqua Clear	A	A	A	A	A		A	A	A
" Chlorinated Trisodium Phosphate	N	N	A	C	A		A	A	A
" Klenzade			A		A		A	A	A
Sesame Seed Oil	A	A	A		A		C	A	A
Shellac—Orange	A	A	A		A		N		
Silica Gel	A	N	A	A	A		A		
Silicate Ester					A				C
Silicone L-45	A	A	A	N	A		A	A	A
Silicone X527	A	A	A	N	A		A	A	A
Silver Nitrate $AgNO_3$	N	N	A	A	A		A	C	
Sludge Acid (Sewerage)	A	A	A		A		C	A	A
Soap Solutions	A	C	A	A	A	A	C	A	A
Soda Ash (Sodium Carbonate)[5] Na_2CO_3	A	C	A	A	A	A	A	A	A
Sodium Arsenite[26] NaAs	N	N	A	A	A		A		
" Bicarbonate $NaHCO_3$	C	A	A	A	A	A	A	A	A
" Bisulfate $NaHSO_4$	N	C	A	A	A	A	A	A	
" Bisulfite $NaHSO_3$	N	C	A	N	A	A	C	C	
" Carbonate (Soda Ash)[5] $NaCO_3$	A	C	A	A	A	A	A	A	A
" Chloride[12] NaCl	A	C	A	A	A	A	A	A	A
" Chromate Na_2CRO_4	A	A	A	N	C		A	A	A
" Cyanide NaCN	A	N	A	A	A		A	A	
Sodium Hydroxide									
" " 0%/20% NaOH	A	N	A	C	A	A	A	A	N
" " Hot 20%/160°F	C	N	A	N	A	N	C	N	N
" " 45%	C	N	C	N	A	A	A	A	N
" Hypochlorite NaClO	N	N	C	N	C	A	A	A	A
" Metaphosphate $Na(PO_3)N$	N	C	A	A	A		C	A	
" Nitrate $NaNO_3$	A	C	A	A	A	A	C	C	
" Orthophenylphenate $NaC_6H_5C_6H_4O$			A		A		A	N	
" Perborate[5] $NaBO_3$	C	N	C	A	C		N	C	
" Peroxide Na_2O_2	C	N	A	N	C	A	N	C	A
" " 50%	N	N	A	N	A	A	A	A	A
" Phosphate, Di Na_2HPO_4	A	C	A	A	A		C	A	
" " Mono[5] NaH_2PO_4	N	A	C	A	A		A	A	
" " Tri[5] Na_3PO_4	A	N	A	A	A		C	A	
" Poly Phosphate	N	C	A	A	A		C	A	
" Silicate Na_2SiO_3	A	A	A	A	A		A	A	
" Sulfate Na_2SO_4	A	C	A	A	A	A	N	A	
" Sulfide[5] Na_2S	A	N	A	N	A	A	A	A	
" Sulfite Na_2SO_3	A	C	A	A	A	A	A	A	
" Thio Sulfate (Hypo) $Na_2S_2O_3$	C	N	A	A	A	A	A	A	
" Tripolyphosphate	N	N	A	A	A			A	
Sorghum	A	N	A	N	A		A	A	
Soy Bean Oil	A	A	A	N	A		N	A	A
Soy Sauce	N	A	A	N	A		A	A	
Sperm Oil	A	A	A		A		N	A	A
Stannic Chloride[12] $SnCl_4$	N	N	N		A	A	C	A	
" Fluoborate $Sn(BF_4)_2$	N	N	A	A	A		A		
Starch	C	A	A	A	A	A	A	C	A
Stearic Acid[12] $CH_3(CH_2)_{16}COOH$		C	A	N	A	A	C	A	
Stoddard Solvent	A	A	A	N	A	A	N	N	A
Styrene			A	N	A				C
Sulfamic acid[27]	N			A	A		A		
Sulfate Liquors	N	N	C	N	A		A		
Sulfur Base Cutting Oil	A	N	A		A		C	A	
Sulfur Chloride SCl	N	N	N				N	C	
" Dioxide[12] SO_2	A	N	C	A			C	C	
" (Molten) S	A	N	A				N	N	
" Trioxide, Dry SO_3		N	C		A		N	C	A
Sulfuric Acid 0%/10%[5] H_2SO_4	N	N	C	C	A	A	C	A	A
" 60%[5]	N	N	N	C	C	A	N	C	A
" Over 75%[3]	N	N	N	C	C	A	N	C	A
" Fuming[5]	N	N	N	N			N	N	C
Sulfurous Acid[12] H_2SO_3	N	N	A		A	A	N	C	A
Tannic Acid[12] $C_{76}H_{52}O_{46}$	C	A	C		A	A	C	C	
Tanning Liquors[5]		A	A	C	A	A	A	C	
" Oil					A		N	A	A
Tartaric Acid[12] $C_4H_6O_6$	C	A	C	A	A	A	A	C	

KEY TO FOOTNOTES:

5. Use Hastelloy "B" shaft
12. Titanium shaft
26. To 20% concentration
27. Has effect on binder for carbon seals and bearings: Model 3010-1151 recommended.

(continued)

TABLE 7.5: IRON, BRONZE, STEEL, SYNTHETIC RESIN AND RUBBER PUMP MATERIALS–ITT JABSCO (continued)

		BODIES, SHAFTS, etc.						IMPELLERS		
		CAST IRON	BRONZE	316 STAINLESS	PHENOLIC	EPOXY	PVC	NEOPRENE	NITRILE (-37)	VITON (-59)
Teepol								A	A	
Tetrachlorethane	$(Cl_2HC)_2$	C	C	A		A				A
Tetra Ethyl Lead	$Pb(C_2H_5)_4$	A		A		A				C
Tetralin (Tetrahydronaphthalene)	$C_{10}H_{12}$					A		N		
Thio Glycolic Acid	$HS{\bullet}CH_2{\bullet}COOH$	N	N	A	N	A		C		
Thionyl Chloride	$SOCl_2$	N	N	N	N		N			N
Toluene, Toluol	C_7H_8	A	A	A	A	A	N	N	N	N
Tooth Paste		N	A	A	N	A		C	A	A
Transformer Oil		A	A	A	A	A	A	N	N	A
Transmission Fluid		A	A	A		A				A
Tributyl Phosphate	$(C_4H_9)_3PO_4$					A		N		N
Trichloroacetic Acid	CCl_3COOH	N	A	N	N	C	A	A	A	A
Trichloroethane	$C_2H_3Cl_3$	A	A	A	N	A				N
Trichloroethane	$C_2H_3Cl_3$	A	A	A	N	A				C
Trichloroethylene[12]	$ClCH=CCl_2$	C	A	A	A	A	N	N	N	N
Trichloropane	$CH_3CHClCHCl_2$	A	A	A	N	A		N	N	A
Trichloropropane	$CH_2ClCHClCH_2Cl$	A	A	A	N			A	A	A
Triethyl Borane	$(C_2H_5)_3B$					A				A
Triethylaluminum	$Al(C_2H_5)_3$									N
Triethanolamine	$N(C_2H_4OH)_3$		A			A		A		
Toluene		A	A	A	N	A		N	N	N
Tung Oil				A		A		C		
Turco W.O. #1								N	N	N
Turpentine		A	C	A		A	C	N	A	A
Tricresyl Phosphate	$(CH_3C_6H_4)PO_4$					A		N		C
Udylite #61				A	N	A		A	A	A
Undertakers Restorative								A	A	A
Urea Formaldehyde						A		C	A	
Urine		A	C	A	A	A	A	N	A	
Vanilla Extract				A	N	A		A	A	C
Valclene 200 (DuPont)			A			A		N	A	N
Varnish		C	A	A	A	A		N	C	
Vegetable Juice[5]		N	C	C	A	A		C	C	
Vegetable Oil		C	A	A	C	A		C	A	A
Vinegar		C	C	A		A		C	C	N
Water Acid, Mine		C	C	A		A	A	C	A	A
" Boiler								C	C	N
" Distilled, Lab Grade[5]		N	N	C	A	A		A	A	A
" Fresh	H_2O	A	A	A	A	A	A	A	A	A
Water, Salt		N	A	A	A	A	A	A	A	A
" Cold		N	A	A	A	A	A	C	C	C
Weed Killers (by trade name)						A				
" Amino–Triazole				A		A		A	A	
" Atrazine–Divron				A		A		A	A	
" Karmex–Diuron				A		A		A	A	A
" Kloben				A		A		A	A	A
" Propazine–50W				A		A		C	A	
" Simazine–80W				A		A		A	A	
" Spray Rite				A		A		N	N	A
" Vacate (Dactal)				A		A		A	A	
Whiskey & Wines		N	C	A	A	A	A	A	A	
White Liquor (Pulp Mill)		C	N	A	A	A	A	A		
White Water (Paper Mill)		A	A	A	A	A		A		
WRDA		A	A	A		A		A	A	
Xylene	$C_6H_4(CH_3)_2$	A	A	A	A	A	N	N	N	A
Zinc Chloride	$ZnCl_2$	N	N	C	A	A	A	A	C	
" Hydrosulfite	ZnS_2O_4	N	N	A	A	A		A		
" Sulfate	$ZnSO_4$	C	C	A	A	A	A	A	A	

KEY TO FOOTNOTES:

5. Use Hastelloy "B" shaft
12. Titanium shaft

TABLE 7.6: IRON, NICKEL AND COPPER ALLOYS FOR CASTINGS AND FORGINGS—JANNEY CYLINDER

CORROSION RESISTANCE CHART

	Concentration	Ferralium 255 ††	316 S/S	Monel ••	Hastelloy C •	Tin Bronze	Al. Bronze	90/10 Cu. Ni.	70/30 Cu. Ni.	Ductile Iron	Naval Brass
Acetic Acid	20%	A	A	B	A	C	A	B	B	C	C
Acetic Acid	50%	A	A	B	A	C	A	B	B	C	C
Acetic Acid Vapour	--	A	B	B	A	--	B	--	--	--	--
Acetic Anhydride	All	A	A	B	B	--	--	B	B	C	C
Acetyl Chloride	--	A	A	A	--	--	--	--	--	--	--
Acid Mixtures 50% HNO_3 50% H_2SO_4	--	B	B	C	B	--	--	--	--	--	--
Acid Mixtures 25% HNO_3 75% H_2SO_4	--	B	B	C	B	--	--	--	--	--	--
Alcohols	--	A	A	A	A	--	A	--	--	B	--
Aluminum Chloride	All	--	C	C	B	C	B	B	B	C	C
Aluminum Hydroxide	All	A	A	A	A	--	A	A	A	--	A
Aluminum Potassium Sulphate (Alum.)	All	A	A	B	A	--	--	--	--	--	--
Ammonium Chloride	All	B	B	A	A	C	C	C	C	C	C
Ammonium Hydroxide	--	A	A	C	A	C	C	C	C	B	C
Ammonium Nitrate	All	A	A	C	A	C	C	C	C	A	C
Ammonium Sulphate (Acid)	--	B	B	B	A	B	A	C	B	C	C
Aniline	--	A	A	A	A	C	B	C	C	A	C
Benzene	--	A	A	A	A	--	A	A	A	B	A
Bromine (Moist)	--	--	C	C	B	--	C	B	B	C	C
Carbon Tetrachloride (Dry)	--	A	A	A	A	B	B	B	A	A	C
Chlorine (Moist)	--	C	C	B	C	C	C	B	--	C	
Chlorine Dioxide	--	--	C	--	A	--	--	--	--	--	--
Chlorosulphonic Acid	--	--	C	B	B	--	--	--	--	--	--
Chromic Acid	--	B	B	C	B	C	C	C	C	--	C
Citric Acid	All	A	B	A	A	A	A	A	A	B	C
Copper Sulphate	--	A	B	B	A	A	B	B	B	C	C
Cupric Chloride	--	C	C	C	B	--	--	--	--	--	--
Dichloroethane	--	--	A	--	A	--	--	--	--	--	--
Ethers	--	A	A	A	A	A	A	A	A	--	A
Ethyl Chloride	--	A	A	--	A	--	--	B	B	--	C
Ethylene Chloride	--	A	A	A	--	--	--	--	--	--	--
Esters	--	A	A	B	A	--	A	--	--	--	--
Ferric Chloride	15%	--	C	C	B	C	C	C	C	C	C
Ferric Sulphate	0-10%	A	A	C	A	--	--	C	C	C	C
Ferric Sulphate	10-30%	B	B	C	A	--	--	C	C	C	C

(continued)

TABLE 7.6: IRON, NICKEL AND COPPER ALLOYS FOR CASTINGS AND FORGINGS– JANNEY CYLINDER (continued)

	CONCENTRATION	FERRALIUM 255 ††	316 S/S	MONEL ••	HASTELLOY C •	TIN BRONZE	AL. BRONZE	90/10 CU. NI.	70/30 CU. NI.	DUCTILE IRON	NAVAL BRASS
Fluorine	--	--	A	A	A	--	--	--	--	--	--
Formic Acid	--	A	B	A	A	A	A	A	A	C	C
Hydrobromic Acid	0-50%	--	C	C	C	--	--	--	--	C	--
Hydrochloric Acid	0-5%	--	C	C	A	C	B	C	C	C	C
Hydrochloric Acid	All	--	C	C	B	C	C	C	C	C	C
Hydrofluoric Acid	All	--	C	B	B	B	B	C	B	B	C
Hydrogen Peroxide	--	A	A	B	A	C	C	B	B	C	C
Hydrogen Sulphide (Dry)	--	--	A	B	A	B	B	A	A	B	A
Hydrogen Sulphide (Moist)	--	--	A	C	A	C	C	C	C	B	C
Hypochlorites	--	--	C	C	A	--	--	--	--	--	--
Lactic Acid	--	A	A	C	A	A	A	A	A	C	C
Magnesium Chloride	--	B	B	B	A	A	A	B	B	B	C
Mercuric Chloride	--	--	C	C	A	--	--	--	--	C	--
Nickel Sulphate	--	A	A	A	A	A	A	--	--	C	--
Nitric Acid	0-70%	A	A	C	A	C	C	C	C	B	C
Nitric Acid	100%	B	B	C	C	C	C	C	C	C	C
Oleic Acid	--	A	A	A	A	A	A	A	A	B	C
Oxalic Acid	All	B	B	A	A	A	A	A	A	C	C
Phosphoric Acid	All	A	A	B	A	A	A	B	B	C	C
Picric Acid	--	A	A	C	A	C	C	--	--	C	--
Potassium Chloride	0-30%	C	C	B	A	B	A	A	A	C	C
Potassium Dichromate	All	--	A	B	B	--	--	C	C	--	C
Silver Nitrate	--	--	B	C	B	--	--	--	--	--	--
Sodium Chloride	0-10%	A	A	A	A	B	A	A	A	C	B
Sea Water	--	A	A	A	A	A	A	A	A	C	B
Sodium Hydroxide	All	B	B	A	A	C	A	A	A	B	C
Sodium Sulphide	--	--	B	B	B	C	B	C	B	C	B
Sulphur Dioxide (Moist)	--	--	B	C	A	B	A	C	C	C	C
Sulphuric Acid	25-90%	A	C	B	A	C	B	B	B	C	C
Sulphuric Acid	98%	A	A	B	A	C	B	B	B	C	C
Sulphuric Acid	20-65%	C	C	B	B	B	A	B	B	C	C
Sulphurous Acid	All	--	C	C	B	--	--	C	C	C	C
Zinc Chloride	All	--	B	B	B	C	B	C	C	C	C

A-Excellent resistance
B-Good resistance
C-Poor resistance
--No information

†† Bonar Langley Alloys
• Cabot
•• Inco

TABLE 7.7: VARIOUS RESIN, ELASTOMER AND STEEL TANK MATERIALS—NALGE

This chart will assist in the selection of NALGENE tanks for use with common chemicals. Under normal conditions, chemicals rated "S" may be safely handled in NALGENE tanks. Chemicals rated "U" are not recommended for storage in NALGENE tanks. This chart applies to unsupported tanks at operating temperatures from 70°F/21°C to 140°F/60°C.

Description	% Conc.	LDPE/ HDPE		XLPE[1]		PP		PVDF		E-CTFE		FRP		PVC		EPDM	NEO-PRENE	VITON	316 Stain Less	Nylon	
		70°	140°	70°	140°	70°	140°	70°	140°	70°	140°	70°	140°	70°	140°	70°	70°	70°		70°	% Conc.
Acetaldehye*	40	U	U	U	U	U	U	S	S	-	-	U	U	-	-	S	U	U	S	U	
Acetamide		-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-	S	S	S	50
Acetic Acid*	1-60	U	U	S	S	U	U	S	S	S	S	S	S	S	S	U	U	U	S	U	
Acetic Acid*	80-100	U	U	S	U	U	U	S	U	S	S	S	U	-	-	-	-	-	-	-	
Acetic Anhydride		-	-	-	-	-	-	U	U	S	-	-	-	-	-	S	S	U	S	-	
Acetone* +		U	U	U	U	U	U	U	U	S	S	U	U	U	U	S	U	U	S	S	100
Acrylic Emulsions*		U	U	S	U	U	U	-	-	-	-	S	U	-	-	-	-	-	-	-	
Acrylonitrile		-	-	-	-	S	U	S	U	S	-	-	-	U	U	U	U	U	-	S	100
Adipic Acid		S	S	S	S	S	S	-	-	S	S	S	-	S	S	-	-	-	-	-	
Alcohol:																					
Amyl		S	S	S	S	S	U	S	S	S	S	S	S	U	U	S	S	S	S	S	
Benzyl		-	-	-	-	S	S	S	S	-	-	-	-	U	U	U	U	S	S	U	100
Butyl		S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	S	-	
Diacetone		-	-	-	-	S	-	S	U	-	-	-	-	-	-	S	S	U	S	-	
Ethyl		-	-	S	S	S	-	S	S	S	S	-	-	S	S	S	S	S	S	S	
Hexyl		-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S	S	-	
Isobutyl		-	-	-	-	-	-	S	S	-	-	-	-	-	-	S	-	S	S	-	
Isoproyl		-	-	S	S	S	-	S	S	-	-	-	-	S	S	S	S	S	S	S	
Methyl		-	-	S	S	S	-	S	S	-	-	-	-	S	S	S	S	U	S	S	
Octyl		-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	-	
Propyl		-	-	S	S	S	-	S	S	-	-	-	-	S	S	S	S	S	S	S	
Allyl Alcohol*		U	U	S	S	S	S	S	S	-	-	S	S	S	U	-	-	-	-	S	100
Aluminum Salts	Conc.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	-	
Aluminum Hydroxide		-	-	S	S	S	-	S	S	S	S	-	-	S	S	-	-	S	S	-	
Alums (All Types)	Conc.	S	S	S	S	S	S	-	-	-	-	S	S	-	-	-	S	S	-	-	
Ammonia, Dry Gas	100	S	S	S	S	S	S	-	-	-	-	S	S	-	-	-	-	-	-	S	100
Ammonia, Solution	30	U	U	S	S	S	S	S	S	S	S	S	U	U	U	S	S	S	-	-	
Ammonium, Salts		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	U	S	10
Amyl Acetate* +	100	U	U	U	U	U	U	S	U	S	S	S	U	-	-	S	U	U	-	S	100
Amyl Alcohol*	100	U	U	S	S	U	U	S	S	S	S	S	S	-	-	S	S	S	-	S	100
Amyl Chloride	100	U	U	U	U	U	U	S	S	S	S	S	U	-	-	-	-	-	-	-	
Aniline*	100	U	U	S	U	S	U	S	U	S	U	-	-	-	-	S	-	S	-	U	100
Antimony Chloride		S	S	S	S	S	U	S	U	S	U	S	S	-	-	-	-	S	-	U	10
Aqua Regia*		U	U	U	U	U	U	S	U	S	S	S	U	U	U	U	U	U	U	-	
Arsenic Acid	80	S	S	S	S	S	S	S	S	S	S	-	-	-	-	-	-	S	-	-	
Barium Salts		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	
Benzaldehyde*	10	U	U	U	U	S	U	S	U	S	U	-	-	-	-	S	U	U	S	U	100
Benzene*		U	U	U	U	U	U	S	S	S	S	S	U	-	-	U	U	S	U	S	100
Benzene Sulfonic Acid*	10	U	U	S	U	S	S	S	U	S	S	S	S	S	S	-	-	S	-	-	
Benzoic Acid	All Conc.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	-	
Black Liquor		See Note 2						S	S	-	-			-	-	S	-	S	-	-	
Bleach	10	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	U	S	-	U	10
Borax	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	-	
Boric Acid	Conc.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	U	
Bromine Gas	Weak Conc.	U	U	U	U	U	U	S	S	S	S	S	S	-	-	-	-	S	-	U	
Bromine Liquid	100	U	U	U	U	U	U	S	S	S	S	-	-	-	-	-	-	S	-	U	

TABLE 7.7: VARIOUS RESIN, ELASTOMER AND STEEL TANK MATERIALS—NALGE (continued)

Description	% Conc.	LDPE/HDPE 70°	LDPE/HDPE 140°	XLPE[1] 70°	XLPE[1] 140°	PP 70°	PP 140°	PVDF 70°	PVDF 140°	E-CTFE 70°	E-CTFE 140°	FRP 70°	FRP 140°	PVC 70°	PVC 140°	EPDM 70°	NEO-PRENE 70°	VITON 70°	316 Stain Less	Nylon 70°	Nylon % Conc.
Bromine Water+		U	U	U	U	U	U	S	S	S	S	-	-	S	S	-	-	S	-	U	
Butadiene		-	-	-	-	-	-	S	S	S	S	-	-	S	S	S	-	S	S	-	
Butane		-	-	-	-	S	-	S	S	S	S	-	-	S	S	U	S	S	S	-	
Butanediol*	100	U	U	S	S	U	U	S	S	S	S	-	-	-	-	-	-	-	-	-	
Butyl Acetate+	100	U	U	S	U	U	U	S	U	S	S	S	U	-	-	-	-	-	-	S	100
Butyl Alcohol*	100	U	U	S	S	U	U	S	S	S	S	S	S	-	-	-	-	S	-	-	
Butylene		-	-	-	-	-	-	S	S	S	S	-	-	S	S	U	-	S	S	-	
Butyric Acid	80	U	U	-	-	S	S	S	S	S	S	S	U	S	U	-	-	S	-	U	100
Cadmium Salts		S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	-	
Calcium Salts		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	-	
Calcium Hypochlorite		S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	U	S	-	-	
Calgon (sodium hexameta phosphate)		U	U	S	S	U	U	S	S	S	S	-	-	-	-	-	S	-	S	-	
Camphor Oil		U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	-	-	-	S	100
Carbon Bisulfide* (disulfide)		U	U	U	U	U	U	S	U	S	U	-	-	-	-	U	U	S	U	S	100
Carbon Dioxide, Wet or Dry	100	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	S	S	-	-	
Carbon Monoxide		S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	S	S	S	-	
Carbon Tetrachloride+		U	U	U	U	U	U	S	S	S	S	S	S	S	U	U	U	S	S	S	100
Carbonic Acid		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	-	
Castor Oil*		U	U	S	S	U	U	S	S	S	S	-	-	S	S	-	S	S	-	-	
Chlorine Gas	100	U	U	U	U	U	U	S	S	S	S	S	S	-	-	U	U	S	-	U	100
Chlorine Liquid		U	U	U	U	U	U	S	S	S	S	-	-	U	U	-	-	-	-	-	
Chlorine Water	Satd.	S	U	S	U	S	U	S	S	S	S	S	S	S	S	-	-	-	-	U	Satd.
Chloroacetic Acid*	100	U	U	U	U	U	U	S	-	S	S	S	U	-	-	S	S	U	U	U	10
Chlorobenzene*+		U	U	U	U	U	U	S	S	S	S	S	U	U	U	U	U	S	S	S	100
Chloroform*+		U	U	U	U	U	U	S	S	S	S	-	-	U	U	U	U	S	S	U	100
Chlorosulfonic Acid*		U	U	U	U	U	U	U	U	S	-	-	-	S	U	U	U	U	U	U	100
Chrome Alum	Satd.	S	S	S	S	S	S	S	S	-	-	-	-	-	-	-	-	S	-	-	
Chromic Acid	50	U	U	S	S	U	U	S	S	S	S	-	-	U	U	S	U	S	S	U	
Chromic Acid & 50% Sulfuric Acid*		U	U	S	U	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	
Citric Acid*	Satd.	U	U	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	U	Conc.
Coconut Oil Derivatives		S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	-	S	100
Cupric Salts		S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	U	S	U	-	
Cuprous Salts		S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	U	S	U	-	
Cottonseed Oil*		U	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	
Cresol*		U	U	S	U	S	U	S	S	S	S	-	-	U	U	U	U	S	S	U	100
Cresylic Acid		-	-	-	-	-	-	S	S	S	S	-	-	S	S	U	U	S	S	-	
Cyclohexane		-	-	-	-	U	U	S	S	S	S	-	-	U	U	U	U	S	S	S	100
Cyclohexanone*		U	U	U	U	S	U	S	U	S	U	-	-	U	U	-	-	-	-	S	100
Detergents*		U	U	S	S	U	U	S	S	S	S	S	S	-	-	-	S	S	-	-	
Developers, Photographic		S	S	S	S	S	S	S	S	-	-	S	U	-	-	-	-	-	-	-	
Dextrin	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	-	
Dextrose	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	-	
Diazo Salts		S	S	S	S	S	S	-	-	-	-	S	S	S	S	-	-	-	-	-	
Diesel Fuel		-	-	S	U	-	-	S	S	S	S	-	-	S	S	U	U	S	S	S	100
Diethylamine		-	-	-	-	-	-	S	U	S.	U	-	-	U	U	U	-	U	S	-	
Diethylene Glycol*		U	U	S	S	S	S	-	-	-	-	S	S	-	-	-	-	-	-	S	90
Dioctylphthalate*		U	U	U	U	U	U	S	U	S	U	S	S	U	U	-	-	-	-	S	
Disodium Phosphate		S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	-	-	
Emulsions, Photographic*		U	U	S	S	U	U	S	S	-	-	S	U	-	-	-	-	-	-	-	
Epsom Salts (Magnesium Sulfate)		S	S	S	S	S	S	S	S	S	S	-	-	S	-	S	S	S	S	-	

(continued)

TABLE 7.7: VARIOUS RESIN, ELASTOMER AND STEEL TANK MATERIALS—NALGE (continued)

Description	% Conc.	LDPE/ HDPE		XLPE[1]		PP		PVDF		E-CTFE		FRP		PVC		EPDM	NEO-PRENE	VITON	316 Stain Less	Nylon	
		70°	140°	70°	140°	70°	140°	70°	140°	70°	140°	70°	140°	70°	140°	70°	70°	70°		70°	% Conc.
Ethyl Acetate* +	100	U	U	U	U	U	U	-	-	S	S	-	-	-	-	-	-	-	-	S	100
Ethyl Alcohol*	100	U	U	S	S	U	U	S	S	-	-	S	S	-	-	-	-	S	-	S	
Ethyl Bromide		U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	
Ethyl Chloride +		U	U	U	U	U	U	S	S	S	S	S	U	U	U	S	U	S	S	S	
Ethyl Ether		U	U	U	U	U	U	S	U	S	S	-	-	U	U	-	-	-	-	-	
Ethylene Chloride		U	U	U	U	U	-	S	S	S	S	-	-	U	U	U	U	S	S	S	100
Ethylene Dichloride*		U	U	U	U	U	U	S	S	S	U	-	-	U	U	U	U	S	S	-	
Ethylene Glycol*		U	U	S	S	U	U	S	S	S	S	S	S	S	S	S	S	S	S	S	95
Ethylene Oxide		S	U	S	U	S	U	S	S	S	S	-	-	U	U	U	U	U	-	-	
Fatty Acids*		U	U	S	S	S	S	S	S	-	-	S	S	S	S	U	U	S	S	-	
Ferric Salts		S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	U	
Ferrous Salts		S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	U	
Fish Solubles*		U	U	S	S	U	U	-	-	-	-	S	S	S	S	-	-	-	-	-	
Fluoboric Acid		S	S	S	S	S	S	S	S	S	-	S	S	S	S	-	S	S	U	-	
Fluorine		U	U	U	U	U	U	S	-	S	-	U	U	-	-	-	-	S	-	-	
Fluosilicic Acid	32	S	S	S	S	S	S	S	S	S	S	S	U	-	-	-	-	S	-	-	
Fluosilicic Acid	Conc.	S	U	S	S	S	U	S	S	S	S	S	U	-	-	-	-	S	-	-	
Formaldehyde*	40	U	U	S	U	S	S	S	U	S	S	S	S	S	S	S	S	S	-	-	
Formic Acid*	100	U	U	S	S	S	S	S	S	S	S	S	U	-	-	S	S	U	-	U	90
Freon 11		-	-	-	-	-	-	S	S	S	S	-	-	S	S	U	S	U	S	-	
Freon 113		-	-	-	-	-	-	S	S	S	S	-	-	S	S	U	S	U	S	S	100
Freon 12		S	U	S	U	S	U	S	S	S	S	-	-	-	-	-	S	U	-	-	
Fructose	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	
Fruit Juice		S	S	S	S	-	-	S	S	S	S	-	-	S	S	U	U	S	S	S	100
Fruit Pulp*		U	U	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S	-	
Fuel Oil*		U	U	S	U	S	U	S	S	S	S	S	S	-	-	-	S	S	S	S	100
Furan Resin		-	-	-	-	S	-	-	-	-	-	-	-	-	-	U	U	S	S	-	
Gallic Acid*	Satd.	U	U	S	S	S	S	S	U	S	S	-	-	-	-	-	-	S	-	-	
Gasoline* +		U	U	S	U	U	U	S	S	S	S	S	S	-	-	U	U	S	S	S	100
Gelatin		-	-	S	S	S	-	S	S	S	S	-	-	S	S	S	S	S	S	-	
Gin*		U	U	S	U	S	S	S	S	S	S	-	-	-	-	-	-	S	-	-	
Glucose		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	
Glue, P.V.A.		-	-	-	-	S	-	S	S	-	-	-	-	-	-	-	S	S	S	-	
Glycerol*		U	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	
Glycolic Acid*	30	U	U	S	S	S	S	S	U	S	S	S	S	-	-	-	-	S	-	-	
Glycols*		U	U	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	-	
Gold Monocyanide		S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	S	S	S	-	
Grape Juice		-	-	S	S	-	-	S	S	S	S	-	-	-	-	-	S	S	S	-	
Grape Sugar	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	-	
Grease		S	U	S	S	S	U	S	S	S	S	-	-	S	S	-	U	S	S	-	
Heptane* +		U	U	S	U	S	U	S	S	S	S	S	S	S	S	U	U	S	S	S	100
Hexane* +		U	U	S	U	U	U	S	S	S	S	-	-	S	U	U	U	S	S	S	100
Honey		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	
Hydraulic Oils (Petroleum)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	S	U	S	S	100
Hydraulic Oils (Synthetic)		-	-	-	-	-	-	S	U	-	-	-	-	-	-	-	U	S	S	-	
Hydrazine		-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	-	
Hydrobromic Acid	50	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	U	
Hydrochloric Acid	20	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	S	S	U	U	pH2
Hydrochloric Acid	37	S	S	S	S	S	S	S	S	S	S	-	-	S	S	U	U	S	U	U	pH2
Hydrocyanic Acid	Satd.	S	S	S	S	S	S	S	S	S	S	S	-	-	-	S	S	S	-	-	
Hydrofluoric Acid	50	S	U	S	S	S	-	S	S	S	S	-	-	S	U	U	S	S	U	-	
Hydrofluoric Acid	75	-	-	S	S	S	-	S	S	-	-	-	-	-	-	U	U	S	U	-	
Hydrofluosilicic Acid	32	S	S	S	S	S	S	S	S	S	S	S	U	-	-	-	-	S	-	-	
Hydrofluosilicic Acid	Conc.	S	U	S	S	S	U	-	-	S	S	S	U	-	-	-	-	S	-	-	

(continued)

TABLE 7.7: VARIOUS RESIN, ELASTOMER AND STEEL TANK MATERIALS—NALGE (continued)

Description	% Conc.	LDPE/HDPE 70°	LDPE/HDPE 140°	XLPE[1] 70°	XLPE[1] 140°	PP 70°	PP 140°	PVDF 70°	PVDF 140°	E-CTFE 70°	E-CTFE 140°	FRP 70°	FRP 140°	PVC 70°	PVC 140°	EPDM 70°	NEOPRENE 70°	VITON 70°	316 Stainless	Nylon 70°	Nylon % Conc.
Hydrogen	100	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	
Hydrogen Chloride Gas, Dry		S	S	S	S	S	S	S	S	-	-	S	S	-	-	-	-	-	-	-	
Hydrogen Peroxide	30	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	-	U	
Hydrogen Phosphide	100	S	S	S	S	-	-	S	U	S	S	-	-	-	-	-	-	-	-	-	
Hydrogen Sulfide		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	S	Satd.
Hydrogen Sulfide, Aqueous Sol'n		S	S	S	S	S	U	S	S	S	S	-	-	S	S	S	U	S	S	-	
Hydroquinone		S	S	S	S	S	S	S	S	S	S	-	-	S	S	-	-	S	-	U	Dilute
Hypochlorous Acid	Conc.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	-	
Inks*		U	U	S	S	S	S	S	U	-	-	-	-	-	-	-	-	-	S	S	
Iodine		-	-	-	-	S	U	S	S	-	-	-	-	U	U	U	-	S	U	U	3
Iodine (KI Sol'n)	Conc.	U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	
Isopropyl Alcohol		U	U	S	S	S	U	S	S	S	S	-	-	-	-	-	S	S	S	S	
Isopropyl Ether		-	-	-	-	S	-	S	U	S	U	-	-	-	-	U	U	U	S	S	100
Isooctane		-	-	-	-	-	-	-	-	S	U	-	-	-	-	S	S	S	-	S	
Jet Fuel (JP3, JP4, JP5)		-	-	-	-	-	-	S	S	S	S	-	-	S	S	U	U	S	S	S	
Kerosene*		U	U	U	U	S	U	S	S	S	S	S	S	S	S	U	U	S	S	S	
Ketones		-	-	-	-	S	-	U	U	-	-	-	-	-	-	S	U	U	S	S	
Lactic Acid*	90	U	U	S	S	S	S	S	U	S	U	S	S	-	-	S	S	S	-	S	90
Lard Oil		-	-	S	S	-	-	S	S	S	S	-	-	-	-	U	U	S	S	-	
Latex*		U	U	S	S	S	S	-	-	-	-	-	-	-	-	-	U	S	S	-	
Lead Acetate	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	S	
Lime		-	-	S	S	-	-	-	-	-	-	-	-	-	-	S	S	S	-	-	
Linseed Oil*		U	U	S	U	S	S	S	S	S	S	S	S	S	S	-	S	S	-	S	
Lube Oil*		U	U	U	U	S	U	S	S	S	S	-	-	-	-	-	-	S	-	-	
Magnesium Salts		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	
Maleic Acid		S	U	S	U	S	U	S	S	S	S	-	-	S	S	U	U	S	S	U	Conc.
Mercuric Salts	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	U	
Mercurous Salts	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	U	
Mercury		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
Methyl Acetate		-	-	-	-	-	-	S	U	-	-	-	-	-	-	U	U	U	S	S	100
Methyl Alcohol*	100	U	U	S	S	S	S	S	S	-	-	S	U	-	-	S	S	S	-	S	
Methyl Bromide		U	U	U	U	U	U	S	S	-	-	-	-	U	U	U	U	S	-	-	
Methyl Butyl Ketone		-	-	-	-	U	U	S	U	S	S	-	-	-	-	S	U	U	S	-	
Methyl Cellosolve		-	-	-	-	-	-	S	S	S	S	-	-	U	U	U	U	U	-	-	
Methyl Chloride*		U	U	U	U	U	U	S	S	S	S	-	-	U	U	U	U	S	S	-	
Methyl Isobutyl Ketone		-	-	-	-	U	U	S	U	S	S	-	-	U	U	U	U	U	S	S	100
Methyl Ethyl Ketone* +	100	U	U	U	U	U	U	U	U	S	S	-	-	U	U	S	-	-	-	S	100
Methyl Methacrylate		-	-	-	-	-	-	S	U	S	U	-	-	S	-	U	U	U	-	-	
Methyl Sulfuric Acid*		U	U	S	U	S	U	S	U	S	S	S	S	S	S	-	-	-	-	-	
Methylamine		-	-	-	-	-	-	U	U	S	U	-	-	U	U	-	-	-	S	-	
Methylene Chloride*	100	U	U	U	U	U	U	U	U	S	U	-	-	-	-	-	-	-	-	S	100
Milk		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
Mineral Oils*		U	U	U	U	S	U	S	S	S	S	S	S	S	S	-	S	S	-	S	
Molasses	Comm.	S	S	S	S	S	S	-	-	S	S	S	S	-	-	U	-	-	-	-	
Naphtha*		U	U	U	U	S	U	S	S	S	S	S	S	S	S	U	U	S	S	-	
Naphthalene*		U	U	U	U	S	S	S	S	S	S	S	S	U	U	U	U	S	U	S	
Nickel Salts		S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	-	-	
Nicotine*	Dilute	U	U	S	S	S	S	S	U	S	S	-	-	-	-	-	-	-	-	-	
Nicotinic Acid*		U	U	S	S	S	S	S	S	S	S	-	-	S	S	-	-	-	-	-	
Nitric Acid	0–30	S	S	S	S	U	U	S	S	S	S	S	U	S	S	-	-	S	-	U	0.1
Nitric Acid	30–50	S	U	S	U	U	U	S	S	S	S	S	U	S	S	U	U	S	S	U	
Nitric Acid	50–70	U	U	U	U	U	U	S	U	S	S	-	-	S	U	-	-	S	-	-	
Nitric Acid	95–98	U	U	U	U	U	U	U	U	S	S	U	U	U	U	-	-	U	-	-	
Nitrobenzene*	100	U	U	U	U	U	U	S	U	S	S	-	-	-	-	S	U	U	-	U	100

(continued)

TABLE 7.7: VARIOUS RESIN, ELASTOMER AND STEEL TANK MATERIALS—NALGE (continued)

Description	% Conc.	LDPE/HDPE 70°	LDPE/HDPE 140°	XLPE[1] 70°	XLPE[1] 140°	PP 70°	PP 140°	PVDF 70°	PVDF 140°	E-CTFE 70°	E-CTFE 140°	FRP 70°	FRP 140°	PVC 70°	PVC 140°	EPDM 70°	NEO-PRENE 70°	VITON 70°	316 Stain Less	Nylon 70°	Nylon % Conc.
Oils*																					
Essential		-	-	-	-	-	-	S	S	S	S	-	-	-	-	-	U	-	S	S	
Mineral		-	-	-	-	-	-	S	S	S	S	-	-	-	-	-	S	S	S	S	100
Vegetable		-	-	-	-	-	-	S	S	S	S	-	-	-	-	-	S	S	S	S	100
Lubricating		-	-	-	-	-	-	S	S	S	S	-	-	-	-	-	S	S	S	S	100
Oils and Fats*		U	U	U	U	S	U	S	S	S	S	S	S	-	-	-	S	S	-	S	
Oleic Acid	Conc.	U	U	U	U	S	U	S	S	S	S	S	S	-	-	U	U	S	-	S	100
Oleum		-	-	-	-	U	U	U	U	S	U	-	-	U	U	U	U	S	S	U	
Orange Extract		S	S	S	S	S	S	S	S	S	S	-	-	-	-	-	-	-	-	-	
Oxalic Acid	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	U	10
Ozone		U	U	U	U	U	U	S	S	S	S	-	-	S	S	-	-	S	-	U	
Palmitic Acid		S	U	S	U	S	S	S	S	S	S	S	S	-	-	-	-	S	-	-	
Paraffin		-	-	-	-	-	-	S	S	S	S	-	-	S	S	U	-	S	-	S	
Pentane		-	-	-	-	-	-	S	S	S	S	-	-	-	-	U	U	S	S	S	100
Perchloric Acid	10	S	S	S	S	S	S	S	S	S	S	S	U	S	U	-	-	S	-	U	10
Perchlorethylene		U	U	U	U	U	U	S	U	S	S	-	-	-	-	U	U	S	S	S	100
Phenol Carbolic Acid	5	S	U	S	U	S	S	S	S	S	S	-	-	-	-	U	U	S	-	U	
Phosphoric Acid	50	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	U	3
Phosphoric Acid	85	S	U	S	U	S	S	S	S	S	U	S	S	-	-	S	S	S	-	U	
Phosphorus Pentoxide	100	S	S	S	S	S	U	S	S	S	S	-	-	-	-	-	-	-	-	-	
Phosphorus Trichloride	100	S	S	-	-	-	-	S	S	S	S	-	-	-	-	-	-	-	-	-	
Photographic Solutions*		U	U	S	S	S	S	S	S	S	S	S	U	S	S	-	-	-	-	-	
Pickling Baths, Hydrochloric Acid*		U	U	S	S	S	S	-	-	-	-	S	S	-	-	-	-	-	-	-	
Pickling Baths, Sulfuric Acid*		U	U	S	S	S	S	-	-	-	-	S	S	-	-	-	-	-	-	-	
Pickling Baths, Sulfuric-Nitric*		U	U	S	U	S	U	-	-	-	-	S	U	-	-	-	-	-	-	-	
Picric Acid*	1	U	U	S	U	S	-	S	U	S	U	S	S	U	U	U	S	S	-	-	
Plating Solutions, Without Wetting Agents		S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	S	S	S	-	
Potassium Salts		S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	-	
Potassium Hydroxide*		U	U	S	S	S	S	S	U	S	S	S	S	S	S	S	U	S	U	S	10
Propane		-	-	-	-	-	-	S	S	S	S	-	-	-	-	U	-	S	S	S	
Propyl Alcohol*		U	U	S	S	S	S	S	S	S	S	-	-	-	-	-	-	S	-	-	
Propylene Glycol*		U	U	S	S	-	-	-	-	-	-	S	S	-	-	-	U	S	S	-	
Pyridine*		U	U	S	U	S	S	U	U	U	U	-	-	U	U	U	U	U	U	S	
Pyrogallic Acid		-	-	-	-	-	-	S	U	S	S	-	-	S	U	-	-	S	S	-	
Rayon Coagulating Bath*		U	U	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	
Selenic Acid		S	U	S	U	S	U	-	-	-	-	-	-	S	S	-	-	-	-	-	
Shortening*		U	U	S	S	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	
Silicic Acid		S	S	S	S	S	S	S	S	S	-	S	S	S	S	-	-	S	-	-	
Silver Salts		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
Soap Solution*	Any Conc.	U	U	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	S	
Sodium Salts		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	
Sodium Hexametaphosphate*		U	U	S	S	U	U	-	-	-	-	-	-	-	-	-	S	-	S	-	
Sodium Hydroxide*	20	U	U	S	S	S	-	S	S	S	S	-	-	S	S	S	-	S	S	-	
Sodium Hydroxide	Conc.	U	U	S	S	S	-	-	-	-	-	S	U	-	-	-	-	-	-	-	
Sodium Hypochlorite		S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	U	S	-	U	
Sour Crude*		U	U	S	U	S	U	S	S	S	S	S	S	-	-	-	-	S	-	-	
Stannic Salts		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	
Stannous Salts		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	-	
Starch Solution	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	-	
Stearic Acid*	100	U	U	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	-	
Stoddard's Solvent		-	-	-	-	S	-	S	S	S	S	-	-	U	U	U	U	S	S	S	100
Styrene		-	-	-	-	-	-	S	S	S	S	-	-	-	-	U	U	S	S	S	

(continued)

TABLE 7.7: VARIOUS RESIN, ELASTOMER AND STEEL TANK MATERIALS—NALGE (continued)

Description	% Conc.	LDPE/ HDPE 70°	LDPE/ HDPE 140°	XLPE[1] 70°	XLPE[1] 140°	PP 70°	PP 140°	PVDF 70°	PVDF 140°	E-CTFE 70°	E-CTFE 140°	FRP 70°	FRP 140°	PVC 70°	PVC 140°	EPDM 70°	NEO-PRENE 70°	VITON 70°	316 Stain Less	Nylon 70°	Nylon % Conc.
Sulfur		S	U	S	U	U	U	S	S	S	S	-	-	S	S	S	S	S	-	S	
Sulfur Chloride		-	-	-	-	-	-	S	U	S	U	-	-	-	-	U	U	S	U	-	
Sulfur Dioxide		S	U	S	U	S	U	S	S	S	S	S	S	-	-	-	U	S	U	-	
Sulfuric Acid	0–50	S	S	S	S	S	S	S	S	S	S	S	S	S	S	-	S	S	-	U	10
Sulfuric Acid	50–75	U	U	S	U	S	U	S	S	S	S	-	-	S	S	U	U	S	U	-	
Sulfuric Acid	75–95	U	U	S	U	U	U	S	S	S	S	-	-	U	U	U	U	S	U	-	
Sulfuric Acid	95–98	U	U	U	U	-	-	S	U	S	S	-	-	U	U	U	U	S	U	-	
Sulfuric Acid, Fuming*		U	U	U	U	U	U	U	U	S	U	-	-	-	-	-	-	S	-	-	
Sulfurous Acid	Conc.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	-	-	S	-	-	
Tallow		S	U	S	U	S	S	S	S	S	S	-	-	-	-	-	-	S	S	S	
Tannic Acid*	Conc.	U	U	S	S	S	S	-	-	-	-	S	S	-	-	-	-	S	-	-	
Tanning Liquors		-	-	-	-	-	-	S	U	S	S	-	-	S	S	-	-	-	S	-	
Tartaric Acid	Satd.	S	S	S	S	S	S	S	S	-	-	S	S	-	-	-	S	S	-	S	
Tetrachlorethane		-	-	-	-	S	-	S	S	S	S	-	-	-	-	U	-	S	S	-	
Tetrahydrofuran*		U	U	U	U	U	U	U	U	U	U	-	-	U	U	U	U	U	S	S	100
Thionyl Chloride		U	U	U	U	U	U	-	-	S	S	-	-	U	U	-	-	-	-	U	
Toluene+*		U	U	U	U	U	U	S	S	S	S	S	U	-		-	-	S	-	S	
Transformer Oil*		U	U	S	U	S	U	-	-	S	S	-	-	S	S	-	-	-	-	S	
Trichloroethylene		U	U	U	U	U	U	S	S	S	S	S	S	U	U	U	U	S	S	S	100
Trisodium Phosphate	Satd.	S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	S	90
Turpentine*		U	U	U	U	U	U	S	S	S	S	S	S	S	S	U	U	S	S	-	
Urea*	Conc.	U	U	S	S	S	S	S	S	S	S	S	S	-	-	-	-	-	-	S	
Urine		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	-	
Vanilla Extract*		U	U	S	S	S	S	-	-	S	U	-	-	-	-	-	-	-	-	-	
Vinegar		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	-	
Water, Acid, Mine		-	-	S	S	S	-	S	S	S	S	-	-	S	S	-	U	S	S	-	
Water, Distilled		-	-	S	S	S	-	S	S	S	S	-	-	-	-	S	S	S	S	S	
Water, Fresh		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
Water, Salt		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
Wetting Agents*		U	U	S	S	U	U	S	S	S	S	S	S	-	-	-	-	-	-	-	
Whiskey*		U	U	S	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	-	
White Liquor (Pulp Mill)		-	-	-	-	S	-	S	S	S	S	-	-	-	-	-	S	S	S	-	
White Water (Paper Mill)		-	-	-	-	S	-	-	-	S	S	-	-	-	-	-	S	S	S	-	
Wines		S	S	S	S	S	S	S	S	S	S	-	-	S	S	-	-	S	-	S	
Xylene*+		U	U	U	U	U	U	S	S	S	S	U	U	U	U	U	U	S	S	S	
Yeast		S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	-	
Zinc Salts		S	S	S	S	S	S	S	S	S	S	S	S	-	-	S	S	S	-	-	

LEGEND

S—Satisfactory
U—Unsatisfactory
-—No Test Data
*—These chemicals can cause stress-cracking of LDPE and HDPE under certain conditions. Rotomolded tanks are essentially stress-free and are not usually affected by stress-cracking chemicals. However, these chemicals may affect the service life of tanks with welded fittings or seams, and unsupported tanks operating under heavy loads. Use XLPE tanks which have excellent environmental stress-crack resistance.
+—Permeation by this solvent may cause softening, swelling and/or considerable loss of fluid in polyethylene tanks.
1—XLPE exhibits high environmental stress-crack resistance, but available data is limited and tests are recommended for severe conditions or chemicals not listed in this chart.
2—Mostly satisfactory, but black liquor varies considerably in composition and temperature. Field testing is recommended.

MATERIALS

LDPE—Low-Density Polyethylene
HDPE—High-Density Polyethylene
XLPE—Cross-linked High-Density Polyethylene
PP—Polypropylene
PVDF—Polyvinylidene Fluoride (also known as Kynar, a registered trademark of Penwalt Corp.)
E-CTFE—Ethylene-Chlorotrifluoroethylene (also known as Halar, a registered trademark of Allied Chemical Corp.)
FRP—Fiberglass-Reinforced Polyester
PVC—Polyvinyl Chloride
EPDM—Ethylene Propylene Diene Monomer
NEOPRENE—A Chloroprene polymer, synthetic rubber
VITON—A fluoroelastomer, registered trademark of E.I. Dupont de Nemours and Company, Inc.
NYLON—Generic name for long-chain polyamides which have recurring amide groups as an integral part of the main polymer chain

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER

KEY SYMBOLS: This Chemical Resistance Guide was compiled from available charts and tables provided by material manufacturers. Their nomenclature was condensed into key symbols. Their descriptive words shown below can aid in making judgements as to pump suitability for specific applications.

(A) ACCEPTABLE:
Excellent Resistance
Fully Resistant
Suitable
Recommended
Excellent Compatiblity
Fully Compatible

(Q) QUESTIONABLE
Good Resistance
Minor Effect
Moderate Effect
Slight Effect
Slight Attack
Fair Resistance

(N) NOT RECOMMENDED
Severe Effect
Unsatisfactory
Not Acceptable
Do Not Use

( ) DATA NOT AVAILABLE AT THIS TIME

CHEMICAL RESISTANCE GUIDE

CODE LETTERS
A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS: BRONZE 85-5-5-5	METALS: CAST IRON	METALS: NICKEL-SILVER 412	METALS: ALUMINUM 356	METALS: STAINLESS STEEL 303	METALS: STAINLESS STEEL 316 / W88	METALS: HASTELLOY "C"	ELASTOMERS: NEOPRENE	ELASTOMERS: BUNA N	ELASTOMERS: VITON	ELASTOMERS: URETHANE	ELASTOMERS: ETHYL. PROPYL.	ELASTOMERS: BUTYL	NON-METALLIC: TEFLON	NON-METALLIC: NYLON	NON-METALLIC: NORYL	NON-METALLIC: POLYESTER	NON-METALLIC: RYTON	NON-METALLIC: CHEMICAL GRADE CARBON	
Accent										A						A			A		
Acetaldehyde	Cold		Q		A	A	A	A	N	N	Q		A	A	A	A		A	A	A	
Acetamide			N						A	A			A		A						
Acetate Solvents		A	N	A					N	N			A	A	A	A					
Acetone	Cold & Boiling	A	A	A	A	A	A	A	N	N	N				A	A	N	A/Q	A	A	
Acetyl Chloride	Cold & Boiling						Q		N	N	A				A	N	N		A	A	
Acetonitrile	Cold						A								A				A	A	
Acetophenone	Cold						A	A/Q							A				A	A	
Acetylene	Cold	N	A	N			A	A	Q	A			A		A	A			A	A	
Acetylene Tetrabromide			N								A				A						
Acetyl Chloride	Cold & Boiling						Q		N	N	A				A	N	N		A	A	
Acid Mine Water	Cold						Q	A							A				A/Q	A	
Acid, Acetic (50% Unaerated)	Cold		N				A	A	N						A	N			A	A	
Acid, Acetic (50% Unaerated)	Boiling		N				Q	A	N						A	N			A	A	
Acid, Acetic (100% Unaerated)	Cold		N				A	A	N						A	N			A	A	
Acid, Acetic (100% Unaerated)	Boiling		N				Q	A	N						A	N			A	A	
Acid, Acetic Anhydride	Cold		A				A	A	Q						A	N			A	A	
Acid, Acetic Anhydride	Boiling		A				A	A	Q						A	N			A	A	
Acid, Acetic, Vapor		Q	Q	Q	N	A	A	A	N	Q	N				A						
Acid, Arsenic	Boiling	N	N			A	A/Q		A	A					A	A				A	
Acid, Benzene Sulphonic			N	A		Q	A	Q	A		A				A				A	A	
Acid, Benzoic	Cold	A	N	A		A	A	A	Q	N	A				A	N				A	
Acid, Boric	Boiling	A	N	A	A	A	A	A	A	A	A				A	N				Q	
Acid, Butyric	Cold	Q	N	Q	A	Q	A	A	N	Q	Q				A	N				A	
Acid, Carbolic (Phenol)	Cold	Q	N	Q	A		A*	A	Q		A				A	N			A	A	
Acid, Carbonic		A	N		A		A	A	A	Q	A				A	A				A	
Acid, Chloric	Cold						N	A							A					A	
Acid, Chloroacetic	Cold	N	N			N	N	A	A						A	N				A	
Acid, Chlorosulphonic			N				N	A			N				A	N			N	A	
Acid, Chromic (5%)	Cold	N	N	N	Q	Q	A	A			A				A	N			A	A	
Acid, Chromic (10%)	Boiling	N	N	N	Q	Q	Q	A			A				A	N			A/Q	A	
Acid, Chromic (50%)	Boiling	N	N	N	Q	Q	N	A/Q			A				A	N			Q	A	
Acid, Citric (15%)	Cold		N				A	A		A	A				A	Q			A	A	
Acid, Citric (15%)	Boiling		N				A	A							A	Q			A	A	
Acid, Citric (Concentrated)	Boiling	Q	N	Q	A	A	A/Q	A	A	Q			A	A	A	Q			A	A	
Acid, Cresylic		Q	Q			A	A	A/Q	N	Q	A				A	N					
Acids, Fatty		Q	N		A	A	A	A	N	A	N				A	A				A	
Acid, Fluoroboric			N			Q		A	A	A	A				A	Q					
Acid, Fluorosilicic		Q	N		Q	N	A/Q	A	A	A	A		A	A	A	N			A	A	
Acid, Formic	Cold to Hot	Q	N	Q	Q	Q	A*	A	Q	N			A	A	A	N	A	N	A/Q	A	

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS–OBERDORFER (continued)

CODE LETTERS
A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

		METALS							ELASTOMERS						NON-METALLIC						
NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Acid, Fumaric										A			A	A	A						
Acid, Gallic	Boiling	Q			A	Q	A	A			A		A	A	A	A			A	A	
Acid, Glacial Acetic			N					A			A		A		A	N	Q	N	A	A	
Acid, Glue Solution	Hot						A	A												A	
Acid, Glycolic							A	A							A				A	A	
Acid, Hydrogromic	Boiling	Q/N	N	Q	N	N	N	A/Q	Q	Q	A		A	A	A		A			A	
Acid, Hydrochloric (15%)		Q		Q	N	N	N	A	A	A	A		A	A	A	N	A	A	A	A	
Acid, Hydrochloric (20% Unaerated)							N	A							A				A/Q	A	
Acid, Hydrochloric (20%)	Cold	Q	N				N	A	A		A				A				Q/N	A	
Acid, Hydrochloric (30%)	Cold	N		N	N	N	N	A	Q	A	A		A	A	A	N	A	Q	A	A	
Acid, Hydrochloric (37%)	Cold	N	N				N	A	Q	Q	N				A	N	A		A/N	A	
Acid, Hydrochloric (All)	Hot	N	N		N		N	A/Q	N	N	A				A	N			A	A	
Acid, Hydrocyanic		N	N	N	A	A	A	A	A	A	A		A		A	A	·A			A	
Acid, Hydrofluoric (up to 50%)		Q	N	Q	N	N	N	A/Q	Q	N	Q		A		A	N	Q	N	A	A	
Acid, Hydrofluoric (50% to 100%)		N	N	N	N	N	N	A/Q	N	N	Q		Q		A	N	N	N	A	A	
Acid, Hydrofluosilicic		A		A		N	N	N	Q	Q	A		A		A						
Acid, Hydroxyl-Acetic		N			N				A	A	A		A		A						
Acid, Hypochlorous		N			N	N				A	A				A						
Acid, Lactic (5%)	Cold	Q	N	Q	Q	A	A	A	Q	Q	A		A		A	Q/N	A		A	A	
Acid, Lactic (5%)	Hot	Q	N	Q	Q	A	A	A	Q	Q	A		A		A	Q/N	A		A	A	
Acid, Lactic (10%)	Hot to Boiling	Q	N	Q	Q	Q	Q	A	Q	Q	A		A		A	Q/N	A		A	A	
Acid, Lactic, Salts							A	A												A	
Acid, Maleic		Q			Q	Q	A	A	N		A				A	A	A			A	
Acid, Malic	Cold & Hot	N			N		A	A	Q	A	A				A	A				A	
Acid, Molybdic (5%)	Cold						A	A												A	
Acid, Muriatic (20% Unaerated)	Cold						N	A							A				A/Q	A	
Acid, Muriatic (20%)	Cold						N	A							A				Q/N	A	
Acid, Muriatic (30%)		N		N	N	N			Q	A	A		A		A						
Acid, Muriatic (37%)	Cold						N	A							A				Q/N	A	
Acid, Muriatic (All)	Hot						N	A/Q							A					A	
Acid, Naphthenic		Q			Q	A	A			A	A				A						
Acid, Neville											A										
Acid, Nitric (10%)	Cold	N		N	N	Q	A	A	N	N	A		A		A	N	A	A	N/Q	A	
Acid, Nitric (35%)	Cold						A	A							A				A/Q	A	
Acid, Nitric (Concentrated)	Cold	N	N	N	Q	Q	A	A	N	N	N				A	N	N	Q	Q	A	
Acid, Nitric (Concentrated)	Boiling						A/Q	N							A				Q	A	
Acid, Nitric (Fuming)	Cold	N	N	N	N	N	A	A	N	N	Q				A	N	A		A/Q	A	
Acid, Nitrous (5%)	Cold	A					A								A					A	
Acid, Oleic (5%)	Cold	Q	N	A	A	A	A	A	N	A	A				A	A	Q			A	
Acid, Oxalic (10%)	Cold	Q	Q	A	A	A/Q	A/Q	A	A	N	A		A		A	N	N			A	
Acid, Oxalic (10%)	Boiling						N	A							A					A	
Acid, Palmitic		Q		Q						A					A						
Acid, Perchloric		N		N	N	N							A		A		N				
Acid, Phosphoric (Crude)		N	N	N	N	Q	Q	A	Q	Q	A		A		A	N			A		
Acid, Phosphoric (1%)	Cold	Q	N		N		A/Q	A	Q	N	A				A	N	A		A	A	
Acid, Phosphoric (10%)	Cold	Q	N		N		A	A	Q	N	A				A	N	A		A	A	
Acid, Phosphoric (50%)		Q	N	Q	N	Q	Q	A	A	A	A		A		A	N	A		A	A	
Acid, Phosphoric (Pure)		N	N	N	N	Q	Q	A	Q	A	A		A		A	N	A		A	A	
Acid, Picric Water Solution		N	A		N	Q	A	A	Q	A	A				A	A					
Acid, Propionic		Q			N		A/Q	A			N				A					A	

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Acid, Pyrogallic		Q					A	A			A				A					A	
Acid, Pyroligeneous		Q			Q	Q							A		A						
Acid, Salicylic	Hot	Q			A	Q		A					A		A					A	
Acid, Stearic (Concentrated)	Boiling	A	Q	A	Q	A	A	A	Q	A	A				A	A	A			A	
Acid, Succinic	Hot						A	A												A	
Acid, Sulphuric (5%)	Cold	N	N		N		A/Q	A	Q	N	A				A	N	A		A	A	
Acid, Sulphuric (5%)	Boiling	N	N		N		N	A/Q	Q	N	A				A	N	A		A	A	
Acid, Sulphuric (10%)		Q	N	Q	N	N	Q	A	N	Q	A		A		A	N'	A	Q	A		
Acid, Sulphuric (30%)	Cold	N	N		N		N	A	N	N	A				A	N	A		A	A	
Acid, Sulphuric (30%)	Boiling	N	N		N		N	N	N	N	A				A	N	A		A	A	
Acid, Sulphuric (75%)		N	N	N	N	N	N	Q	N	Q	A		A		A	N	A		Q		
Acid, Sulphuric (Concentrated)	Cold	N	N		N		A	A	N	N	A				A	N	A		A/Q	A	
Acid, Sulphuric (Concentrated)	Boiling	N	N		N		N	N	N		A				A	N				A	
Acid, Sulphuric (Fuming)	Cold	Q	N	Q	N	N	Q	Q	N	N	A				A				Q	A	
Acid, Sulphurous	Hot	N	N	N	N	A	A	A	N	Q	A		A		A	N	A			A	
Acid, Tannic (10%)	Cold & Hot	A	Q	A	Q	Q	A	A	Q	A	A				A	N	A				
Acid, Tartaric	Cold & Hot	A	Q	A	N	Q	A	A	A	Q	A				A	N	A			A	
Acid, Trichloroacetic (50%)		N	N	Q	N	N	N	A/Q		Q	A		A		A				A	A	
Acid, Oric (Concentrated)							A	A												A	
Acrylonitrile		Q	Q		A		Q	Q	N	N	N				A	A	Q		A		
Aero Grease										A											
Aero Shell Fluid No. 12										A											
Aerozine 50													A								
Alcohol, Amyl	Cold	A	A	A	A		A	A	A	A	N				A	A	Q	Q	A	A	
Alcohol, Benzyl		A	A	A	A		A	A	Q	N	A				A	A	A		A	A	
Alcohol, Butyl	Cold	A	N	A	A		A	A	A	A	A				A	A	A		A	A	
Alcohol, Butyl Ethyl	Cold						A	A							A				A	A	
Alcohol, Diacetone		A	A	A	A		A	A	A	Q	A				A	A	A				
Alcohol, Ethyl		A	A	A	A		A	A	A	Q	Q			A	A	A	Q		A	A	
Alcohol, Hexyl		A	A	A	A		A	A	A	A	A				A	A	A				
Alcohol, Isobutyl		A	Q	A	A		A	A	A	A	A			A	A	A	A				
Alcohol, Isopropyl		A	Q	A	A		A	A	A	A	A			A	A	A	A		A	A	
Alcohol, Methyl		A	A	A	A		A	A	A	A	N			A	A	A	A		A	A	
Alcohol, Methyl Propyl	Cold						A	A							A				A	A	
Alcohol, Octyl		A	A	A	A		A	A	A	A	A			A	A	A	A				
Alcohol, Propyl		A	Q	A	A		A	A	A	A	A				A	A	A		A	A	
Alcohol, Aminoethanol	Cold				Q		A									A	A		A	A	
Alka Form	Cold						A								A					A	
Alkasene											A										
Alkyl Benzene											A				A						
Allyl Chloride											A				A						
Allydiglycol Carbonate													A	A	A						
Alum		Q		Q						A					A	N					
Aluminum Acetate (Saturated)	Cold	Q					A	A		A					A					A	
Aluminum Bromide										A					A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
- A Acceptable
- Q Questionable
- N Not Recommended
- BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

TEMP. CLASSIFICATION: Cold—Room Ambient to 100°F; Hot—Medium Temp. 100°F to 200°F; Boiling—High Temp. 200°F & Up; Blank—No Temp. Listed—Use Cold

NAME OF LIQUID	TEMP. CLASSIFICATION	METALS							ELASTOMERS						NON-METALLIC					
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Aluminum Chloride (5%)	Cold	Q	N	Q	Q	N	N	A	A	A	A				A	N	A	N	A	Q
Aluminum Fluoride (5%)	Cold						Q	A	A	A	A				A	N	A			A
Aluminum Hydroxide (Saturated)	Cold	A	A	A	Q	A	A		A	A	A				A	A	A			A
Aluminum Nitrate					N	Q				A					A					
Aluminum Oxide		N	N				A		A		A				A					
Aluminum Oxyalate	Cold							A							A					A
Aluminum Potassium Sulphate (Alum)	Boiling	Q			Q		Q	Q	A	A	A				A	N	A			A
Aluminum Sulphate (Saturated)	Cold	Q	N	Q	Q	A	A	A	A	A	A				A	Q	A	A	A	A
Aluminum Sulphate (Saturated)	Boiling						A	A							A				A	A
Aluminum Sulphate Chlorohydroxide	Cold				N		N								A				A	A
Amines		N	N		A	A	A	A	N	Q	N		A		A	A	Q		.	
Ammonia, Anhydrous (Liquid)	Cold	N	A	N	A	A	A	A	A	A	N				A	A	A	A	A/Q	A
Ammonia Liquors		N	A	N	A	Q	A	A	A	A	N				A	A	A	A	A	
Ammonia Nitrate		N	A	N	A	A	A		Q	A					A		A			
Ammonium Alum	Cold						A	A												A
Ammonium Bicarbonate	Hot	N	Q	N	Q	A	A		A	A					A					A
Ammonium Bifluoride		N	N	N	N	A	A	A	A	A	A				A		A			
Ammonium Bromide	Cold						A	A							A					A
Ammonium Carbonate	Cold & Boiling	N	A	N	Q	A	A	A	A	A	A				A	A	A			A
Ammonium Chloride (50%)	Cold & Boiling	N	N	N	N	N	A/Q	A	A	A	N				A	N	A	Q	A	A
Ammonium Hydroxide (10%)		Q	A	Q	Q	A	A	A	A	A	A				A	A	A	Q	A	A
Ammonium Hydroxide (46.5%)		N	A	N	Q	A	A	A	A	Q	A		A		A	Q	A		A	A
Ammonium Monosulphate							A	A												A
Ammonium Nitrate	Cold	N	A	N	A	A	A	A	A	A	A				A	N	A	Q	A	A
Ammonium Nitrite										A					A					
Ammonium Oxalate	Cold	N	N			A	A	A	A	A					A					A
Ammonium Persulphate	Cold	N	N		Q	A	A	A	Q	A	A				A	N	A	A		A
Ammonium Phosphate		Q	Q	Q	N	Q	A	A	A	A	A				A	A	A	A		
Ammonium Sulphate (5% Aerated)	Cold						A	A							A				A	A
Ammonium Sulphate (Saturated)	Boiling						A	Q							A				A	A
Ammonium Sulphate (Saturated)	Cold & Boiling	Q	Q	Q	Q	Q	A	A	A	A	N				A	N	A	A	A	A
Ammonium Sulphide		N		N	A	Q	A	A	A	A					A					
Ammonium Thio-Sulphate		N	N	N		A	A		A	A					A					
Ammonium Thio-Cyanate		N		N	Q					A					A					
Ammonium Thio-Cyanide										A					A					
Amyl Acetate		A	Q	A	A	A	A/Q	A	N	N	N		A	A	A	N	N	Q	A	A
Amyl Alcohol		A	A	A	A		A	A	A	A	N				A	A	Q	Q	A	A
Amyl Borate										A					A					
Amyl Chloride		Q			N	Q	Q	A	N	A	Q				A	A	N	A		A
Amyl Chloronaphthalene											A				A					
Amyl Naphthalene											A				A					
Amyl Nitrate										A					A					
Anhyorous Hydrogen Fluoride													A		A					
Anhyorous Hydrazine													A	A	A					
Aniline (Saturated)	Cold	Q	Q	Q	Q		A	A	N	N	N		A	A	A	Q	N	N	A	A

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Aniline Dyes		Q	Q	Q		A	A		Q	Q	Q		A	A	A						
Aniline Hydrochloride (55)	Cold	N			N	N	Q	N					A	A	A					A	
Aniline Oil		A	A			A	A		N	N	Q				A						
Anise Oil		N	N			A	A		Q						A						
Ansul Ether																					
Ansul Oil										A											
Anti-Freeze, Dowgard		A	A	A	A	A	A		A	A	A										
Anit-Freeze, Hubbard-Hall		A	A	A	A	A	A		A	A	A										
Anti-Freeze, Permaguard		A	A	A	A	A	A		A	A	A										
Anti-Freeze, Prestone		A	A	A	A	A	A		N	A	Q										
Anti-Freeze, Pyro-Permanent		A	A	A	A	A	A		A	A	A										
Anti-Freeze, Pyro-Super		A	A	A	A	A	A		N	A											
Anti-Freeze, Shell Zone		A	A	A	A	A	A		A	A	A										
Anti-Freeze, Texaco P. T.		A	A	A	A	A	A		A	A	A										
Anti-Freeze, Telar		A	A	A	A	A	A		A	A	A										
Anti-Freeze, Zerex		A	A	A	A	A	A		A	A	A										
Anti-Freeze, Valvolene		A	A	A	A	A	A		Q	Q											
Antimony Salts										A					A	N					
Antimony Trichloride	Cold				N		N	A	Q						A	N				A	
Aqua Regia		N			N		N	N	N	N	A				A	N	N	N	N	A	
Arochlor						Q			N	Q	A					A	N				
Argon Gas										A					A						
Aromatic Hydrocarbons		Q	A		A		Q		N	N	A				A		N				
Arsenic Compounds		N			A	A	A			A					A						
Asphalt		A	A	A	A	A	A		Q	Q	A				A	A			A		
Asphalt Emulsions	Cold				Q		A	A							A				A	A	
Asphalt Topping		A		A	Q	A	A		A	Q	Q				A						
ASTM Oils No. 1, No. 2, No. 3		A	A			A	A		Q	A	A										
Automotive Gasoline		A	A	A	A	A	A	A	N	A	A				A	A	N		A	A	
Aviation Gasoline		A	A	A	A	A	A	A	N	A	A				A	A	N		A	A	
Barbecue Sauce		N	N				A		A	A					A						
Bardol B										A											
Barium Carbonate	Cold	A			A		A	A	A	A	A				A	A	A		A	A	
Barium Chloride	Hot						A	A							A				A	A	
Barium Chloride (Saturated)	Cold	A	Q	A	Q	A	A	A	A	A	A				A	Q	A	A	A	A	
Barium Hydrate							A	A												A	
Barium Hydroxide	Cold	A	A	A	N	A	A	A	A	A	A				A	A	A		A	Q	
Barium Nitrate	Hot	N	A		A	A	A		A	A	A				A		A			A	
Barium Sulphate	Cold	Q			A	Q	A	A	A	A	A				A	A	A	A	A	A	
Barium Sulphide		N		N	N	Q	A		A	A	A				A	A	A			A	
Beef Extract		N	N			A	A		A	A	A				A						
Beer		A	N	A	A	A	A	A	A	A	A				A	A	A	A	A	A	
Beet Sugar Syrups		A	A	A	A	A	A		A	A	A				A	A	A				
Benzaldehyde		N	A		A	N	A	A	N	N	Q		A	A	A	A	N	A	Q/N	A	

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
- A Acceptable
- Q Questionable
- N Not Recommended
- BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS: BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	ELASTOMERS: NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	NON-METALLIC: TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Benzene	Cold	A	A	A	A		A	A	N	N	A				A	A	N	Q	A	A
Benzine (Gasoline)		A	A	A	A	A	A	A	N	A	A				A	A	N		A	A
Benzol (Benzene)	Hot	A	A	A	A	A	A	A	N	N	Q				A	A	N	A	A	A
Benzonitrile							A/Q	A/Q							A	A	N		A	A
Benzyl Benzoate											A				A					
Benzyl Choride		N	N		Q		N	A/Q	N		A				A	A	N		A	A
Bichloride of Mercury										A					A					
Black Sulphate Liquor		Q		Q							A				A					
Bleach Liquor		Q		Q											A					
Boiler Feed Water		A		A		A	A		Q	Q	N				A					
Borax		A	A	A	A	A	A	A	A	A	A				A	A	A	A	A	A
Bordeaux Mixture		A		A						A					A					
Boron Fuels		N	N			A	A				A				A					
Brake Fluid		A	A	A			A	A	A	N					A			A		
Brewery Slop		A	A	A			A	A	A	A	A				A					
Bright Copper Plating Solution													A		A					
Bright Nickle Plating Solution													A		A					
Brine		A	N	A		A	A	A	A	A	A				A				A	A
Bromine (Wet)		Q		Q	Q	N	N		N	N	A				A	N	A	N	Q	
Bromobenzene											A				A					
Bunker C. Fuel Oil		A		A	A	A	A		Q	A					A					
Butadiene				Q	A		A	A/Q	Q	A	A		A	A	Q				Q	A
Butane		A	A	A	A	A	A	A/Q	A	A	A				A	A	N		A	A
Butanol (Butyl Alcohol)		A	A	A	A		A	A	A	A	A				A					
Butter		N	N	A	A	A	A		Q	A	A				A		A			
Buttermilk		N	N	A	A	A	A		A	A	A				A		A			
Butyl Acetate	Cold	A	A	A	A	Q	Q	A	N	N	N		A	A	A	A	N	A	A	A
Butyl Amine					A		A			A					A	A	N		Q	A
Butyl Benzoate													A	A						
Butyl Butyrate													A	A	A					
Butyl Carbitol													A	A	A					
Butyl Cellosolve				Q					N	N			A	A	A					
Butyl Ether					A		A								A	A	N		A	A
Butyl Oleate											A				A					
Butyl Phthalate								A					A		A	A	N		A	A
Butyl Stearate										A					A					
Butylene		A			A		A		Q	A	A				A				A	A
Butyraldehyde		N	A				N		N				A	A	A					
Cabot OHT Grease										A										
Cadenza Perfume										A										
Calcine Liquors										A					A					
Calcium Acetate										A					A					
Calcium Bisulphate		Q	N		N	A	A		A		A				A	A	A	N		
Calcium Bisulphide		Q			Q		A	A	A	A	A				A	A	A			

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS

A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

		METALS							ELASTOMERS						NON-METALLIC						
NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Calcium Bisulphite		Q		Q	Q		A		A	A	A				A	A					
Calcium Carbonate	Cold	A		A	A		A	A	A	A	A				A	A	A			A	
Calcium Chlorate (Dilute)	Hot or Cold	Q					A	A	A		A				A	A				A	
Calcium Chloride	Cold	Q	Q	A	Q	A	A*	A	A	A	A				A	N	A	A	A	A	
Calcium Hydroxide (10%)	Boiling	A	A	A	Q	A	A	A	A	A	A		A		A	A	A			A	
Calcium Hydroxide (50%)	Boiling						Q	A							A					A	
Calcium Hypochlorite (2%)	Cold	N	N		Q		A*	A	Q	A					A					A	
Calcium Hypochlorite (20% on Plastics)		Q	N	Q	Q	Q	A*	A	Q	Q	A				A	N	A	A	A	A	
Calcium Nitrate	Cold				Q		Q	A/Q		A	A				A	N	A		A	A	
Calcium Phosphate										A					A					A	
Calcium Salts										A					A						
Calcium Sulphate	Cold	A	A		Q	A	A	A/Q	Q	A	A				A	N	A		A	A	
Calgon		Q	N			A	A		A	A	A						A				
Caliche Liquors										A					A						
Camphor							A	A												A	
Cane Sugar Liquors		A	A	A	A	A	A		A	A	A				A	A					
Capella AA										A											
Carbamate											A				A						
Carbinol (Methanol)										A					A						
Carbitol										A					A						
Carbon Disulphide	Cold	Q			A		A		N	N	A				A	A					
Carbon Dioxide		A	N	A	A	A	A	A	A	A	Q				A				A	A	
Carbon Disulphide		Q	A	Q	A	A	A		N	N	A				A	A	N		A	A	
Carbon Monoxide		Q	N		A	A	A	A	A	A	A				A	A	A			A	
Carbon Tetrachloride		A	Q	A	Q	A	A	A	N	N	A				A	A	N	A	A	A	
Carbonated Beverages		Q	N	Q	A	A	A	A	A	A	A		A		A	A	A		A	A	
Casein										A					A						
Castor Oil		A	A	A	A	A	A		A	A	A				A	A			A	A	
Catsup		Q	N		N	A	A		Q	A	A				A	A	A				
Caustic Soda (See Sodium Hydroxide)							A	A							A				A	A	
Cellosolve					A		A	A					A	A	A	A	N		A	A	
Cellulose					A					A					A						
Cellulube		A	A			A	A		N	N	A		A	A							
Cellutherm											A										
Cetane (Hexadechie)									Q	A					A	A					
China Wood Oil (Tung)						A	A		A						A						
Chlorinated Lime		N	N			A	A		Q	Q					A						
Chlorinated Salt Brine										A					A	Q					
Chlorinated Solvents (Chl. Water on Plastics)		A					Q				A				A	N	A	N			
Chlorinated Water (Saturated)	Cold				Q		Q*	A							A				Q	A	
Chlorinated Biphenyl											A				A						
Chlorine (Anhyrous Liquid)		Q	Q	Q	A	A	N	A	A	A	A				A	N	A		Q		
Chloroacetone		N	N				A		Q				A		A						
Chlorobenzene	Cold	A	N		A	A	A	A	N	N	A				A	A	N	N	A	A	
Chloro Bromomethane		N	N		Q		A				Q				A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS

A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

TEMP. CLASSIFICATION: Cold—Room Ambient to 100°F; Hot—Medium Temp. 100°F to 200°F; Boiling—High Temp. 200°F & Up; Blank—No Temp. Listed—Use Cold

NAME OF LIQUID	TEMP. CLASSIFICATION	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Chlorobutadiene		N	N				A				A				A						
Chloroethanol																N	Q		A	A	
Chloroform	Cold	A	N	A	A	A	A	A	N	N	A				A	Q	N	A	A	A	
Chlorophenal (5% Aqueous)							A	A							A	N	Q		A	A	
Chlorotoluene											A				A						
Chlorox (Bleach		A	N		Q	A	A	A	Q	Q	Q					N	A		Q		
Chlorophenol							A	A			A				A	N	N		A	A	
Chocolate Syrup		N	N		A	A	A		A	A	A				A	A	A				
Chrome Alum										A	A				A					A	
Chrome Plating Solution	Cold									A			A		A						
Cider		A	N		A	A	A		A	A	A				A	A	A			A	
Cinnamon Oil		N	N			A	A		Q						A						
Citgo Gasoline													A								
Citric Oils		N	N		Q	A	A		N	A	A				A		A				
Citrus Pectin Liquor						A	A		A	A	A				A						
Clay Slurry					A					A					A						
Clove Oil		N	N			A	A		Q						A						
Coal Tar					A				Q	A					A						
Cobalt Chloride					N					A					A						
Coca Cola													A		A						
Coca Butter										A					A						
Coconut Oil		A	A			A	A		N	A	A				A						
Cod Liver Oil		N	N			A	A		N	A	A				A						
Coffee	Boiling	A			A	A	A	A	A	A	A				A	A	A			A	
Coke Oven Gas											A				A						
Coliche Liquors															A						
Condor 1008									A												
Convalex 10											A										
Coolanol 35									A												
Coolanol 45									A												
Copal Varnish (Saturated)	Cold						A	A												A	
Copper Acetate	Cold				N		A	A		A					A					A	
Copper Ammonium Acetate					N					A					A						
Copper Carbonate (Saturated)							A	A												A	
Copper Chloride		Q	N	Q	N	N	N	A	Q	A	A				A	N	A	N	A	A	
Copper Chloride (1% Aerated)	Cold						A*	A							A				A	A	
Copper Chloride (5% Aerated)	Cold						N	A							A				A	A	
Copper Cyanide (Saturated)	Boiling	Q	N		N	A	A	A	A	A	A				A	N	A	N	A	A	
Copper Nitrate		Q		Q	N	A	A	A	A	A	A				A	A	A	A		A	
Copper Nitrate (50% Aqueous)	Cold						A	A							A					A	
Copper Plating Solution					N								A		A						
Copper Salts					N					A					A						
Copper Sulphate (5%)	Cold	N	N		N		A	A	A	A	A				A	N	A		A	A	
Copper Sulphate (Saturated)	Boiling	Q	N	Q	N	A	A	A	A	A	A				A	N	A	Q	A	A	
Corn Starch Slurry					A					A					A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS

- A Acceptable
- Q Questionable
- N Not Recommended
- BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC					
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Corn Oil		A	A	A	A	A	A		Q	A	A				A					
Cotton Seed Oil		A	A	A	A	A	A	A	Q	A	A				A	A	A	A	A	A
Cream		N	N		A	A	A		Q	A	A				A	A	A			
Creosols		Q	Q		A	A	A	A	N	Q	Q				A	N			A	A
Creosote Oil (Coal Tar)	Hot	A	A	A	A	A	A	A	N		A				A					A
Cresyldiphenyl Phosphate																			A	A
Crotonaldehyde					A								A		A					
Crude Oil					A		Q	A			A				A				A	A
Cumene											A				A					
Cupric Chloride	Hot						N	A												A
Cupric Nitrate							A	A												A
Cuprous Ammonia Acetate										A					A					
Cutting Oil (Water Soluble)		A	A	A	A	A	A		N	Q	A				A					
Cutting Oil (Sulfur Base)		A	A	A	A	A	A		Q	A					A					
Cyanic Compounds										A					A					
Cyanogen													A		A					
Cyclehexamone													A	A	A	A	N		A	
Cycleweld L808										A										
Cyclohexane		N	A		A		A	A	N	A	A				A	A	N		A	A
Cyclohexanol					Q		A	A		A	A				A	A	N		A	A
Cyclohexanone					A		A	A		N	N				A	A	N		A	A
Cyclohexylamine									A	A			A	A	A					
DDT (Toluene Solvent)		A				A	A			A					A					
DDT (Kerosene Solvent)		A				A	A			A					A					
Dairy EEZ										A										
Decalin										N	A								N	
Decane										A					A					
Delco Shock Absorber Fluid										A										
Delvac 1100 Series Motor Oil		A		A	A	A	A		Q	A	A	A								
Delvac 1200 Series Motor Oil		A		A	A	A	A		Q	A	A	A								
Delvac 1300 Series Motor Oil		A		A	A	A	A		Q	A	A	A								
Delvac Special Motor Oil		A		A	A	A	A		Q	A	A	A								
Denatured Alcohol										A					A					
Detergent Water Solutions		A		A	Q	A	A	A	A	A	A				A	A	A	A	A	A
Developing Solutions (Hypos)		N	N				A	A	A	A	A				A					A
Diacetone					A								A	A	A					
Diacetone Alcohol		A		A	A				A	Q	A		A	A	A					
Diamylamine													A	A	A					
Dibenzyl Ether		N	N				A		N						A					
Dibenzyl Sebacate											A				A					
Dibromoethyl Benzene											A				A					
Dibutyl Cellosolve Adipate													A	A	A					
Dibromochloropropane		N	N				A				A		N		A					

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
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*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC					
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Dibutyl Ether		N	N				A		N						A					
Dibutyl Phthalate										B	B		A		A				A	A
Dibutyl Sebacate													A		A					
Dibutylamine													A		A					
Dichlorobenzene											A				A					
Dichloroethane						A	A	A	N	Q	A				A	A				
Dichloro-Butane											A				A					
Dichloro-Pentane									N	Q	A				A					
Dichlorohexylamine										A					A					
Diesel Fuel		A	A	A	A	A	A	A	N	A	A				A	A	N	A	A	A
De-Ester Synthetic Lubricants		A	A			A	A				A				A					
Diethanolamine									A	A			A		A				A	A
Diethyl Aniline													A		A					
Diethyl Benzene									N	N	A				A					
Diethyl Carbonate													A		A					
Diethyl Ether		Q			A	Q									A					
Diethyl Formaldehyde													A		A					
Diethyl Hydrazine													A		A					
Diethyl Maleate													A		A					
Diethyl Sebacate									N		A				A					
Diethyl Sulphate									A	A					A					
Diethylamine		A			A		A		A	A	N		A	A	A		A			
Diethylene Glycol		Q			Q	Q	A		Q	Q	Q		A		A	A	A			
Diethylene Triamine													A	A	A					
Di-Isobutyl Ketone													A	A	A					
Di-Isobutylene					A		A			A					A				A	A
Di-Isooctyl Sebacate											A				A					
Di-Isopropyl Benzene											A				A					
Di-Isopropyl Ketone									N	N	N		A	A	A					
Dimethyl Aniline													A	A	A	A	N		A	A
Dimethyl Formamide					A		A	A		A					A	A	N		A	A
Dimethyl Phthalate					A		A	A					A	A	A				A	A
Dimethyl Sulfoxide																A	A		A	A
Dinitro Toluene						A	A				Q				A					
Dinitrochloro Benzene											A				A					
Dioctyl Sebacate									N		Q			A	A					
Dioxane									A	A	A		A	A	A	A	N			
Dioxolane													A		A					
Dipentene					A					A					A					
Diphenyl					A					A					A					
Diphenyl, Chlorinated											A				A					
Diphenyl Oxides		A	A		A	A	A		N	A	A				A					
Diphenyl, Ether					A		A	A							A				A	A
Dioctyl, Phthalate					A		A	A							A				A	A
Disinfectant Deodorant		A				A	A		Q	A	A				A					

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
A Acceptable
Q Questionable
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*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC					
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Distillery Wort		A	Q			A	A		A						A					
Divinyl Benzene											A				A					
DMT (Dimethyl-Terephthalate)													A		A					
DNCB (Dinmrochlorobenzene)											A				A					
DTE Light Hydraulic Oil		A		A	A	A	A		Q	N	A	A								
DTE Medium Hydraulic Oil		A		A	A	A	A		Q	N	A	A								
DTE Heavy Medium Hydraulic Oil		A		A	A	A	A		Q	N	A	A								
DTE Extra Heavy Hydraulic Oil		A		A	A	A	A		Q	N	A	A								
DTE 23 Hydraulic Oil		A		A	A	A	A		Q	N	A	A								
DTE 24 Hydraulic Oil		A		A	A	A	A		Q	N	A	A								
DTE 25 Hydraulic Oil		A		A	A	A	A		Q	N	A	A								
DTE 26 Hydraulic Oil		A		A	A	A	A		Q	N	A	A								
DTE 950 Hydraulic Oil		A		A	A	A	A		Q	N	A	A								
Dow Corning 3		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 4		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 5		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 11		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 33		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 44		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 55		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 200		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 510		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 550		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 710		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning 1208		A		A	N	A	A		N	N	A	N	Q							
Dow Corning 4050		A		A	N	A	A		N	N	A	N	Q							
Dow Corning 6620		A		A	A	A	A		A	A	A	A	A	A						
Dow Corning F60		A		A	N	A	A		A	A	A	A	A							
Dow Corning F61		A		A	N	A	A		A	A										
Dow Corning XF60		A		A	N	A	A		A	A	A	A	A							
Dow Gauge Fluid R-200		A		A	A	A	A		A	A	A	A	A	A						
Dowtherm A		A		A	A	A	A		N	N	A	N	N			A	N		A	A
Dowtherm E				A	N	A	A		N	N	A	N	N			A	N		A	A
Dowanols										A										
Drip oil											A				A					
Dry Cleaning Fluids											A				A					
DTW 322 Oil										A										
DuPont Val Clene										A										
Dyes, Abrasive									N	N	Q				A					
Dyes, Water Base		Q			A	A	A		A		A				A		A			
Dyewood, Liquor							A													A
Elba Lyn Cologne									A											
Elco 28 EP Lubricant										A										
Embalming Fluid		A		A		A	A			A					A					

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
- A Acceptable
- Q Questionable
- N Not Recommended
- BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC					
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Epichlorohydrin					A		A	A	N		N		A	A	A	A	N		A	A
Esso HDX 40										A										
Esso Golden Gasoline		A		A	A	A	A			A										
Esso Motor Oil		A		A	A	A	A			A										
Esso Transmission Fluid		A		A	A	A	A			A										
Esso Turbo Oil										A										
Ethane		A			A		A		A	A	A				A		N			
Ethanolamine					Q		A		Q	A	N		A	A	A				A	A
Ether Compounds		A	Q	A	A	A	A	A	N	N	N		A		A	Q	N		A	A
Ethyl Acetate		A	A	A	A	A	A	A	N	N	N		A	A	A	A	N		A	A
Ethyl Acetoacetate													A	A	A					
Ethyl Acrylate										N	N		A	A	A					
Ethyl Alcohol		A		A	A			A	A	Q	Q				A	A	Q		A	A
Ethyl Amine									A						A					
Ethyl Benzene					A					Q	A				A					
Ethyl Benzoate											A				A					
Ethyl Bromide									A						A					
Ethyl Cellosolve													A	A	A					
Ethyl Cellulose										A					A					
Ethyl Chloride		A	Q	A	N	A	A	A	Q	A	A				A	A	N	Q	A	A
Ethyl Chloride (5%)							Q	A							A				A	A
Ethyl Chlorocarbonate											A				A					
Ethyl Chloroformate											A				A					
Ethyl Dichloride											A				A					
Ethyl Ether		A	Q			A	A		N	N	N				A					A
Ethyl Formate											A				A					
Ethyl Hexanol										A					A					
Ethyl Mercaptan									A						A					
Ethyl Oxalate											A				A					
Ethyl Pentachlorobenzene											A				A					
Ethyl Pyridine									A						A					
Ethyl Silicate													A		A					
Ethyl Sulphate							N		A	A	A				A					
Ethylene					A				A	A					A					
Ethylene Bromide					A								A		A					
Ethylene Chloride		A	Q		A		A	A	N	N	A				A	N	N		A	A
Ethylene Chlorohydrin											A				A					
Ethylene Diamine					A		A	A					A		A	N	N		A	A
Ethylene Dibromide											A				A				A	
Ethylene Dichloride		Q	A		Q		A	N	N	N	A				A	A	N		A	A
Ethylene Glycol		A	A	A	A	A	A	A	A	A	A				A	A	Q	A	A	A
Ethylene Oxide		A	N		A		A		N	N	N		A		A	A	A			A
Ethylene Trichloride					A						A				A					
Fatty Acids		Q	Q		A	A	A	A	N	A	N				A	A	A	A		A

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS

- A Acceptable
- Q Questionable
- N Not Recommended
- BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS: BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	ELASTOMERS: NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	NON-METALLIC: TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
FC-77 (Cyclic Fluorinated Ether)																			A	A
Ferric Chloride		N	N		N	N	N	A	A	A	A				A	N	A	N	A	A
Ferric Chloride (1%)	Cold						N	A							A				Q	A
Ferric Chloride (1%)	Boiling						N	N							A				Q	A
Ferric Chloride (5%)	Cold						N	N							A				A	A
Ferric Hydroxide	Cold						A	A												A
Ferric Nitrate		N			N	A	A	A	A	A	A				A	N	A	A	A	A
Ferric Nitrate (1% to 5%)	Cold						A	A							A				A	A
Ferric Oxide									Q						A					
Ferric Sulphate		N	N		N	Q	Q	A	A	A	A				A	N	A	A	A	A
Ferric Sulphate (1% to 5%)	Cold						A	A							A				A	A
Ferrous Ammonium Citrate								A												A
Ferrous Chloride		Q	N	Q	N	N	N	Q	Q	Q	Q				A	N	A	Q	A	A
Ferrous Sulfate		Q	N	Q	N	A	A	A	A	A	A				A	N	A	A	A	A
Ferrous Sulfate (Dilute)	Cold						A	A							A				A	A
Ferrous Sulfate (Concentrated)	Hot						N	Q							A				A	A
Fish Oil		N	N			A	A		A	A					A					
Flo-Cool 180 (Silicate Ester)																			A	A
Fluorinated Cyclic Ether													A		A					
Fluoro Benzene											A				A					
Fluorolube										A										
Formaldehyde (Formaline)		A	Q	A	A	A	A*	A	N	A	A				A	Q	A	Q	A	A
Formaldehyde (40%)	Cold				Q		A	A	A	Q	N				A	Q	A		A	A
Freon					A		A	A							A				A	A
Freon 11		A	Q	A	A	Q	A		N	Q	N				A	A	A	A	A	A
Freon 12		A	A	A	A	N	N		A	A	Q				A	A	A	A	A	A
Freon 13		A		A	A				A	A					A					
Freon 21		A		A	A				A						A	A				
Freon 22		A	Q	A	A	Q	Q		Q	Q	N				A	A	A		A	A
Freon 31		A		A	A				Q	Q	N				A					
Freon 32		A		A	A				A	A					A					
Freon 112		A		A	A				A	A					A					
Freon 113		A		A	A		A		A	A	A				A	A			A	A
Freon 114		A		A	A				A	A					A					
Freon 115		A		A	A				A	A					A					
Freon BF		A		A	A					A					A					
Freon MF		A		A	A					A					A					
Freon TF		A		A	A		A		A	A	A				A	A	N		A	A
Fruit Juices		Q	N	Q		A	A	A	A	A	A				A	A	A		A	A
Fuel Oil		A		A	A	A	A	A	Q	A	A				A	A	A	A	A	A
Furan, Furfuran		A		A	A	A	A		A	N	A				A				A	A
Furfural		A	A	A	A	A	A	A	N	N	Q				A	A	N	A	A	A

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

		METALS							ELASTOMERS						NON-METALLIC					
NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Furfuryl Alcohol					A								A		A					
Gasoline		A	A	A	A	A	A	A	N	Q	A				A	A	N	A	A	A
Gelatin		A	N	A	A	A	A	A	A	A	A				A	A	A		A	A
Ginger Oil		N	N			A	A		A		A				A					
Glaubers Salt										A					A					
Glucose		A	A	A	A	A	A		A	A	A				A	A	A			A
Glue		A	A	A	A	A	A		A	A	A				A	A				A
Glue Sizing		A				A	A			A					A					
Glycerin (Glycerol)		A	A	A	A	A	A	A	A	A					A	A	N	A	A	A
Glycols										A	A				A				A	A
Gold Monocyanide		N	N			A	A		A	A	A				A					
Graco Hand Cream										A										
Graham Transmission Oil										A										
Grain Mash										A					A					
Grapefruit Oil		N	N			A	A		N	N		A			A					
Grape Juice		Q	N		A	A	A		N	Q	A				A		A			
Grease		A	A		A	A	A		N	N	A				A	A				
Green Sulphate Liquor													A	A	A					
Hair Solution (Breck-Clairol)						A	A		A	A	A	A								
Helium					A								A		A					
Heptane		A	A		A	A	A	A	N	A	A				A	A	N	A	A	A
Hexachlord Acetone													A	A	A					
N-Hexaldehyde													A		A					
Hexamine					A								A		A					
Hexane		A	A		A	A	A	A	N	A	A				A	A	N	A	A	A
Hexone													A		A					
Hexyl Alcohol		A		A	A				A	A	A				A					
High Energy Fuels		A			A				N	Q	A				A					
High Viscosity Lubricant										A					A					
Honey		A	A	A	A	A	A		A	A	A				A	A	A			A
Horse Radish									A	N					A					
Hough-O-Safe (1000 and 1100 Series)											A		A							
Hough-O-Safe (600 Series)										A			A							
Hough-O-Safe 271 (Water and Glycol Base)										A			A							
Hough-O-Safe 5040 (Water-Oil Emulsion)										A										
Houughton MIH Light										A										
Houghton Transformer Oil										A										
Hydraulic Fluids		A	A		A	A	A		N	Q	A				A	A		A		
Hydrazine (Water Base)		N	Q		A	A	A		A	A	A		A	A	A					A
Hydrazine (Alcohol Base)		N	Q		A	A	A		A	A	A		A	A	A					A

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
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*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Hydrocarbons Light		A		A						A					A						
Hydro Drive MIH Light										A											
Hydro Drive (MIH10 and 50)										A											
Hydrogen		A		A	A				A	A	A		A	A	A			A	A		
Hydrogen Bromide										A					A						
Hydrogen Chloride		Q		Q		Q			A	A			A	A	A						
Hydrogen Peroxide	Cold	Q	N	Q	A	Q	A/Q	A	B	A	A				A	B		A	A/Q	A	
Hydrogen Peroxide	Hot						A/Q	A							A				A/Q	A	
Hydrogen Peroxide (10%)		N	N		A		A/Q	A	N	A					A	B			A	A	
Hydrogen Peroxide (50%)							A/Q	A	Q	N	A				A	N			A/Q	A	
Hydrogen Sulphide	Cold	N	N	Q	A	Q	A	A	N	Q	N		A		A	N	A	Q	A	A	
Hydrolube-Water/Ethylene Glycol										A			A								
Hydroquinone					A					Q	A				A					A	
Hydyne													A								
Hyposulphite Soda (Hypo)							A													A	
Ice Cream		Q		A	A	A	A			A					A						
Ink		Q	N		Q	A			A	A	A				A	A	A			A	
Insecticides											A				A						
Iodine		N	N		N		N	A	N	Q	A				A	N	A			A	
Iodine (in Alcohol for Plastics)						N	N	A	N	A	A				A	N	A	N			
Idoform					A	A	A				Q		A		A	A				A	
Iron Sulphate										A					A						
Isotane					A				N	A	A				A		N				
Iso-Butane										A					A						
Iso-Butyl Alcohol		A		A	A				A	A	A				A						
Iso-Butyl Methyl Ketone													A	A	A						
Iso-Butyl N-Butyrate										A			A		A						
Iso-Butylene															A						
Iso-Butyraldehyde													A		A						
Iso-Octane										A	A				A				A		
Iso-Pentane										A					A						
Iso-Propyl Alcohol		A	A			A	A	A	A	A	A				A		A		A	A	
Iso-Propyl Benzene											A				A						
Iso-Propyl Ethers									Q	A					A						
Iso-Butyl Alcohol		A		A	A				A	A	A				A						
Isododecane										A					A						
Isophorone (Ketone)													A	A	A						
Isopropanol										A					A						
Isopropyl Alcohol		A		A	A			A	A	A	A				A		A		A	A	
Isopropyl Chloride											A				A						
Isopropyl Ether		A			A		A		Q	A	N				A		N				
Isotox										A											
Jet Fuel (JP1 - JP6)		A	A	A	A	A	A	A	N	A	A				A	A	N	A	A	A	

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
- A Acceptable
- Q Questionable
- N Not Recommended
- BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

TEMP. CLASSIFICATION: Cold—Room Ambient to 100°F; Hot—Medium Temp. 100°F to 200°F; Boiling—High Temp. 200°F & Up; Blank—No Temp. Listed—Use Cold

NAME OF LIQUID	TEMP. CLASSIFICATION	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
J. D. Auto. Transmission Fluid										A											
J. D. T. 303 Oil										A											
J. I. Case No. 144 Oil										A											
Kerosene		A	A	A	A	A	A	A	N	A	A				A	A	N	A	A	A	
Kerosene & Naphtha		A	A	A	A	A	A		N	A	A				A						
Ketones		A			A	A	A	A	N	N	N		A	A	A	A	N	A	A	A	
Keystone No. 87 HX Grease										A											
Keystone Penetrating Oil										A											
Keystone Vetostan										A											
Laquers		A	Q	A	A	A	A		N	N	N				A	A	Q			A	
Lard	Cold	A	A	A	A	A	A	A	Q	A	A				A	A				A	
Larvacide		N	A			A	A		N	N	N				A						
Latex		A			A	A	A		A	A	A				A	A	A				
Lavender Oil											A				A						
Lead	Molten						N	A							N				N	A	
Lead Acetate		Q			N		A	A	A	A	N				A	A	A	A		A	
Lead Nitrate					N				A	A					A						
Lead Sulfamate									A	A	A				A						
Lemon Oil						A	A		Q		A				A						
Lignin Liquor		A				A	A		A	A	A				A						
Lime		A	A	A	N		A		A	A	A				A		A				
Lime Bleach					N					A					A						
Lime Sulphur		Q		A	N				A	A			A		A						
Lime Water					N					A					A						
Lindol											Q		A								
Linseed Oil		A	A	A	A	A	A	A	N	A	A				A	A	A	A	A	A	
Liquid Petroleum Gas (LPG)										A					A				A		
Liquor Lime										A					A						
Liquor - Pulp Mill										A					A						
Liquor Steep									A						A						
Liquor Sulphate									A						A						
Lithium Bromide		A	A						N	A	A				A						
Lithium Chloride		Q			Q	A	A			A					A						
Lithium Hydroxide		N			N	Q									A						
Lube Oil SAE 10, 20, 30, Etc.		A	A	A	A	A	A	A	A	A	A				A	A			A	A	
Lubricating Oils		A	A	A	A	A	A	A	A	A	A				A	A		A	A	A	
Lye, Caustic (34%)	Hot						A	A					A	A	A					A	
Lysol	Boiling						A/Q	A												A	
Magnesium Acetate										A					A						
Magnesium Carbonate							A	A	A	A					A		A			A	
Magnesium Chloride (5%)	Cold	A	N	Q	Q	A	A	A	A	A	A				A	Q	A	A	A	A	
Magnesium Chloride (5%)	Hot						A/Q	A							A				A	A	

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
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NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Magnesium Hydroxide	Cold	A	A	A	N	A	A	A	A	A	Q				A	A	A		A	A	
Magnesium Nitrate		N	N			A	A	A	A	A	A				A	A	A	A	A	A	
Magnesium Oxide		A	A			A	A		A	A	Q				A						
Magnesium Sulphate (5%)	Hot	A	A	A	A	A	A	A	A	A	Q				A	A	A	A	A	A	
Magnesium Sulphite & Sulphate										A											
Malathon Spray (50%)										A											
Maleic Anhydride					A			A	N	N	A				A					A	
Maleic Hydroxide													A		A						
Malt Beverages									A	A					A						
Manganese Carbonate							A	A/Q												A	
Manganese Chloride (50%)	Boiling						A	A		A					A					A	
Manganese Nitrate									A	A	Q				A						
Marsh Gas										A					A						
Mash		A				A	A		A	A					A		A				
Massey Ferguson Hyd. Oil										A											
Mayonnaise		N	N		N	Q	A	A	A	A	A				A	A	A			A	
Medium Synthetic Oil A										A											
Malamine Resins		N	N			N	N		Q	Q					A						
Mercaptans											A				A						
Mercuric Bichloride (.07%)	Cold						A	N												A	
Mercuric Chloride		N	N	N	N	N	N	A	Q	A	A				A	A	A			Q	
Mercuric Cyanide		N			N		A	A		A					A		A			A	
Mercurous Nitrate							A	A							A					A	
Mercury		N	A	N	N	A	A	A	Q	A	A				A	A	A			A	
Mercury Salts		N		N	N					A					A						
Mesityl Oxide													A								
Metalicoil A185															A						
Methanol		A	A	A	A	A	A	A	A	A	N				A	A		A	A	A	
Methyl Acetate		A			A		A	A	A	N	N		A		A						
Methyl Acrylate									A	N	N		A		Q						
Methyl Alcohol		A	A	A	A	A	A	A	A	A	N				A	A		A	A	A	
Methyl Bromide											A				A						
Methyl Butyl Ketone					A	A	A		N	N	N		A	A	A		N				
Methyl Cellosolve		A			A				N	Q	N		A		A		Q				
Methyl Chloride		Q	A	A	N	A	A	A	N	Q	A				A	A	N				
Methyl Chlorosilanes											A				A						
Methyl Cyclopentane							A		N		A				A						
Methyl Ether													A		A						
Methyl Ethyl Ketone		A			A	A	A	A	N	N	N		A	A	A	A	N	A	A	A	
Methyl Ethyl Ketone Peroxide															A						
Methyl Formate					A								A		A						
Methyl Isobutyl Ketone					A	A	A	A	N	N	N		A	A	A	A	N	A	A	A	
Methyl Isopropyl Ketone						A	A		N	N	N		A	A	A	A	N	A	A		
Methyl Methacrylate									Q	A	A				A						
Methyl Oleate											A				A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Methyl Salicylate					A								A		A						
Methyl Cyclopentane										A					A						
Methylene Bromide			A				A		N		Q				A						
Methylene Chloride		A	A		Q	Q	A	A	N	N	A				A	N	N	N	A/Q	A	
Methylene Dichloride							A				A				A						
Mikro Klene										A											
Milk		A	N	A	A	A	A		A	A	A				A	A	A			A	
Mine Water		A		A		A	A	A		A					A				A	A	
Mineral Oil		A	A	A	A	A	A		Q	A	A				A	A	A	A	A	A	
Mineral Spirits										A					A	A	A	A	A		
Minesafe Sunoco 3XF										A						A	A	A	A		
Mobil ATF200		A		A	A	A	A		Q	A	A	A				A	A	A	A		
Mobil ATF220		A		A	A	A	A		Q	A	A	A				A	A	A	A		
Mobil Amberex 24		A		A	A	A	A		A							A	A	A	A		
Mobil Auto. Transmission Fluid		A		A	A	A	A			A						A	A	A	A		
Mobil FF. Hyd. Transmission Fluid		A		A	A	A	A			A						A	A	A	A		
Mobil Fluid VB200 Type A		A		A	A	A	A			A						A	A	A	A		
Mobil Grease No. 1		A		A	A	A	A			A						A	A	A	A		
Mobil Jet Oil No. 2		A		A	A	A	A			A						A	A	A	A		
Mobil Kote 503										A						A	A	A	A		
Mobilgas W200, Type A		A		A	A	A	A			A						A	A	A	A		
Mobillube EP140, SAE140		A		A	A	A	A			A						A	A	A	A		
Mobillube GX90-EP Lube		A		A	A	A	A			A						A	A	A	A		
Mobil Oil		A		A	A	A	A			A						A	A	A	A		
Mobil Oil DTE										A						A	A	A	A		
Mobil Oil SAE20		A		A	A	A	A			A						A	A	A	A		
Molasses		A	A	A	A	A	A	A	A	A	A				A	A	A		A	A	
Mono Bromobenzene											A				A						
Mono Chlorobenzene											Q				A						
Mono Ethanolamine					Q								A		A						
Mono Methylether											A				A						
Mono Vinyl Acetate											A				A						
Morpholine					A		A	A							A	A	N		A/Q	A	
Motor Oil					A		A	A		A	A				A	A	A		A	A	
Multi-Circuit Etch		N	N			N	N				A										
Mustard		A	N		A	A	A		A	Q	A				A	A	A				
Naphtha		Q	A		A	A	A	A	N	Q	A				A	A	N	A	A	A	
Naphthalene		Q	A		A	A	A	A	N	N	A				A		N	A	A	A	
Natural Gas		A		A						A					A						
Neatsfoot Oil										A					A						
Nickel Acetate					N					A					A						
Nickel Chloride	Cold	A	N		N	Q	A*	A	Q	A	A				A	A	A	A		A	
Nickel Nitrate (10%)	Cold						A	A							A				A	A	
Nickel Plating Solution					N								A		A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
- A Acceptable
- Q Questionable
- N Not Recommended
- BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS: BRONZE 85-5-5-5	METALS: CAST IRON	METALS: NICKEL-SILVER 412	METALS: ALUMINUM 356	METALS: STAINLESS STEEL 303	METALS: STAINLESS STEEL 316 / W88	METALS: HASTELLOY "C"	ELASTOMERS: NEOPRENE	ELASTOMERS: BUNA N	ELASTOMERS: VITON	ELASTOMERS: URETHANE	ELASTOMERS: ETHYL. PROPYL.	ELASTOMERS: BUTYL	NON-METALLIC: TEFLON	NON-METALLIC: NYLON	NON-METALLIC: NORYL	NON-METALLIC: POLYESTER	NON-METALLIC: RYTON	NON-METALLIC: CHEMICAL GRADE CARBON	NON-METALLIC
Nickel Sulphate	Cold	Q	N	N	N	Q	A	A	Q	A	A				A	A	A	A	A/Q	A	
Niter Cake										A					A						
Nitro Benzene		Q	Q		A	A	A	A	N	Q	N				A	A	N	A	A	A	
Nitrogen		A		A	A					A					A			A	A	A	
Nitroethane					A					A					A						
Nitromethane								A		A					A	Q	Q		N	A	
Nitropropane											N				A	A					
Nivda Hand Lotion										A											
Northia No. 4										A											
N.Y. & N.J. Lubricating Oil 83R		A		A	A	A	A			A											
Oakite													A								
Octachloro Toluene											A				A						
Octadecane										A					A						
Octyl Alcohol										A					A						
Oil Aniline		A	A		Q	A	A	N	N	N	Q				A	Q	N				
Oil Anise						A	A		Q						A						
Oil ASTM No. 1 & No. 3		A	A			A	A		Q	A	A										
Oil, Bay						A	A		Q		A										
Oil, Bone		A	A			A	A		N	A	A										
Oil, Castor		A	A	A	A	A	A		A	A	A				A						
Oil, Chevron		A	A	A	A	A	A		Q	A	A										
Oil, Cinnamon						A	A		Q						A						
Oil, Citric		N	N			A	A		N	A	A				A	A					
Oil, Clove						A	A		Q	A					A	A					
Oil, Coconut		A	A			A	A		N	A	A				A	A					
Oil, Cod Liver					A	A	A		N	A	A				A	A					
Oil, Corn		Q	A		A	A	A		Q	A	A				A	A					
Oil, Cottonseed		A	A		A	A	A		Q	A	A				A	A			A		
Oil, Creosote			A		A	A	A		A	A	Q				A						
Oils - Crude	Hot & Cold						A*	A											A	A	
Oil, Diester Syn. Lube		A	A	A	A	A	A				A				A						
Oil, Dromus		A	A	A		A	A			Q											
Oil, Ginger						A	A		A	A	A				A						
Oil, Hydraulic		A	A	A	A	A	A		A	Q	A				A						
Oil, Lemon						A	A		Q		A				A						
Oil, Linseed		A	A		A	A	A		N	A	A				A	A					
Oil, Mineral	Hot & Cold	A	A	A	A	A	A	A	A	A	A				A	A	A		A	A	
Oil, Olive		A	A	A	A	A	A		Q	A	A				A	A			A	A	
Oil, Orange						A	A		Q	A	A				A	A					
Oil, Pale		A	A			A	A		N						A						
Oil, Palm		A	A		A	A	A		Q	A	A				A	A					
Oil, Peanut		A	A		A	A	A		N	A	A				A						
Oil, Pella		A	A			A	A		N	A	A				A						
Oil, Peppermint		A				A	A		N	N	A				A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
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- N Not Recommended
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NAME OF LIQUID	TEMP. CLASSIFICATION (Cold—Room Ambient to 100°F; Hot—Medium Temp. 100°F to 200°F; Boiling—High Temp. 200°F & Up; Blank—No Temp. Listed—Use Cold)	METALS: BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	ELASTOMERS: NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	NON-METALLIC: TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Oil, Pine		N	Q		A	A	A		N	A	A				A						
Oil, Rapeseed		A	A			A	A		Q	A	A				A						
Oil, Red		Q	Q				A		N		A				A						
Oil, Rose						A	A		Q		A				A						
Oil, Royal Triton		A	A	A		A	A		A	A	A										
Oil, Sesame Seed		A	A		A	A	A		Q	A	A				A						
Oil, Shell Dieselene		A	A			A	A		N	A	A										
Oil, Silicone		A	A	A	A	A	A		A	A	A				A	A	A				
Oil, Soybean		A	A			A	A		N	A	A				A	A					
Oil, Sperm		A	A			A	A		N	A	A				A						
Oil, Sulphur Base Cutting		A	A			A	A		Q	A					A						
Oil, Tanning							A		N	A	A				A						
Oil, Turbine		A	A	A	A	A	A		A	A	A				A						
Oil, Tung							A		Q						A						
Oil, Vegetable		A	A			A	A		Q	A	A				A						
Oil, Water Soluble Cutting		A	A			A	A		Q	A					A						
Oil, OF Birchwood									N		A				A						
Oleum (25% for Plastics)								A	N	N	A		A		A		N	N			
O-Dichloro Benzene											A				A						
Orange Oil						A	A		Q	A	A				A	A					
Oronite M2-V											A										
Oronite 8200 & 8515									A												
Oronite 8600											A										
Ortho-Dichloro Benzene											A				A						
Ortho-Chloro Ethyl Benzene											A				A						
Orthocide										A											
Orthocryl										A											
Ortho Dichloro Benzene															A						
Oxygen, Gaseous (Low Pressure)		A		A	A				A						Q						
Oxygen, Liquid		A		A	A										Q						
Ozone					A				A						Q						
Ozone (High Conc.)					A								A		Q						
Paint (with Xylene)		A	A	A		A	A		N	Q	Q				A						
Paint Thinner, Duco		A									A				A						
Palm Oil		A	A			A	A		Q	A	A				A						
Paracymene											A				A						
Paraffin	Molten	A		A	A	A	A	A		A	A				A		A		A	A	
Para-Al-Ketone															A						
Para-Dichlorbenzene											A				A						
Paraformaldehyde					Q								A		A						
Paraplex G62									N	A											
Parker O-Lube										A											
Peanut Oil		A	A		A	A	A		N	A	A				A						
Pectin Liquor										A					A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS

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NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Penicillin, Liquid					A										A						
Penolalube										A											
Penola Univis										A											
Peppermint Oil		A				A	A		N	N	A				A						
Pepsi Cola					A								A								
Penthane		A			A		A	A	A	A	A						N				
Pentachloro Phenol											A				A						
Pentasol																					
Perchloroethylene		A	A		A	A	A	A	N	Q	A				A	N	N		A	A	
Petrolatum		A			A		A		A	A	A						N				
Petroleum Ether							A						A		A						
Phenol (Carbolic Acid)		Q	N	Q	A	A	A	A	Q	N	A				A	N	Q		A	A	
Phenol, Formaldehyde Mix											A				A	A	N	N	A		
Phenolic Resins							A	A												A	
Phenyl Benzene											A				A						
Phenyl Ethyl Ether															A						
Phenyl Hydrazine											A				A						
Phenyl Benzene											A				A						
Phenyl Cellosolve													A	A	A						
Phorone													A	A	A						
Phosphate Esters											A		A	A	A						
Phosphoric Anhydride (Dry)							A		N	N	N				A					A	
Phosphorous Trichloride					N		A	A					A	A	A				A	Q	
Phtographic Developer		N	N		Q		A	A	A	A	A				A		A				
Phthalic Anhydride					A	A		A				A			A						
Pickling Solution									N		Q		A	A	A						
Picoline Alpha										A											
Pine Oil		N	Q			A	A		N	A	A				A						
Pine Tar Oil							A	A												A	
Pinene											A				A						
Pipeline Cleaner		A	A			A	A		A	N	A										
Plasticizer									Q	N	A										
Polyderm Moisturizer Lotion									A												
Polyvinyl Acetate													A	A	A						
Polyvinyl Acetate Emulsion														A	A						
Postage Meter Ink										A											
Potassium Acetate										A					A						
Potassium Bichromate	Cold						A	A												A	
Potassium Bicarbonate		N	A			A	A		A						A	A	A	A	A	A	
Potassium Bromide	Cold	Q			Q		A	A	A	A	A				A	A	A	A	Q	A	
Potassium Carbonate	Cold	N	A		Q	A	A	A	A	A	A				A	A	A	A	A	A	
Potassium Chlorate	Cold						A	A							A				A	A	
Potassium Chloride	Cold	Q	A	N	A	A	A	A	A	A	A				A	A	A	A	A	A	
Potassium Chromate		A	A	A	A		A	A	A	A	A				A		A		A	A	
Potassium Cupro Cyanide		N		N						A					A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

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*Subject to pitting when allowed to dry.
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NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Potassium Cyanide		N	A	N	N	A	A	A	A	A	A				A	A	A	A	A	Q	
Potassium Dichromate		N	A	N	A	A	A	A/Q	A		A				A	N	A	N	A	A	
Potassium Ferricyanide	Cold	A			Q		A	A		N					A	A				A	
Potassium Hydrate							A	A												A	
Potassium Hydroxide (5%)	Hot	N	Q	A	N	A	A	A	A	A	A				A	A	A	N	A	A	
Potassium Hydroxide (50%)	Hot	N	Q	A	N	A	A	A	A	A	A				A	A	A	N	A	A	
Potassium Hydroxide (50%)	Boiling	N	Q	A	N	A	A/Q	A/Q	A	A	A				A	A	A	N	A	A	
Potassium Hypochlorite							N	A							A					A	
Potassium Iodide							A	A							A					A	
Potassium Nitrate	Cold	A			A		A	A	A	A	A				A	A	A	A	A	A	
Potassium Oxalate							A	A												A	
Potassium Perfluoroacetate										A					A						
Potassium Permanganate		Q	A		A	A	A/Q	A	A	A	A		A		A	N	A	N	A	A	
Potassium Phosphate		Q	N			A	A		A	A					A						
Potassium Silicate										A					A						
Potassium Sulphate (5%)	Cold	Q	A	N	A	A	A	A	A	A	A				A	A	A	A	A	A	
Potassium Sulphate (5%)	Hot	Q	A	N	A	A	A/Q	A/Q	A	A	A				A	A	A	A	A	A	
Potassium Sulphide							A	A/Q			A				A				A	A	
Potassium Sulphite										A	A				A				A	A	
Prestone		A		A	A	A	A		N	A	Q										
PRL 3161 Oil										A											
PRL High Temp. Hyd. Oil											A										
Producer Gas										A					A						
Propane		A	A	A	A				A	A	A				A	A	N				
Propone Profionitrile										A					A						
Propanol										A					A						
Propion-Aldehyde														A		A					
Propyl Acetate													A	A	A						
N-Propyl Acetone													A	A	A						
Propyl Alcohol		A		A	A					A	A				A			A			
Propyl Nitrate										A	N				A						
Propylene											A				A						
Propylene Chlorohydrin											A/Q				A					A	
Propylene Dichloride									N	N	A				A						
Propylene Glycol		A	A		A		A		Q	A	A				A				A	A	
Pyridine		N	A		A		A/Q	A	A	N	N				A	Q	N		A	A	
Pub Cologne									A												
Pulp Stock										A					A						
Purelube Motor Oils		A		A	A	A	A			A											
Puritan Motor Oil		A		A	A	A	A			A											
Pydravls		A		A					N	N	A			A							
Pyrolube											A										
Quinine Bisulphate (Dry)							A/Q	A							A						
Quinine Sulphate (Dry)							A	A							A					A	

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
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*Subject to pitting when allowed to dry.
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TEMP. CLASSIFICATION: Cold—Room Ambient to 100°F; Hot—Medium Temp. 100°F to 200°F; Boiling—High Temp. 200°F & Up; Blank—No Temp. Listed—Use Cold

NAME OF LIQUID	TEMP. CLASSIFICATION	METALS							ELASTOMERS						NON-METALLIC					
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Rapeseed Oil		A	A	A		A	A		Q		A				A					
Red Gage Oil										A	A									
Resin Solvent						A	A		N	N										
Rose Oil						A	A		Q		A	A			A					
Rosin		A		A	A		A	A		A					A	A				
Rum		A		A		A	A		A	A	A				A	A	A			
Rust Inhibitors		A		A		A	A		A/Q	A	A				A					
Salad Dressing		A	N		A	A	A		Q	A	A				A	A	A			
Sal Ammoniac		N		N	N	N	Q	A/Q	A	A					A					A
Salt Brine (Sat.)	Hot						A**	A							A				A	A
Salt Cake		Q				A	A		N	A					A					
Salt Solution		A		A		A	A		A	A	A				A					
Salt Water		A		Q		A	A		A	A	A				A					
Sanitizers						A	A		A	A	A									
Sea Water		A/Q		A	Q	A	A	A	A	A	A				A	A	A		A	A
Sesame Seed Oil		A	A	A		A	A		Q	A	A				A					
Sewage		A		A		A	A		Q	A	A				A					
Shave Cream		A		A		A	A		A	A	A				A					
Shell Alvania Grease No. 2		A		A	A	A	A		A	A	A									
Shell Tellus No. 27		A		A	A	A	A		A	A	A									
Shellac		A	A	A	A	A	A		N	A					A	A				
Silica Gel		N	A				A		A						A					
Silicate Esters									A		Q				A					
Silicone X527		A	A	A	A	A	A		A	A	A									
Silicone Tetrachloride					A						A				A					
Silicone Oils		A		A	A	A	A		A	A	A				A	A				
Silver Bromide					N		A**	A							A		A			A
Silver Chloride							N	A/Q							A					A
Silver Cyanide							A	A							A					A
Silver Nitrate		N	N		Q		A	A/Q	A	Q	A		A		A	A	A			A
Silver Salts		N		N		A	A			A					A					
Sizing Starch										A					A					
Skelly Solvent B, C, E										A										
Skydrol 500 & 7000		A		A		A	A						A	A						
Soap Solutions	Cold	A	A	A	Q	A	A	A	Q	A	A				A	A	A	A	A	A
Socony ALHD No. 1		A		A	A	A	A		Q	A	A	A								
Socony 60195		A		A	A	A	A		Q	A	A	A								
Socony Auto. Transmission Fluid		A		A	A	A	A		Q	A	A	A								
Socony Delvac		A		A	A	A	A		Q	A	A	A								
Socony M-4731-A		A		A	A	A	A		Q	A	A	A								
Socony Mobil Type A		A		A	A	A	A		Q	A	A	A								
Socony XRP 226A		A		A	A	A	A		Q	A	A	A								
Socony XPP 227A		A		A	A	A	A		Q	A	A	A								
Socony RL-362A Shock		A		A	A	A	A		Q	A	A	A								

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS

A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Socony SAE 3001L		A		A	A	A	A		Q	A	A	A									
Socony Vacuum Amvac 781		A		A	A	A	A		Q	A	A	A									
Socony Vacuum PD959B		A		A	A	A	A		Q	A	A	A									
Socony Vacuum Velacity No. 10		A		A	A	A	A		Q	A	A	A									
Soda Ash (Sodium Carbonate)	Cold	A	A	A		A	A/Q	A/Q	A	A	A				A				A	Q	
Soda, Caustic (20%)		Q		A		A	A		A	A	N		A		A						
Soda, Caustic (50%)		N				Q			A	A	N		A		A						
Sodium Acetate	Cold	A			A	Q	A	A	Q	A	N				A	A	A	A	A	A	
Sodium Aluminate		A			Q	A	A		A	A	A				A		A		A		
Sodium Arsenite		N	N			A	A		N						A						
Sodium Benzoate								A												A	
Sodium Bicarboate	Hot	Q	Q	A	Q	A	A	A/Q	A	A	A				A	A	A	A	A	A	
Sodium Bichromate							A	A		A					A					A	
Sodium Bisulphate		Q	N	A	Q	A	A	A/Q	A	A					A	A	A	A	A	A	
Sodium Bisulphite		Q	N	A			A	A	Q	A/Q	A				A	A	A	A		A	
Sodium Borate		A					A	A	A	A	A				A	A				A	
Sodium Bromide	Cold						A	A							A					A	
Sodium Carbonate		A	Q	A	Q	A	A/Q	A/Q	A	A	A				A	A	A	A	A	A	
Sodium Chlorate		A		A			A	A	A	A	A				A	A	A		A	A	
Sodium Chloride		A	A	A	Q	A	A**	A	A	A	A				A	A	A	A	A	A	
Sodium Chromate		A	A	A	A		A	A	A	A	A				A	Q	A		A	A	
Sodium Citrate							A	A							A					A	
Sodium Cyanide		N	A	N	N	A	A	A	A	A	A				A	A	A	A	A	A	
Sodium Ferricyanide							Q**	A							A					A	
Sodium Ferrocyanide											A				A					A	
Sodium Fluoride	Cold	Q			Q		Q	A	N	N	Q			A	A					A	
Sodium Hydrosulphite		Q			A			A	A	A	A				A	A				A	
Sodium Hydroxide (15%)	Cold	N	A		N		A	A	A		N				A	Q	A		A	A	
Sodium Hydroxide (20%)		Q	A	A	N	A	A	A	A	A	N		A	A	A	A	A	N	A		
Sodium Hydroxide (30%)	Cold				N		A	A							A	A	A		A/Q	A	
Sodium Hydroxide (50%)	Cold	N	Q	Q	N	Q	N	A	A	A	N		A	A	A	A	A	N	A	A	
Sodium Hypochlorite		Q	N	Q	Q	Q	N	A	A	Q	A				A	Q	A	A	A	A	
Sodium Hyposulphite							A	A												A	
Sodium Loctate							A	A												A	
Sodium Metaphosphate		Q	N		A	A	A		Q	A	A				A	A					
Sodium Nitrate	Cold						A	A/Q							A				A	A	
Sodium Nitrite		Q	A	A	A	A	A	A	Q	A	A				A	A	A	A	A	A	
Sodium Orthophenylphenate						A	A		A	N					A						
Sodium Perborate		N	Q		A	Q	Q		N	Q	A				A		A				
Sodium Peroxide	Boiling	Q	N	Q	A	A	A	A/Q	N	Q	A			A	A	N				A	
Sodium Phosphate (5%)							A	A												A	
Sodium Phosphate Mono		A	N		A	N	Q	Q		A	A				A						
Sodium Phosphate DI		Q	A	Q	N	A	A		Q	A					A						
Sodium Phosphate TRI		N	A		N	A	A		Q	A					A						
Sodium Phosphate															A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS

A Acceptable
Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Sodium Polyphosphate		Q	A			A	A		Q	A					A						
Sodium Silicate		A	A	A	Q	A	A	A	A	A	A				A	A	A	A	A	A	
Sodium Sulphate (5%)	Cold						A	A							A				A	A	
Sodium Sulphate (Conc.)	Cold	Q	A	A	A	A	A	A/Q	N	A	A				A	A	A	A	A	A	
Sodium Sulphide (Sat.)	Cold	Q	A	Q	N	A	A	A/Q	A	A	A				A	A	A	A	A	A	
Sodium Sulphite (5%)	Cold	Q	A	Q	A	A	A/Q	A	A	A	A				A	N				A	
Sodium Sulphydrate										A					A						
Sodium Tetraborate							A		A	A	A				A		A				
Sodium Thiosulphate		Q	Q	Q	A		A	A	A	A	A				A	A	A		A	A	
Sodium Tripolyphosphate		N	N				A			A					A						
Solder, Tin Based	Molten						Q	A												A	
Soluble Oil		A		A	A	A	A		A	A											
Sorghum		N	A			A	A		A	A	A				A	A					
Sovasol No. 1, 2, 3		A		A		A	A		A												
Sovasol No. 73 & 74		A		A		A	A			A											
Soy Bean Oil		A	A	A		A	A		N	A	A				A						
Soy Sauce		A	N	A	A	A	A		A	A	A				A	A	A				
Sperm Oil		A	A	A		A	A		N	A	A				A						
Spry										A											
Standard Oil IR Hyd. Med.										A											
Standard Oil, UGL																					
Stannic Chloride	Cold	N	N		N	N	N	A/Q	Q	A	A				A	N	A	N		A	
Stannic Fluoborate		N	N				A		A	A	A				A		A				
Stannous Chloride	Cold	N			N		Q	A	A	A	A				A	N		A	A	A	
Starch		A	Q	A	A	A	A		A	A	Q				A	A	A		A	A	
Steam	Boiling				N		A	A							A				A	A	
Stoddard Solvent		A	A	A	A	A	A	A	N	A	A				A	A	N	A	A	A	
Styrene		A			A		A		N	N	Q				A		A				
Sucrose Solutions		A		A	A	A	A		A	A	A				A						
Sugar Juice		A			A		A	A	A	A	A				A	A	A		A	A	
Sugar Solutions		A		A	A	A	A		A	A	A				A						
Sulphate Liquors		N	N		A	Q	Q	A	A						A						
Sulphate of Lime													A	A	A						
Sulphite Liquors											A										
Sulphur (Dry)	Molten	N		N	A	A	A	A	N	N	A				A				A	Q	
Sulphur Base Cutting Oil		A	A	A		A	A		Q	A				A							
Sulphur Chloride		Q	N	Q	N	N	N	A	N	Q	A				A	A	A			A	
Sulphur Dioxide (Wet)	Cold	Q		Q	A	Q	A	A	Q	Q	A				A	Q	N		A	A	
Sulphur Hexafluoride									A		A				A						
Sulphur Trioxide		A		A	A	Q			N	Q	A		A		A	N	N				
Sulphinol							A								A				A	A	
Sulpholane							A									A	A		A	A	
Sulphur (Wet)							A**	A							A				A	Q	
Sulphur Dioxide (Dry)		A	A		A		A	A/Q	N	Q	A				A	A			A	A	
Sulphonated Fatty Alcohols									A						A						

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS

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BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC					
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Sulphonated Vegetable Oils										A					A					
Sulphuric Anhydride	Cold							A												A
Sunoco SAE 10		A		A	A	A	A			A										
Sunoco No. 3661										A										
Sunoco All Purpose Grease		A		A	A	A	A			A										
Super Shell Gas		A		A	A	A	A			A	A									
Synthetic Detergent		Q		A	A	A	A			A					A					
Syrups		A		A						A					A					
Talc Slurry									A	A					A					
Tall Oil					A					A					A					
Tallow	Hot	A		A	A	A	A		A	A					A	A	A			A
Tannin									A	A					A					
Tanning Liquors		A		A	Q	A	A		A	A	A				A					
Tanning Oil									N	A	A				A					
Tar		A		A	A	A	A		Q	Q	A				A					
Tectyl 502										A										
Teepol									A	A										
Terpineol											A				A					
Teresso Oil No. 47										A										
Tertiary Butyl Alcohol										A					A					
Tertiary Butyl Catechol											A				A					
Tertiary Butyl Mercaptan											A				A					
Tetra Bromethane											A				A					
Tetra Butyl Titanate													A		A					
Tetrachloroethane		Q	Q			A	A		N	N	A				A	A	N			
Tetraethyl Lead		A	A			A	A			A	Q				A					
Tetrahydrofuran		N			Q		A		N	N	N		A		A	A	N	A	Q	A
Tetralin									N		A				A				A	A
Texaco Capella B & D										A										
Texaco Regal A & B (RO) Starfak No. 2										A										
Texaco 3450 Gear Oil										A										
Texaco Regal B										A										
Texamatic Auto Transmission Fluid No. 1859, 1876 Type E		A		A	A	A	A			A										
Thiokol TP90B, TP95													A							
Thionyl Chloride		N	N				N				N				A					
Tide Water Oil Beedol Multi, Gear 140										A										
Tin Salts										A					A					
Titanium Tetrachloride											A				A					
Toluene		A	A	A	A	A	A	A	N	N	Q				A	A	N	A	A	A
Toluene Diisocyanide													A	A	A					
Tomato Juice		A		A	A	A	A	A	A	A					A		A		A	A
Tomato Pulp		A		A	A	A	A	A	A	A					A		A		A	A

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS—OBERDORFER (continued)

CODE LETTERS
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NAME OF LIQUID	TEMP. CLASSIFICATION Cold—Room Ambient to 100°F Hot—Medium Temp. 100°F to 200°F Boiling—High Temp. 200°F & Up Blank—No Temp. Listed—Use Cold	METALS							ELASTOMERS						NON-METALLIC						
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W86	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON	
Toothpaste		A	N			A	A		Q	A	A				A						
Transformer Oil		A	A	A	A	A	A		N	A	A				A	A	N		A	A	
Transformer Pyranol		A		A		A	A		N	N	A										
Transmission Fluid		A	A	A	A	A	A			A	A				A						
Trancil 10C										A											
Tri-Aryl Phosphate													A		A						
Tributoxy Ethyl Phosphate													A		A						
Tributyl Mercaptan											A				A						
Tributyl Phosphate									N		N		A		A						
Trichloro Benzene					A						A				A						
Trichloroethane		A	A		Q		A	A	N	N	Q				A		N				
Trichloroethylene		A	Q	A	Q	A	A	A	N	Q	A			A	A	N	N	N	Q	A	
Trichloropane		A	A				A		N	N	A				A						
Trichloropropane		A	A	A		A	A		A	A	A				A		N				
Tricresyl Phosphate		A					A	A	N	N	A		A	A	A	A	A				
Triethanol Amine		A						A	A				A	A	A				A	A	
Triethyl Borane											A				A						
Triethyl Aluminum											N				A						
Triethyl Phosphate					A		A	A							A				A	A	
Triethanolamine		A		A	A			A	A						A				A	A	
Tri Film 250										A											
Tri-Fluoro-Vinylchloride											A				A						
Trinitrotoluene											A				A						
Tri-Normal-Butyl Phosphate										A					A						
Trioctyl Phosphate													A	A	A						
Tripoly Phosphate													A	A	A						
Triphenyl Phosphite							A/Q									A	N		A	A	
Trisodium Phosphate					Q		A	A							A				A	A	
Tricresyl Phosphate		A					A	A	N	N	Q				A		A				
Tung Oil						A	A	A	Q						A					A	
Turpentine		A	A	A	A	A	A	A	N	A	A				A	A	N	A	A	A	
Urea Formaldehyde									Q	A					A						
Urine		Q	A		A	A	A		N	A	A				A	A	A				
Vanilla Extract							A		A	A	Q				A						
Valclene 200		A		A		A	A		N	A	N										
Vapona									A												
Varnish		A	Q	A	A	A	A	A	N	A	A				A		N			A	
Veedol Aturbrio No 60										A											
Vegetable Juices		Q	N	Q	Q	Q	A	A	Q	A	A				A	A	A			A	
Vegetable Oil		A	Q	A	A	A	A		A	A	A				A						
Versilube F-50										A											
Vinegar	Cold	Q	Q	Q	Q	A	A	A	Q	Q	N				A	A	A	A	A	A	

(continued)

TABLE 7.8: METAL, ELASTOMER AND PLASTIC PUMP MATERIALS–OBERDORFER (continued)

CODE LETTERS
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Q Questionable
N Not Recommended
BLANK—No Information

*Subject to pitting when allowed to dry.
**Subject to attack when hydrochloric acid is present.

TEMP. CLASSIFICATION: Cold—Room Ambient to 100°F; Hot—Medium Temp. 100°F to 200°F; Boiling—High Temp. 200°F & Up; Blank—No Temp. Listed—Use Cold

NAME OF LIQUID	TEMP. CLASSIFICATION	METALS							ELASTOMERS						NON-METALLIC					
		BRONZE 85-5-5-5	CAST IRON	NICKEL-SILVER 412	ALUMINUM 356	STAINLESS STEEL 303	STAINLESS STEEL 316 / W88	HASTELLOY "C"	NEOPRENE	BUNA N	VITON	URETHANE	ETHYL. PROPYL.	BUTYL	TEFLON	NYLON	NORYL	POLYESTER	RYTON	CHEMICAL GRADE CARBON
Vinyl Pyridine													A	A	A					
Vinylidene Chloride													A	A	A					
Viscose										A					A					
Vitriol Oil													A		A					
Water - Deionized	Cold	N		N	N	A	A	A							A	A	A	A	A	A
Water to 180°F — Tap		A	Q	A	A	A	A	A	A	A	A				A	A	A		A	A
Water, Boiling		A	Q	A	A	A	A	A	N	N					A	A	A		A	A
Water, Boiler		A		A	N	A	A		Q	Q	N				A					
Water, Distilled		Q	N	A	A	Q	A	A	A	A	A				A	A	A		A	A
Water, Mine		A	Q	A	Q	A	A		Q	A	A				A	A	A		A/Q	A
Water, Salt	Cold	A	N	A	A	A	A*	A	A	A	A				A	A	A		A	A
Water, Sea	Cold				Q		A/Q*	A							A				A	A
Water with Soluable Oil		A		A	A	A	A		A	A	A				A					
Weed Killers		Q		Q	A	A	A		A	A	A				A	A				
Wemco C										A										
Whiskey & Wines		A	N	A	A	A	A		A	A	A				A	A	A			A
White Gas										A					A					
White Liquor		N	Q	Q		A	A	A	A	A	A				A	A	A	A		A
Xylene		A	A	A	A	A	A	A	N	N	A				A	A	N	A	A	A
Xylidenes - Mixed Aromatic Amines										A					A					
Xylol		A		A	A	A	A		N	N	A				A					
Yeast							A			A					A	A				A
Zeolite									A	A					A					
Zinc Acetate					Q				A	A					A					
Zinc Ammonium Chloride					Q					A					A					
Zinc Chloride	Cold	Q	N	Q	N	Q	Q**	A	A	A	A				A	N	A	N	A	Q
Zinc Chloride	Boiling						N	A/Q							A				A	Q
Zinc Cyanide										A					A					
Zinc Hydrosulfite		N	N		N	A	A		A	A					A		A		A	
Zinc Nitrate										A					A					
Zinc Phosphate Solution										A					A					
Zinc Salts										A					A					
Zinc Sulphate (25%)							A	A							A				A	A
Zinc Sulphate (Saturated)		A	Q	Q	N	A	A	A/Q	A	A	A				A	A	A	A	A	A

TABLE 7.9: GLASS, METAL AND PLASTIC PIPING SYSTEMS—O-I/SCHOTT PROCESS SYSTEMS

Chemical Resistance of Corrosion-Resistant Piping Systems

MATERIALS
A—Very Good Service
B—Moderate Service
C—Limited or Variable Service
F—Unsatisfactory
Blank—No Information

CHEMICALS
Solids assumed in solution.

*Data represented is to be used as a guide only. For specific information, test under actual operating conditions.

Chemicals	GLASS, "KIMAX®" BRAND & DURAN	DURIRON; Fe, 14 Si; Durichlor, Fe, 14 Si, 3 Mo	304 STAINLESS STEEL; Fe, 18 Cr, 8 Ni	TEFLON (Polytetraflouroethylene)	POLYETHYLENE	POLYVINYL CHLORIDE Rigid or Unplast	POLYPROPYLENE	CER-VIT® C-126
Maximum Operating Temperature	400	450	450	450	150	150	180	450
ACETIC ACID, 100%, CH_3COOH	A	A	F	A	F	F	C	A
ACETIC ACID, Dilute 50%	A	A	F	A	B	C	A	A
ACETIC ANHYDRIDE, $(CH_3CO)_2O$	A	A	B	A	F	F	F	A
ACETONE, CH_3COCH_3	A	A	A	A	F	F	B	A
ACETYL CHLORIDE, CH_3COCl	A	B	A	A	F	F	B	A
ALUMINUM CHLORIDE, $AlCl_3$	A	B	F	A	A	A	A	A
ALUMINUM HYDROXIDE, $Al(OH)_3$	A	B	A	A	A	A	A	A
ALUMINUM SULFATE, $Al_2(SO_4)_3$	A	B	F	A	A	A	A	A
ALUMS, CONC., $Al_2(SO_4)_3 \cdot K_2SO_4$, etc.	A	B	F	A	A	A	A	A
ALUMS, DILUTE	A	A	A	A	A	A	A	A
AMINES, various	A	A	A	A	F	F	C	A
AMMONIA (Gas), Moist, NH_3	A	A	A	A	A	A	B	A
AMMONIUM CARBONATE, $(NH_4)_2CO_3$	A	B	B	A	A	A	A	A
AMMONIUM CHLORIDE, NH_4Cl	A	B	F	A	A	A	A	A
AMMONIUM HYDROXIDE, NH_4OH	A	B	A	A	A	A	A	A
AMMONIUM NITRATE, NH_4NO_3	A	A	F	A	A	A	A	A
AMMONIUM PERSULFATE, $(NH_4)_2S_2O_8$	A	A	B	A	A	A	B	A
AMMONIUM PHOSPHATE, $(NH_4)_1H_2PO_4$	A	A	A	A	A	A	A	A
AMMONIUM PHOSPHATE, $(NH_4)_2HPO_4$	A	A	A	A	A	A	A	A
AMMONIUM PHOSPHATE, $(NH_4)_3PO_4$	A	A	A	A	A	A	A	A
AMMONIUM SULFATE, $(NH_4)_2SO_4$	A	A	F	A	A	A	A	A
AMYL ACETATE, $C_5H_{11}COOCH_3$	A	A	A	A	F	F	F	A
AMYL ALCOHOL, $C_5H_{11}OH$	A	B	B	A	C	F	A	A
AMYL CHLORIDE, $C_5H_{11}Cl$	A	B	C	A	F	F	F	A
ANTIMONY TRICHLORIDE, $SbCl_3$	A	B	F	A	A	A	A	A
ARSENIC ACID, $HAsO_3$	A	B	F	A	A	A	A	A
BARIUM CARBONATE, $BaCO_3$	A	B	B	A	A	A	A	A
BARIUM HYDROXIDE, $Ba(OH)_2$	A	B	A	A	A	A	A	A
BARIUM SULFIDE, BaS	A	B	B	A	A	A	A	A
BENZALDEHYDE, C_6H_5CHO	A	B	B	A	F	F	C	A
BENZENE, C_6H_6	A	A	B	A	F	F	F	A
BENZOIC ACID, C_6H_5COOH	A	B	B	A	A	A	A	A
BORAX, $Na_2B_4O_7$	A	A	A	A	A	A	A	A
BORIC ACID, H_3BO_3	A	C	F	A	A	A	A	A
BROMINE, Wet, Br_2	A	F	F	A	F	F	F	A
BUTANOL, C_4H_9OH	A	A	A	A	B	B	C	A
BUTYL ACETATE, $C_4H_9COOCH_3$	A	B	B	A	F	F	F	A
BUTYRIC ACID, C_3H_7COOH	A	B	F	A	F	F	A	A
CALCIUM BISULFATE, $CaHSO_4$	A	F	F	A	A	A	A	A
CALCIUM BISULFITE, $CaHSO_3$	A	F	F	A	A	A	A	A
CALCIUM CARBONATE, $CaCO_3$	A	B	A	A	A	A	A	A
CALCIUM CHLORATE, $CaClO_3$	A	B	C	A	A	A	A	A
CALCIUM CHLORIDE, $CaCl_2$	A	B	F	A	A	A	A	A
CALCIUM HYDROXIDE, $Ca(OH)_2$	A	C	A	A	A	A	A	A
CALCIUM HYPOCHLORITE, $Ca(OCl)_2$	A	B	F	A	A	A	F	A
CALCIUM SULFATE, $CaSO_4$	A	B	B	A	A	A	A	A
CARBON DIOXIDE (Dry), CO_2	A	A	A	A	A	A	A	A
CARBON DIOXIDE (Wet or H_2CO_3)	A	A	A	A	A	A	A	A
CARBON DISULFIDE, CS_2	A	A	B	A	F	F	F	A
CARBON TETRACHLORIDE (Moist) CCl_4	A	B	F	A	F	F	F	A
CHLORACETIC ACID, $ClCH_2CO_2H$	A	B	F	A	F	A	C	A
CHLORIC ACID, $HClO_3$	A	B	F	A	F	A	F	A
CHLORINE (Dry), Cl_2	A	B	B	A	A	F	F	A
CHLORINE (Wet), Cl_2	A	C	F	A	A	F	F	A
CHLOROBENZENE, C_6H_5Cl	A	B	B	A	F	F	F	A
CHLOROFORM, $CHCl_3$	A	B	F	A	F	F	F	A
CHROMIC ACID, CrO_3 sol'n	A	B	F	A	A	A	B	A
COPPER CHLORIDE, $CuCl_2$	A	F	F	A	A	A	B	A
COPPER CYANIDE, $Cu(CN)_2$	A	B	B	A	A	A	B	C
COPPER NITRATE $Cu(NO_3)_2$	A	A	A	A	A	A	B	A
COPPER SULFATE $CuSO_4$	A	A	F	A	A	A	B	A
CRESYLIC ACID	A	B	B	A	F	C	F	A
DICHLORETHANE, $C_2H_4Cl_2$	A	B	B	A	F	F	F	A
DIETHYLAMINE, $(C_2H_5)_2NH$	A	A	A	A	F	F	F	A
DIPHENYL, $C_6H_5C_6H_5$	A	A	A	A				A
ETHERS, Various	A	A	B	A	F	F	F	A
ETHYL ACETATE, $C_2H_5COOCH_3$	A	A	B	A	F	F	C	A
ETHYL ALCOHOL, C_2H_5OH	A	A	B	A	A	A	A	A
ETHYL CHLORIDE, C_2H_5Cl	A	A	A	A	F	F	F	A
ETHYLENE CHLOROHYDRIN, $Cl(C_2H_4)OH$	A	B	B	A	F	F	A	A
ETHYLENE DICHLORIDE, $C_2H_4Cl_2$	A	A	B	A	F	F	F	A
ETHYLENE GLYCOL, CH_2OHCH_2OH	A	B	B	A	A	A	B	A
ETHYLENE OXIDE, CH_2OCH_2	A	A	B	A	F	F	F	A
FATTY ACIDS, Various	A	A	F	A	F	A	A	A
FERRIC CHLORIDE, $FeCl_3$	A	C	F	A	A	A	A	A
FERRIC NITRATE, $Fe(NO_3)_3$	A	A	B	A	A	A	A	A
FERRIC SULFATE, $Fe_2(SO_4)_3$	A	B	F	A	A	A	A	A
FERROUS CHLORIDE, $FeCl_2$	A	B	F	A	A	A	A	A
FERROUS SULFATE, $FeSO_4$	A	B	B	A	A	A	A	A
FLUORINE, F_2	F	F	A	C	F	F	F	F
FORMALDEHYDE, CH_2O 37%	A	A	B	A	A	A	A	A
FORMIC ACID, HCOOH	A	A	F	A	A	F	A	A
FUEL OIL	A	A	A	A	F	A	C	A
GALLIC ACID, $(OH)_3C_6H_2COOH$	A	A	B	A	A	A	A	A
GASOLINE, Refined	A	A	A	A	F	C	F	A
GLYCEROL, $CH_2OH.CHOHCH_2OH$	A	A	B	A	A	A	A	A
HYDROBROMIC ACID, HBr	A	F	F	A	A	A	A	A
HYDROCHLORIC ACID, (Conc.), HCl	A	F	F	A	A	F	F	A
HYDROCHLORIC ACID, (Dilute)	A	F	F	A	A	A	A	A
HYDROCHLORIC (Dry Gas)	A	A	C	A	A	C	A	A
HYDROCYANIC ACID, (Conc.), HCN	A	A	F	A	B	A	C	A
HYDROCYANIC ACID (Dil. and Gas)	A	B	F	A	B	A	C	A
HYDROFLUORIC ACID, (Conc.), HF	F	F	F	A	F	F	F	F
HYDROFLUORIC ACID, (Dilute)	F	F	F	A	A	F	B	F
HYDROFLUOSILICIC ACID, H_2SiF_6	F	F	F	A	A	A	C	C
HYDROCARBONS (Aliphatic)	A	A	A	A	F	F	C	A
HYDROCARBONS (Aromatic)	A	A	A	A	F	F	F	A
HYDROGEN GAS, H_2	A	A	A	A	A	A	C	A
HYDROGEN PEROXIDE (Conc.), H_2O_2	A	B	B	A	C	F	B	A
HYDROGEN PEROXIDE (Dilute)	A	C	B	A	A	A	C	A
HYDROGEN SULFIDE (Dry) H_2S	A	B	B	A	C	A	A	A
HYDROGEN SULFIDE (Wet)	A	A	F	A	C	A	B	A
IODINE, I_4 Wet	A	F	F	A	F	F	C	A

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(continued)

TABLE 7.9: GLASS, METAL AND PLASTIC PIPING SYSTEMS—O-I/SCHOTT PROCESS SYSTEMS (cont'd)

MATERIALS
A—Very Good Service
B—Moderate Service
C—Limited or Variable Service
F—Unsatisfactory
Blank—No Information

CHEMICALS
Solids assumed in solution.

*Data represented is to be used as a guide only. For specific information, test under actual operating conditions.

Maximum Operating Temperature	400	450	450	450	150	150	180	450
	GLASS, "KIMAX®" BRAND & DURAN	DURIRON; Fe, 14 Si; Durichlor, Fe, 14 Si, 3 Mo	304 STAINLESS STEEL; Fe, 18 Cr, 8 Ni	TEFLON (Polytetraflouroethylene)	POLYETHYLENE	POLYVINYL CHLORIDE Rigid or Unplast	POLYPROPYLENE	CER-VIT® C-126
IODOFORM, CHI_3	A	A	F	A	F	F	C	A
KEROSENE	A	A	A	A	A	A	F	A
KETONES, Various	A	A	A	A	F	F	F	A
LACTIC ACID, CH_3 CHOHCOOH	A	B	F	A	A	B	B	A
LEAD ACETATE, $Pb(CH_3COO)_2$	A	B	B	A	A	A	A	A
MAGNESIUM CHLORIDE, $MgCl_2$	A	F	F	A	A	A	A	A
MAGNESIUM HYDROXIDE, $Mg(OH)_2$	A	B	A	A	A	A	A	A
MAGNESIUM SULFATE, $MgSO_4$	A	A	B	A	A	A	A	A
MALEIC ACID, $CO_2H\,C_2H_2\,CO_2H$	A	B	F	A	C	A	F	A
MALIC ACID, $CO_2H\,CH_2\,CHOH\,CO_2H$	A	B	A	A	B	A	F	A
MERCURIC CHLORIDE, Hg, Cl_2	A	B	F	A	B	A	A	A
MERCURY, Hg	A	A	A	A	A	A	A	A
METHANOL, Conc., CH_3OH	A	A	C	A	C	A	B	A
METHANOL (Dilute)	A	A	A	A	C	A	B	A
METHYL CHLORIDE, CH_3Cl	A	A	C	A	F	F	F	A
NAPHTHA, Petroleum	A	B	A	A	F	A	F	A
NICKEL CHLORIDE, $NiCl_2$	A	B	F	A	A	A	A	A
NICKEL SULFATE, $NiSO_4$	A	B	B	A	A	A	A	A
NITRATING ACID (>15% H_2SO_4)	A	A	C	A	A	A	A	A
NITRATING ACID (<15% H_2SO_4)	A	A	C	A	C	B	A	A
NITRATING ACID (<15% HNO_3)	A	A	C	A	C	A	C	A
NITRATING ACID (<1% Acid)	A	A	C	A	C	A	C	A
NITRIC ACID, Conc., HNO_3	A	A	F	A	F	F	F	A
NITRIC ACID, Dilute	A	F	F	A	C	A	C	A
NITROBENZENE, $C_6N_5NO_2$	A	A	B	A	F	F	F	A
NITROUS ACID, HNO_2	A	A	B	A	C	A	F	A
OLEIC ACID, $C_8H_{17}CH{:}CH(CH_2)_7CO_2H$	A	B	F	A	F	A	C	A
OXALIC ACID, $CO_2H\,CO_2H$	A	B	F	A	B	A	B	A
PERCHLORIC ACID 70%	A	A	F	A	C	C	C	A
PHENOL (Conc.) C_6H_5OH	A	A	A	A	F	C	A	A
PHOSPHORIC ACID (100%), H_3PO_4	A	B	F	A	B	A	A	A
PHOSPHORIC ACID (>45% Hot)	A	B	F	A	C	A	A	C
PHOSPHORIC ACID (>45% Cold)	A	B	F	A	A	A	A	A
PHOSPHORIC ACID (<45% Cold)	A	B	B	A	A	A	A	A
PHOSPHORIC ANHYDRIDE, Dry or Moist	A	A	A	A	A	F	A	A
PHOSPHORIC ANHYDRIDE, Molten, P_2O_5	F	A	A	F	F	F	F	F
PHTHALIC ANHYDRIDE, $C_6H_4(CO)_2O$	A	B	A	A	F	F	C	A
PICRIC ACID, Sol'n., $HO.C_6H_2(NO_3)_3$	A	B	B	A	C	F	C	A
POTASSIUM BROMIDE, KBr	A	B	C	A	A	A	A	A
POTASSIUM CARBONATE, K_2CO_3	A	A	A	A	A	A	A	A
POTASSIUM CHLORATE, $KClO_3$	A	B	B	A	A	A	A	A
POTASSIUM CHLORIDE, KCl	A	A	F	A	A	A	A	A
POTASSIUM CYANIDE, KCN	A	A	A	A	A	A	A	A
POTASSIUM DICHROMATE, $K_2Cr_2O_7$	A	A	A	A	A	A	A	A
POTASSIUM FERROCYANIDE, $K_4Fe(CN)_6$	A	A	A	A	A	A	A	A
POTASSIUM HYDROXIDE, KOH	A	C	C	A	A	A	A	A
POTASSIUM NITRATE, KNO_3	A	A	A	A	A	A	A	A
POTASSIUM PERMANGANATE, $KMnO_4$	A	A	B	A	B	B	C	A
POTASSIUM SULFATE, K_2SO_4	A	A	B	A	A	A	A	A
POTASSIUM SULFIDE, K_2S	A	A	A	A	A	A	A	A
PYROGALLOL, $C_6H_3(OH)_3$	A	B	B	A	B	B	A	A
SILVER NITRATE, $AgNO_3$	A	A	B	A	A	A	A	A
SODIUM, Molten 210°—400°F.	A	A	A	C	F	F	F	
SODIUM ACETATE, $NaCH_3COO$	A	A	B	A	A	A	A	A
SODIUM BICARBONATE, $NaHCO_3$	A	A	A	A	A	A	A	A
SODIUM BISULFATE, $NaHSO_4$	A	A	F	A	A	A	A	A
SODIUM BISULFITE, $NaHSO_3$	A	F	F	A	A	A	A	A
SODIUM BORATE $NaBO_2$	A	B	F	A	A	A	A	A
SODIUM CARBONATE, Na_2CO_3	A	B	B	A	A	A	A	A
SODIUM CHLORATE, $NaClO_3$	A	A	A	A	A	A	A	A
SODIUM CHLORIDE, NaCl	A	B	C	A	A	A	A	A
SODIUM CYANIDE, NaCN	A	A	A	A	A	A	A	A
SODIUM FLUORIDE, NaF	B	F	F	A	A	A	A	C
SODIUM HYDROXIDE, NaOH<85°F	A	F	F	A	A	A	A	A
SODIUM HYDROXIDE<140°F	B	F	A	A	A	A	A	B
SODIUM HYDROXIDE >160°F	F	F	C	A	A	A	A	C
SODIUM HYPOCHLORITE, NaOCl	A	B	F	A	C	A	C	A
SODIUM HYPOSULFITE, $Na_2S_2O_4$	A	B	B	A	A	A	A	A
SODIUM NITRATE, $NaNO_3$	A	A	A	A	A	A	A	A
SODIUM PEROXIDE, Na_2O_2 10%	A	B	B	A	A	A	A	A
SODIUM PHOSPHATE, (Tri) Na_3PO_4	A	B	B	A	A	A	A	A
SODIUM SILICATE, Na_2SiO_3	A	B	B	A	A	A	A	A
SODIUM SULFATE, Na_2SO_4	A	A	A	A	A	A	A	A
SODIUM SULFIDE, Na_2S	F	F	F	A	A	A	A	A
SODIUM SULFITE, Na_2SO_3	A	F	B	A	A	A	A	A
STANNIC CHLORIDE, $SnCl_4$	A	A	F	A	A	A	A	A
STANNOUS CHLORIDE, $SnCl_2$	A	A	F	A	A	A	A	A
STEARIC ACID, $CH_3(CH_2)_{16}COOH$	A	B	B	A	F	A	C	A
SULFUR, Molten, S	A	A	A	A	A	A	F	A
SULFUR CHLORIDE, (Wet), S_2Cl_2	A	F	F	A	F	C	F	A
SULFUR DIOXIDE (Dry), So_2	A	F	B	A	A	F	A	A
SULFUR DIOXIDE (Wet) $SO_2 + H_2O$	A	C	F	A	C	F	C	A
SULFUR TRIOXIDE, SO_3	A	F	B	A	A	A	F	A
SULFURIC ACID (Fuming to 98%)	A	F	F	A	F	F	F	A
SULFURIC ACID (Hot Conc.) H_2SO_4	A	A	F	A	F	F	F	
SULFURIC ACID (Cold Conc.)	A	A	F	A	F	F	F	A
SULFURIC ACID (75%-95%)	A	A	F	A	F	F	F	A
SULFURIC ACID (10%-75%)	A	A	F	A	A	A	C	A
SULFURIC ACID (<10%)	A	A	F	A	A	A	B	A
SULFUROUS ACID, H_2SO_3	A	C	F	A	B	A	B	A
SULFURYL CHLORIDE, SO_2Cl_2	A	B	B	A	F	C	F	A
TANNIC ACID	A	A	B	A	A	A	A	A
TARTARIC ACID, $(CHOH\,COOH)_2$	A	B	A	A	A	A	A	A
TOLUENE, $CH_3C_6H_5$	A	A	A	A	F	F	F	A
TRICHLORETHYLENE, Dry, Cl_2. C. CHCl	A	A	C	A	F	F	F	A
WATER, Fresh H_2O	A	A	A	A	A	A	A	A
WATER, Distilled Lab.	A	A	A	A	A	A	A	A
ZINC CHLORIDE, $ZnCl_2$	A	A	F	A	A	A	A	A
ZINC SULFATE, $ZnSO_4$	A	A	B	A	A	A	A	A

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TABLE 7.10: NATURAL AND SYNTHETIC FIBERS, POROUS STONE OR POROUS CARBON FILTER TUBE MATERIALS–SETHCO

Sethco filter tubes are fabricated of natural or synthetic fiber wound over a perforated plastic or metal core. The precision winding pattern covers the entire depth of the filter tube with hundreds of funnel shaped tunnels which become gradually finer from the outer surface to the center of the tube and trap progressively finer particles as the fluid travels to the center. This allows much greater solids retention capacity than is associated with surface filter media of the same dimensions.

Types of Filter Tubes and Supporting Cores: Cotton, Dynel, polypropylene, acetate, porous stone or porous carbon filter tubes are available. Supporting perforated cores for cotton, Dynel or polypropylene are stainless steel, polypropylene or steel. Supporting cores for acetate tubes are tin plated copper with voile liner. Porous stone and porous carbon filter tubes do not require supporting cores. Stainless steel cores are recommended for mildly acid and all alkaline solutions, pH 4 to 14. Polypropylene cores are used where all metal contact must be eliminated or where stainless steel is attacked, such as high chloride and sulfuric acid solutions. It is recommended for all acid and alkaline solutions, pH 0 to 14. Two types of polypropylene cores are available: mesh polypropylene and rigid perforated polypropylene. The mesh type of polypropylene is satisfactory for temperatures below 140°F. The more expensive rigid polypropylene cores are used for temperature applications over 140°F, and for double and triple tiered filter chambers because their greater strength is needed here. Perforated steel cores are used for dilute alkaline solutions, solvents, lacquers, oils, emulsions, etc.

Filter Tube Selection: Cotton filter tubes are recommended for moderately acid and alkaline solutions in the pH range of 3 to 11. Polypropylene, Dynel and porous carbon filter tubes are recommended for concentrated acid and alkaline solutions and for all fluoborate solutions over the entire pH range of 0 to 14. Polypropylene filter tubes are also recommended for electropolishing solutions, as well as certain other highly corrosive solutions. Porous stone filter tubes are recommended for concentrated acid solutions. Acetate filter tubes are recommended for water. Sethco filter tubes are available in densities to filter out particles from 150 down to 1 micron.

	ELECTROPLATING SOLUTIONS	FILTER TUBE Material/Core
ACID TYPE (FLUOBORATES)	Copper, Iron, Lead, Tin	Polypropylene/PP or Dynel/PP
ACID TYPE (NOT FLUOBORATES)	Copper, Tin and Zinc—Less than 6 oz/gal sulfuric	Poilypropylene or Cotton/PP
	Copper, Tin and Zinc—Over 6 oz/gal sulfuric acid	Polypropylene/PP or Dynel/PP
	Chromium	Polypropylene/PP or Dynel/PP
	Gold, Indium, Rhodium, Palladium	Polypropylene/PP or Dynel/PP
	Iron Chloride (190°F)	Polypropylene/Rigid PP or Porous Stone
	Nickel (Woods)	Polypropylene/PP or Dynel/PP
	Nickel (Wattts type & Bright)	Polypropylene/PP or Cotton/PP
	Nickel (Hi-chloride)	Polypropylene/PP or Cotton/PP
	Nickel Sulfamate	Polypropylene/PP or Cotton/PP
	Electrotype Copper and Nickel	Polypropylene/PP or Cotton/PP
ALKALINE TYPE	Tin (stannate)	Cotton/SS
ALKALINE CYANIDE TYPE	Brass*, Cadmium*, Copper*, Zinc*	Cotton/SS, Polypropylene/PP or Dynel/PP
	Gold, Indium, Platinum, Silver	Cotton/SS or Polypropylene/PP
PYROPHOSPHATE TYPE	Copper, Iron, Tin, etc.	Cotton/SS or Cotton/PP
ELECTROLESS TYPE	Nickel Plating, Solutions Below 140°F:	Polypropylene/PP Cotton/SS or Cotton/PP
	Above 140°F:	Polypropylene/RPP or Cotton/SS
	Copper Below 140°F:	Polypropylene/PP
	Above 140°F:	Polypropylene/RPP

	CHEMICALS	FILTER TUBE Material/Core
ACIDS	Acetic—Dilute	Cotton/SS or Polypropylene/PP
	Acetic—Concentrated	Polypropylene/PP or Dynel/PP
	Boric Acid	Cotton/SS or Polypropylene/PP
	Chromic Acid, Hydrochloric, Nitric, Phosphoric, and Sulfuric	Polypropylene/PP, Dynel/PP or Porous Stone†
	Hydrofluoric, Fluoboric Acids	Polypropylene/PP or Dynel/PP
ALKALIES	Sodium or Potassium Hydroxide	Polypropylene/PP
	Ammonium Hydroxide—Dilute	Cotton/SS or Polypropylene/PP
	Ammonium Hydroxide—Concentrated	Polypropylene/PP or Dynel/PP
CHEMICALS, MISC.	Biological Solutions	Cotton/SS, Polypropylene/PP or Porous Stone†
	Electropolishing solutions	Porous Stone or Polypropylene/PP
	Pharmaceutical solutions	Cotton/SS, Polypropylene/PP or Porous Stone†
	Photographic solutions	Cotton/SS or Polypropylene/PP
	Radioactive solutions	Cotton/SS or Porous Stone†
	Ultrasonic cleaning solutions	Cotton Special B Compound/SV
	Nickel Acetate 190°F	Cotton/SS
	Food Products	Cotton/SS or Polypropylene/PP
ORGANIC LIQUIDS	Carbon Tetrachloride	Cotton/Steel or SS
	Dichlorethylene	Cotton/Steel or SS
	Hydraulic Fluids	Cotton/Steel or SS
	Lacquers	Cotton/Steel or SS
	Perchlorethylene or Trichlorethylene	Cotton/Steel or SS
	Solvents	Cotton/Steel or SS
PETROLEUM PRODUCTS	Fuel Oil, Diesel, Kerosene, Gasoline, Lube Oil	Cotton/Steel or SS

*When operated as hi-speed baths at high temperatures (above 140°F) or with high alkali content, use Polypropylene/PP or Dynel/PP.
†Porous Stone is recommended for all acids except hydrofluoric and fluoboric.

TABLE 7.11: RESIN, STEEL, ALLOY, TITANIUM, CERAMIC, RUBBER, NATURAL AND SYNTHETIC FIBER PUMP AND FILTRATION SYSTEM MATERIALS—SETHCO

Plating Solutions

PLATING SOLUTION	TEMP.	CPVC	PVC	EPOXY	POLYPRO	NORYL (PPO)	LUCITE	KYNAR	TEFLON	SS 316	CARP 20	HAST. C	TITANIUM	CERAMIC	NEOPRENE	BUNA N	HYPALON	VITON	DYNEL	COTTON	ORLON	NYLON
ANTIMONY	130°F	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	E
ARSENIC	110°F	A	A	B	A	A	A	A	A	A	A	A	A	B-D	A	A	A	A	A	E	E	A
BRASS																						
Regular Brass Bath	100°F	A	A	E	A	A	A	A	A	A	A	A	A	B-D	A	A	A	A	A	A	E	A
High Speed Brass Bath	110°F	A	A	E	A	A	A	A	A	A	A	A	A	E	A	A	A	A	A	E	E	A
BRONZE																						
Copper-Cad. Bronze Bath	RT	A	A	E	A	A	A	A	A	A	A	A	A	B-D	A	A	A	A	A	B	E	A
Copper-Tin Bronze Bath	160°F	A	E	E	A	A	E	A	A	A	A	A	A	E	B	A	A	A	A	E	E	A
Copper-Zn. Bronze Bath	100°F	A	A	E	A	A	A	A	A	A	A	A	A	B-D	A	A	A	A	A	B	E	A
CADMIUM																						
Cyanide Bath	90°F	A	A	E	A	A	A	A	A	A	A	A	A	B-D	A	A	A	A	A	B	E	A
Fluoborate Bath	100°F	A	A	E	A	A	A	A	A	A	A	A	E	E	B-D	B	A	A	A	E	A	E
CHROMIUM																						
Chromic-Sulfuric Bath	130°F	A	A	E	D	E	A	A	A	D	B	A-B	A	A	E	E	A	D	B	E	A	E
Fluosilicate Bath	95°F	A	A	E	D	E	A	A	A	D	B	A-B	D	B	E	E	A	D	A	E	A	E
Fluoride Bath	130°F	A	A	E	D	E	A	A	A	E	B	A-B	D	B	E	E	A	D	B	E	A	E
Black Chrome Bath	115°F	A	A	E	D	E	A	A	A	D	B	A-B	A	A	E	E	A	D	B	E	A	E
Barrel Chrome Bath	95°F	A	A	E	D	E	A	A	A	E	B	A-B	B-D	A	E	E	A	D	A	E	A	E
COPPER (ACID)																						
Copper Sulfate Bath	RT	A	A	E	A	A	A	A	A	D	B	A	A	A	A	A	A	A	A	D	A	E
Copper Fluoborate Bath	120°F	A	A	E	A	A	A	A	A	D	B	A	E	E	B-D	B	A	A	A	E	A	E
COPPER (CYANIDE)																						
Copper Strike Bath	120°F	A	A	E	A	A	A	A	A	A	A	A	A	B-D	A	A	A	A	A	B	E	A
Rochelle Salt Bath	150°F	A	E	E	A	A	E	A	A	A	A	A	A	E	B	A	A	A	A	B	E	A
High Speed Bath	180°F	A	E	E	A	A	E	A	A	A	A	A	A	E	B	A	A	A	A	E	E	A
COPPER (MISC.)																						
Copper Pyrophosphate	140°F	A	A	B	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	B	E	A
Copper (Electroless)	140°F	A	A	E	A	A	A	A	A	F	F	F	F	A	E	E	A	A	A	A	E	A
GOLD																						
Cyanide	150°F	A	E	E	A	A	E	A	A	A	A	A	A	B	A	A	A	A	A	B	E	A
Neutral	75°F	A	A	B	A	A	A	A	A	D	D	A	A	A	A	A	A	A	A	B	E	A
Acid	75°F	A	A	B	A	A	A	A	A	D	D	A	A	A	A	A	A	A	A	A	E	A
INDIUM SULFAMATE	RT	A	A	B	A	A	A	A	A	D	B	A	A	A	A	A	A	A	A	A	A	E
IRON																						
Ferrous Chloride Bath	190°F	A	E	B	D	A	E	A	A	E	E	E	A	A	E	B	A	A	A	E	A	E
Ferrous Sulfate Bath	150°F	A	E	B	A	A	E	A	A	D	B	A	A	A	B	A	A	A	A	E	A	E
Ferrous Am. Sulfate Bath	150°F	A	E	B	A	A	E	A	A	D	B	A	A	A	B	A	A	A	A	E	A	E
Sulfate-Chloride Bath	160°F	A	E	B	A	A	E	A	A	E	E	E	A	A	D	B	A	A	A	E	A	E
Fluoborate Bath	145°F	A	E	B	A	A	E	A	A	E	B	B	E	E	B-D	B	A	A	A	E	A	E
Sulfamate	140°F	A	A	B	A	A	A	A	A	E	B	B	A	A	A	A	A	A	A	E	A	E
LEAD FLUOBORATE		A	A	B	A	A	A	A	A	D	B	A	E	E	B-D	B	A	A	A	E	A	E
NICKEL																						
Watts Type	115-160°F	A	E	A	A	A	A-E	A	A	D	D	A	A	A	A	A	A	A	A	A	A	A
High Chloride	130-160°F	A	E	A	A	A	A-E	A	A	D	D	A	A	A	B	A	A	A	A	D	A	E
Fluoborate	100-170°F	A	E	E	A	A	A-E	A	A	D	B	A	E	E	B-D	B	A	A	A	D	A	E
Sulfamate	100-140°F	A	A	A	A	A	A	A	A	D	B	A	A	A	A	A	A	A	A	A	A	A
Electroless	200°F	A	E	B	E	E	E	A	A	F	F	F	F	A	E	E	B	A	A	A	A	E
RHODIUM	120°F	A	A	B	A	A	A	A	A	E	E	E	E	A	B	A	A	A	A	E	A	E
SILVER	80-120°F	A	A	E	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A
TIN-FLUOBORATE	100°F	A	A	E	A	A	A	A	A	D	B	A	E	E	B-D	B	A	A	A	E	A	E
TIN-LEAD	100°F	A	A	B	A	A	A	A	A	D	B	A	E	E	B-D	B	A	A	A	E	A	E
ZINC																						
Acid Chloride	140°F	A	A	B	A	A	A	A	A	E	E	E	A	A	A	A	A	A	A	E	A	E
Acid Sulfate Bath	150°F	A	E	E	A	A	A	A	A	D	B	A	A	A	B	A	A	A	A	D	A	E
Acid Fluoborate Bath	RT	A	A	E	A	A	A	A	A	D	B	A	E	E	B-D	B	A	A	A	E	A	E
Alkaline Cyanide Bath	RT	A	A	E	A	A	A	A	A	A	A	A	A	E	A	A	A	A	A	E	E	A

SYMBOL IDENTIFICATION

A – Excellent
B – Good
C – Good to 80°F
D – Moderate effect (use under limited conditions)
E – Not recommended
F – Autocatalytic
X – Unknown

(continued)

TABLE 7.11: RESIN, STEEL, ALLOY, TITANIUM, CERAMIC, RUBBER, NATURAL AND SYNTHETIC FIBER PUMP AND FILTRATION SYSTEM MATERIALS–SETHCO (continued)

Industrial Chemicals

CHEMICAL	CPVC	PVC	EPOXY	POLYPRO	NORYL (PPO)	LUCITE	KYNAR	TEFLON	SS 316	CARP 20	HAST. C	TITANIUM	CERAMIC	NEOPRENE	BUNA N	HYPALON	VITON	DYNEL	COTTON	ORLON	NYLON
ACETALDEHYDE	E	E	X	C	X	E	X	A	A	A	A	A	A	E	B	E	A	X	A	X	X
ACETIC ACID, 20%	B	B	B	A	A	A	A	A	A	A	A	A	A	D	D	A	E	A	E	A	E
ACETIC ACID, 80%	D	D	C	B	B	D	A	A	A	A	A	A	A	B	D	A	E	E	E	A	E
ACETIC ACID, GLACIAL	E	D	C	C	D	E	A	A	A	A	A	A	A	D	E	E	E	E	E	A	E
ACETIC ANHYDRIDE	E	E	X	A	E	E	D	A	D	C	A	A	A	A	A	A	E	E	E	X	E
ACETONE	E	E	B	B	X	E	D	A	A	A	A	A-D	A	D	E	D	E	D	A	A	A
ALUMINUM CHLORIDE	A	A	A	A	A	A	A	A	D	D	A	D	A	A	A	A	A	A	E	A	E
ALUMINUM FLUORIDE	A	A	B	A	A	A	A	A	C	D	B	D	X	A	A	A	A	A	E	A	E
ALUMINUM SULFATE	A	A	A	A	A	A	A	A	D	B	A	A	A	A	A	A	A	A	D	A	D
AMMONIA, 10%	A	A	C	A	A	A	A	A	A	A	A	A	A	A	E	A	A	A	E	X	A
AMMONIUM CHLORIDE	A	A	A	A	A	A	A	A	D	C	A	A	A	A	A	A	A	A	D	A	E
AMMONIUM NITRATE	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	D	A	E
AMMONIUM PERSULFATE	A	A	X	A	A	A	A	A	C	B	B	X	A	A	A	A	A	A	D	A	E
AMMONIUM PHOSPHATE	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	D	A	D
AMMONIUM SULFATE	A	A	A	A	A	A	A	A	B	A	A	A	A	A	B	B	B	A	D	A	E
AMYL ACETATE	E	E	C	E	E	E	A	A	A	A	A	A	A	E	E	E	E	D	X	A	D
AMYL ALCOHOL	B	B	X	X	D	E	A	A	A	A	A	A	A	A	B	B	B	A	B	A	A
AMYL CHLORIDE	E	E	C	X	E	E	A	A	C	A	A	X	A	X	X	E	A	E	X	E	D
ANILINE	E	E	C	C	E	E	A	A	A	A	A	A	A	E	E	B	A	E	X	E	D
AQUA REGIA	E	E	E	X	E	E	C	A	E	E	D-E	A	A	E	E	B	A	D	E	D	E
ARSENIC ACID	A	A	X	A	A	A	A	A	X	B	X	X	A	A	X	X	A	A	E	D	E
BARIUM CHLORIDE	A	A	A	A	A	A	A	A	C	B	A	A	A	A	B	B	B	A	D	A	A
BARIUM SULFATE	A	A	A	A	A	A	A	A	B	B	A	A	A	A	A	A	A	A	D	A	A
BEER	A	A	A	A	A	A	A	A	A	A	A	A	A	A	E	A	A	E	A	E	E
BENZALDEHYDE	E	E	X	C	E	E	C	A	A	A	A	A	A	E	E	E	E	D	A	A	A
BENZENE (BENZOL)	E	E	C	C	E	E	C	A	A	A	A	A	A	E	E	E	D	E	A	A	A
BENZOIC ACID	A	A	A	A	A	C	A	A	B	B	A	C	A	E	E	E	A	A	X	A	D
BORAX (SODIUM BORATE)	A	A	A	A	A	X	A	A	A	A	A	X	A	A	B	B	B	A	A	A	A
BORIC ACID	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	A	A	A	B
BROMINE WATER	C	C	C	E	A	X	A	A	E	E	A	A	A	E	E	E	A	A	E	D	E
BUTYL ACETATE	E	E	C	E	E	X	C	A	B	B	A	X	A	X	B	E	E	A	A	A	A
BUTYRIC ACID	D	D	B	A	A	D	A	A	B	A	A	C	A	E	X	E	D	A	X	A	E
CALCIUM BISULFITE	A	A	A	A	A	X	A	A	B	B	A	C	A	A	A	A	A	X	B	X	X
CALCIUM CHLORIDE	A	A	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A	A	D	A	E
CALCIUM HYPOCHLORITE	A	A	X	A	A	A	A	A	D	D	B	A	A	E	B	A	D	A	E	E	E
CALCIUM SULFATE	A	A	A	A	A	A	A	A	B	B	A	A	A	A	A	A	A	A	D	A	E
CARBON TETRACHLORIDE	C	C	C	C	E	X	A	A	B	B	A	A	A	E	E	E	A	A	A	A	A
CARBONIC ACID	A	A	B	A	A	A	A	A	B	A	A	X	A	A	B	B	B	A	A	A	A
CHLOROACETIC ACID	A	A	C	D	X	E	A	A	E	X	A	A	A	E	E	A	A	A	X	A	E
CHLORINE WATER	A	A	X	E	D	X	A	A	E	B	B	A	A	E	E	B	A	A	E	A	E
CHLOROBENZENE	E	E	X	C	E	E	A	A	A	A	A	X	A	E	E	E	A	D	A	A	A
CHLOROFORM	E	E	C	E	E	E	A	A	A	A	A	A	A	E	E	E	D	A	A	A	E
CHLOROSULFONIC ACID	C	C	X	E	X	E	E	A	D	D	A	A	A	E	E	X	E	A	E	A	E
CHROMIC ACID, 10%	A	A	D	A-D	A	A	A	A	B	A	A	A	A	E	E	A	A	A	E	A	E
CHROMIC ACID, 30%	A	A	E	A-D	E	A	A	A	B	A	A	A	A	E	E	A	A	A	E	A	E
CHROMIC ACID, 50%	E	E	E	A-D	E	D	A	A	C	B	A	A	A	E	E	A	A	D	E	A	E
CITRIC ACID	A	A	A	A	A	A	A	A	B	A	A	A	A	A	E	A	A	A	A	A	D
COPPER CHLORIDE	A	A	A	A	A	A	A	A	B	B	A	A	A	A	B	B	B	A	D	A	E
COPPER CYANIDE	A	A	D	A	A	A	A	A	A	A	A	A	A	A	B	X	B	A	A	E	A
COPPER NITRATE	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	A	D	A	E
COPPER SULFATE	A	A	A	A	A	A	A	A	B	A	A	A	A	A	B	B	B	A	D	A	D
CRESYLIC ACID	B	B	X	X	X	X	A	A	A	A	A	A	A	X	X	X	A	D	A	A	E
ETHYL ACETATE	E	E	B	C	E	E	C	A	B	B	B	X	A	E	X	E	E	A	A	A	A
ETHYL CHLORIDE	E	E	C	E	E	E	A	A	A	A	B	A	A	D	E	D	A	A	X	A	A
ETHYLENE GLYCOL	A	A	A	A	A	A	A	A	B	A	A	X	A	A	B	B	B	A	A	X	X
FATTY ACIDS	A	A	A	A	A	D	A	A	A	A	A	A	A	B	A	X	B	A	A	B	E
FERRIC CHLORIDE	A	A	A	A	A	A	A	A	E	E	B-C	A	A	A	E	B	B	A	E	A	E

SYMBOL IDENTIFICATION

A – Excellent
B – Good
C – Good to 80°F
D – Moderate effect (use under limited conditions)
E – Not recommended
F – Autocatalytic
X – Unknown

(continued)

TABLE 7.11: RESIN, STEEL, ALLOY, TITANIUM, CERAMIC, RUBBER, NATURAL AND SYNTHETIC FIBER PUMP AND FILTRATION SYSTEM MATERIALS—SETHCO (continued)

CHEMICAL	CPVC	PVC	EPOXY	POLYPRO	NORYL (PPO)	LUCITE	KYNAR	TEFLON	SS 316	CARP 20	HAST. C	TITANIUM	CERAMIC	NEOPRENE	BUNA N	HYPALON	VITON	DYNEL	COTTON	ORLON	NYLON
FERRIC NITRATE	A	A	A	A	A	A	A	A	B	A	B	A	A	A	B	B	B	A	D	A	E
FERRIC SULFATE	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	A	D	A	E
FERROUS CHLORIDE	A	A	A	A	A	A	A	A	E	E	B	A	A	A	X	B	B	A	E	A	E
FERROUS SULFATE	A	A	A	A	A	A	A	A	D	B	A	A	A	A	X	B	B	A	E	D	E
FLUOBORIC ACID	A	A	X	A	B	B	A	A	B	A	A	E	E	A	X	B	X	A	E	D	E
FLUOSILICIC ACID	A	A	D	A	B	B	A	A	B	B	B	E	E	B	A	X	B	A	E	A	E
FORMALDEHYDE, 40%	B	B	A	A	A	A	A	A	A	A	A	A	A	A	B	B	E	A	A	D	E
FORMIC ACID	C	C	C	A	A	E	A	A	B	A	A	A	A	A	E	B	E	A	D	A	A
FREON 12 (WET)	C	C	B	A	A	X	X	A	E	X	X	X	A	D	B	E	A	A	A	A	A
FUEL OILS	A	A	X	C	A	X	D	A	A	A	A	A	A	A	B	B	B	X	B	X	X
FURFURAL	E	E	X	E	E	X	A	A	B	A	A	X	A	E	E	X	E	A	X	A	A
GASOLINE	C	C	B	E	E	E	A	A	A	A	A	E	A	E	B	E	A	D	A	A	A
GLYCERINE (GLYCEROL)	A	A	A	A	X	A	A	A	A	A	A	A	A	A	B	B	B	A	A	A	A
HEPTANE	A	A	B	C	E	X	A	A	A	A	A	X	A	D	A	B	B	X	A	X	X
HEXANE	C	C	C	C	X	X	A	A	A	A	A	X	A	A	X	B	B	A	A	A	A
HYDROBROMIC ACID, 20%	A	A	B	A	A	X	A	A	E	E	A	A	C	D	E	A	A	A	E	D	E
HYDROCHLORIC ACID, 0-25%	A	A	A	A	A	A	A	A	E	E	B-C	D	C	A	X	A	B	A	E	A	E
HYDROCHLORIC ACID, 25-37%	A	A	A	A	A	A	A	A	E	E	B-C	D	C	A	X	A	A	A	E	A	E
HYDROCYANIC ACID	A	A	X	A	A	A	A	A	A	A	A	X	C	X	B	X	A	X	E	X	X
HYDROFLUORIC ACID, 10%	C	C	X	A	A	A	A	A	C	C	B	E	E	A	X	A	A	A	E	E	E
HYDROFLUORIC ACID, 30%	C	C	X	B	D	D	A	A	C	C	B	E	E	A	X	A	A	A	E	E	E
HYDROFLUORIC ACID, 60%	D	D	X	B	E	D	A	A	C	C	B	E	E	E	X	D	A	A	E	E	E
HYDROFLUOSILICIC ACID, 20%	A	A	D	A	B	B	A	A	B	B	B	E	E	A	A	X	B	A	E	A	E
HYDROGEN PEROXIDE, 30%	A	A	C	A	X	A	A	A	B	A	A	B	X	D	E	A	A	A	E	A	E
HYDROGEN PEROXIDE, 50%	C	C	X	X	X	X	A	A	B	A	A	X	X	D	E	A	A	A	E	A	E
HYDROGEN PEROXIDE, 90%	E	E	X	X	X	X	C	A	B	A	A	X	X	E	E	D	A	A	E	A	E
HYDROGEN SULFIDE, AQ.SOL.	C	C	A	A	A	A	A	A	B	A	A	A	X	A	E	B	B	X	C	X	X
IODINE (IN ALCOHOL)	E	E	X	C	D	X	A	A	B	B	A	E	A	E	E	E	A	X	X	X	X
KEROSENE	B	B	A	C	X	A	A	A	A	A	A	A	A	E	B	E	A	X	A	X	X
KETONES	E	E	X	E	E	E	C	A	A	A	A	A	A	E	E	E	E	X	A	X	X
LACQUER THINNERS	D	D	X	C	E	E	X	A	A	A	A	A	A	E	E	X	X	X	A	A	A
LACTIC ACID	B	B	A	A	A	D	B	A	B	A	B	A	A	A	X	B	B	A	D	A	D
LEAD ACETATE	A	A	A	A	A	A	A	A	A	A	A	A	A	E	X	E	A	A	A	A	A
LUBRICATING OIL	C	C	X	C	X	A	A	A	A	A	A	A	A	E	A	D	A	X	A	X	X
MAGNESIUM CHLORIDE	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	D	A	A
MAGNESIUM NITRATE	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	D	A	A
MAGNESIUM SULFATE	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	D	A	A
MALEIC ACID	A	A	B	A	A	X	A	A	B	A	A	A	A	X	X	A	A	X	D	X	X
METHYL ALCOHOL	C	C	X	A	A	X	A	A	A	A	A	A	A	A	B	B	D	A	A	A	A
METHYL CHLORIDE	E	E	X	E	E	E	A	A	A	A	A	A	A	E	E	E	A	X	A	X	X
METHYL ETHYL KETONE	E	E	C	C	E	E	E	A	A	A	A	A	A	E	E	E	E	E	A	A	A
METHYL ISOBUTYL KETONE	E	E	B	C	E	E	B	A	A	A	A	A	A	E	E	E	E	X	A	X	X
METHYLENE CHLORIDE	E	E	X	E	E	E	D	A	A	A	A	A	A	E	E	E	D	A	A	A	E
NAPHTHA	B	B	A	C	X	E	A	A	A	A	A	A	A	E	D	E	A	X	A	X	X
NAPHTHALENE	E	E	B	C	X	X	A	A	A	A	A	A	A	E	E	E	D	X	A	X	X
NICKEL CHLORIDE	A	A	A	A	A	A	A	A	B	B	A	A	A	A	B	B	B	A	D	A	A
NICKEL SULFATE	A	A	A	A	A	A	A	A	B	A	B	A	A	A	B	B	B	A	D	A	A
NITRIC ACID, 10%	A	A	X	A	A	D	A	A	B	A	A	A	A	E	E	A	A	A	E	A	E
NITRIC ACID, 20%	A	A	X	A	B	E	A	A	B	A	A	A	A	E	E	A	A	A	E	B	E
NITRIC ACID, 50%	A	A	X	C	E	E	A	A	B	A	A	A	A	E	E	E	A	A	E	D	E
NITRIC ACID, ANHYDROUS	E	E	X	E	E	E	D	A	B	A	B	A	A	E	E	E	B	A	E	E	E
NITRO BENZENE	E	E	X	C	E	E	B	A	B	A	B	A	A	E	E	E	E	E	E	A	A
OILS AND FATS	A	A	X	A	X	X	X	A	A	A	A	A	A	A	A	X	A	X	A	X	X
OLEIC ACID	A	A	A	C	A	X	A	A	B	B	B	X	A	D	A	D	D	A	A	A	E
OLEUM, 25%	E	E	E	X	E	E	E	A	X	X	A	X	A	E	E	E	A	X	E	X	X
OXALIC ACID	A	A	A	A	A	D	A	A	C	B	B	C	A	X	X	A	A	A	D	A	E
PHENOL	C	C	D	B	E	A	A	A	B	B	A	A	A	E	E	E	A	E	A	A	A

SYMBOL IDENTIFICATION

A — Excellent
B — Good
C — Good to 80°F
D — Moderate effect (use under limited conditions)
E — Not recommended
F — Autocatalytic
X — Unknown

(continued)

TABLE 7.11: RESIN, STEEL, ALLOY, TITANIUM, CERAMIC, RUBBER, NATURAL AND SYNTHETIC FIBER PUMP AND FILTRATION SYSTEM MATERIALS—SETHCO (continued)

CHEMICAL	CPVC	PVC	EPOXY	POLYPRO	NORYL (PPO)	LUCITE	KYNAR	TEFLON	SS 316	CARP 20	HAST. C	TITANIUM	CERAMIC	NEOPRENE	BUNA N	HYPALON	VITON	DYNEL	COTTON	ORLON	NYLON
PHOSPHORIC ACID, 0-50%	A	A	A	A	A	A	A	A	B	B	A	C	A	B	X	A	B	A	E	A	E
PHOSPHORIC ACID, 50-100%	B	B	D	B	A	A	A	A	B	B	A-B	C	A	B	X	A	B	A	E	B	E
POTASSIUM BICARBONATE	A	A	A	A	A	A	A	A	B	B	B	A	A	A	B	B	B	A	A	A	A
POTASSIUM BROMIDE	A	A	A	A	A	A	A	A	B	B	A	A	A	A	B	B	B	A	D	A	D
POTASSIUM CARBONATE	A	A	A	A	A	A	A	A	B	B	B	A	A	A	B	B	B	A	A	B	A
POTASSIUM CHLORATE	A	A	X	A	A	A	A	A	A	A	X	A	A	A	B	B	B	A	E	A	D
POTASSIUM CHLORIDE	A	A	A	A	A	A	A	A	D	C	A-B	A	A	A	B	B	B	A	D	A	D
POTASSIUM CYANIDE	A	A	B	A	A	A	A	A	A	B	B	A	A	A	B	B	B	A	A	E	A
POTASSIUM DICHROMATE	A	A	A	A	A	A	A	A	A	A	B	A	A	A	B	B	B	A	E	A	E
POTASSIUM HYDROXIDE	A	A	A	A	A	D	A	A	B	B	B	A-C	E	A	D	B	B	A	D	D	A
POTASSIUM NITRATE	A	A	A	A	A	A	A	A	B	B	B	A	A	A	B	B	B	A	E	A	D
POTASSIUM PERMANGANATE	A	A	B	A	A	A	A	A	B	B	A	A	A	A	B	B	B	A	D	E	E
POTASSIUM SULFATE	A	A	B	A	A	A	A	A	B	B	B	A	A	A	B	B	B	A	D	A	D
PROPYL ALCOHOL	C	C	X	X	X	X	A	A	A	A	A	A	A	A	B	B	B	X	A	X	X
SOAPS	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	X	A	X	X
SODIUM ACETATE	A	A	A	A	A	A	A	A	B	B	B	A	A	D	E	A	E	A	A	A	A
SODIUM BICARBONATE	A	A	A	A	A	A	A	A	B	A	B	A	A	A	B	B	B	A	A	D	A
SODIUM BISULFATE	A	A	X	A	A	A	A	A	A	A	B	A	A	A	B	B	B	A	D	A	D
SODIUM BISULFITE	A	A	A	A	A	A	A	A	B	B	B	A	A	A	B	B	B	A	D	A	D
SODIUM CARBONATE	A	A	A	A	A	A	A	A	B	A	B	A	A	A	B	B	B	A	A	B	A
SODIUM CHLORATE	A	A	X	A	A	A	A	A	B	B	B	A	A	A	E	B	B	A	E	A	D
SODIUM CHLORIDE	A	A	A	A	A	A	A	A	B	B	B	A	A	A	B	B	B	A	A	A	A
SODIUM CYANIDE	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	A	A	D	A
SODIUM HYDROXIDE, 20%	A	A	A	A	A	D	A	A	A	A	A	A	E	A	B	B	E	A	E	E	A
SODIUM HYDROXIDE, 50%	A	A	A	A	A	D	A	A	A	A	A	A	E	A	B	B	E	A	E	E	A
SODIUM HYPOCHLORITE	A	A	X	A	A	A	A	A	D	X	A-B	A	A	D	E	A	D	A	E	D	E
SODIUM NITRATE	A	A	A	A	A	A	A	A	A	A	B	A	A	A	B	B	B	A	D	A	A
SODIUM SILICATE	A	A	B	A	A	A	A	A	B	B	B	X	A	A	A	A	A	A	A	D	A
SODIUM SULFATE	A	A	A	A	A	A	A	A	A	A	A	X	A	A	B	B	B	A	D	A	A
SODIUM SULFIDE	A	A	X	A	A	A	A	A	B	B	B	A	A	A	E	B	B	A	D	D	A
STANNIC CHLORIDE	A	A	A	A	A	A	A	A	E	C	B	A	A	A	B	D	B	X	B	X	X
STEARIC ACID	A	A	B	C	X	X	A	A	A	A	A	A	A	D	E	D	A	X	A	X	X
STODDARDS SOLVENT	E	E	X	X	E	X	A	A	A	A	A	A	X	E	X	X	A	X	A	X	X
SULFURIC ACID, 0-10%	A	A	A	A	A	A	A	A	E	A	B	C	A	A	D	A	A	A	D	A	E
SULFURIC ACID, 10-75%	A	A	C	A	A	D	A	A	E	A	B	D	A	E	E	A	A	A	E	D	E
SULFURIC ACID, 75-100%	C	C	E	C	A	E	A	A	E	A	B	E	A	E	E	D	A	A	E	E	E
TANNIC ACID	A	A	A	A	X	X	A	A	B	B	B	A	A	A	E	B	B	A	A	A	E
TANNING LIQUORS	A	A	X	A	X	X	X	A	A	A	A	A	A	X	A	X	A	X	D	X	X
TARTARIC ACID	A	A	A	A	A	X	A	A	B	B	B	A	A	A	E	B	B	X	A	X	X
TETRAHYDROFURANE	E	E	X	C	E	X	D	A	A	A	A	X	A	X	E	X	X	E	A	A	A
TOLUENE (TOLUOL)	E	E	B	C	E	E	A	A	A	A	A	A	A	E	E	E	E	E	A	A	A
TRICHLOROETHYLENE	E	E	B	C	E	X	A	A	B	B	A	A	A	E	E	E	A	E	A	A	E
TRICRESYLPHOSPHATE	E	E	X	X	X	X	X	A	A	A	A	B	A	E	E	E	A	X	X	X	X
TURPENTINE	B	B	C	C	X	X	A	A	A	A	A	X	A	E	E	E	A	A	A	A	A
UREA	A	A	B	A	X	X	A	A	B	B	B	A	A	A	E	A	E	X	A	X	X
VINEGAR	A	A	B	A	A	A	A	A	A	A	A	A	A	A	E	B	B	A	A	A	A
WHITE LIQUOR (ACID)	A	A	X	X	A	X	A	A	A	A	A	X	A	X	A	X	A	X	D	X	X
XYLENE (XYLOL)	E	E	B	E	E	E	A	A	A	A	A	X	A	E	E	E	A	E	A	A	A
ZINC CHLORIDE	A	A	A	A	A	A	A	A	B	A	B	A	A	A	B	B	B	A	D	D	E
ZINC SULFATE	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	D	A	D

SYMBOL IDENTIFICATION

A — Excellent
B — Good
C — Good to 80°F
D — Moderate effect (use under limited conditions)
E — Not recommended
F — Autocatalytic
X — Unknown

TABLE 7.12: PLASTIC AND STEEL PUMP MATERIALS—THOMPSON-CHEMTROL

Comparative Resistance of Thompson CF Pump Construction Materials to Various Corrosive Media

CODE

A	–	Excellent
B	–	Good
C	–	Good to 80° Fahrenheit
D	–	Moderate effect: May be used under certain conditions
E	–	Not recommended

OPERATING TEMPERATURE LIMITS

Polyvinyl Dichloride (CPVC) (PVDC)	225° F (non-pressure)
Polyvinyl Dichloride (CPVC) (PVDC)	180° F (pressure)
Teflon	500° F
Type 316 Stainless steel	Very high
Hastelloy C - 276	Very high

	PVDC	Type 316 SS	Hastelloy C-276	Teflon
Acetaldehyde	E	A	A	A
Acetic Acid, 20%	C	A	A	A
Acetic Acid, 80%	D	A	A	A
Acetic Acid, Glacial	D	A	A	A
Acetic Anhydride	E	A	A	A
Acetone	E	A	A	A
Aluminum Chloride	A	D	C	A
Aluminum Fluoride	A	D	B	A
Aluminum Hydroxide	A	A	A	A
Aluminum Sulfate	A	D	A	A
Ammonia Liquid	A	A	A	A
Ammonium BiFluoride	A	A	A	A
Ammonium Carbonate	A	A	A	A
Ammonium Chloride	A	A	A	A
Ammonium Hydroxide	A	A	A	A
Ammonium Nitrate	A	A	A	A
Ammonium Persulfate	A	A	A	A
Ammonium Phosphate	A	A	A	A
Ammonium Sulfate	A	B	A	A
Amyl Acetate	E	A	A	A
Amyl Alcohol	C	A	A	A
Amyl Chloride	E	A	A	A
Aniline	E	A	A	A
Aqua Regia	D	E	D, E	A
Arsenic Acid	A	A	A	A
Barium Carbonate	A	A	A	A
Barium Chloride	A	A	A	A
Barium Hydroxide	A	A	A	A
Barium Sulfate	A	A	A	A
Barium Sulfide	A	A	A	A
Beer	A	A	A	A
Benzaldehyde	E	A	A	A
Benzene (Benzol)	E	A	A	A
Bensoic Acid	A	A	A	A
Benzoic Acid	A	A	A	A
Borax (Sodium Borate)	A	A	A	A
Boric Acid	A	D	A	A
Bromine Water	D	D	A	A
Butyl Acetate	E	D	A	A
Butyric Acid	D	A	A	A
Calcium Bisulfide	A	A	A	A
Calcium Carbonate	A	A	A	A
Calcium Chloride	A	A	A	A
Calcium Hydroxide	A	A	A	A
Calcium Hypochlorite	A	D	C, D	A
Calcium Sulfate	A	A	B	A
Carbon Bisulfide	E	A	A	A
Carbon Tetrachloride	C	B	A	A
Carbonic Acid	A	A	A	A
Chloracetic Acid	C	D	A	A
Chlorine Water	A	E	B	A
Chlorobenzene	E	A	A	A
Chloroform	E	A	B	A
Chlorosulfonic Acid	D	B	A	A
Chromic Acid, 10%	A	A	A, B	A
Chromic Acid, 50%	A	B	A, B	A
Citric Acid	A	A	A	A
Copper Chloride	A	E	–	A
Copper Cyanide	A	A	A	A
Copper Nitrate	A	A	A	A
Copper Sulfate	A	A	A	A
Cresylic Acid	B	A	A	A
Ethyl Acetate	E	A	A	A
Ethyl Chloride	E	A	B	A
Ethyl Dichloride	E	A	B	A
Ethylene Glycol	A	A	A	A
Fatty Acids	A	A	A	A
Ferric Chloride	A	E	B, C	A
Ferric Nitrate	A	A	A	A
Ferric Sulfate	A	D	A	A
Ferrous Chloride	A	E	B	A
Ferrous Sulfate	A	A	A	A

(continued)

TABLE 7.12: PLASTIC AND STEEL PUMP MATERIALS—THOMPSON-CHEMTROL (continued)

	PVDC	Type 316 SS	Hastelloy C-276	Teflon
Fluoboric Acid	A	D	A	A
Fluosilicic Acid	A	A	A, B	A
Formaldehyde	C	A	A	A
Formic Acid	C	B	A	A
Freon 12 (wet)	C	E	–	A
Fuel Oils	A	A	A	A
Furfural	E	A	A, B	A
Gasoline	C	A	A	A
Glycerine (Glycerol)	A	A	A	A
Heptane	C	A	A	A
Hexane	C	A	A	A
Hydrobromic Acid, 20%	A	E	B	A
Hydrochloric Acid, 0-25%	B	E	B, C	A
Hydrochloric Acid, 25-40%	B	E	B, C	A
Hydrocyanic Acid	A	A	–	A
HydroFluoric Acid, 10%	C	E	B	A
HydroFluoric Acid, 30%	C	E	B	A
HydroFluoric Acid, 60%	D	E	B	A
HydroFloursilicic Acid	D	E	B	A
Hydrogen Peroxide, 30%	B	D	A	A
Hydrogen Peroxide, 50%	C	D	A	A
Hydrogen Peroxide, 90%	E	D	A	A
Hydrogen Sulfide, Aq. Sol.	C	D	A	A
Iodine (in alcohol)	E	E	B	A
Kerosene	B	A	A	A
Ketones	E	A	A	A
Lacquer Thinners	D	A	A	A
Latic Acid	B	D	A	A
Lead Acetate	A	B	A	A
Liquors	A	A	A	A
Lubricants	B	A	A	A
Magnesium Chloride	A	B	A	A
Magnesium Hydroxide	A	A	A	A
Magnesium Nitrate	A	A	A	A
Magnesium Sulfate	A	B	B	A
Maleic Acid	A	A	B	A
Mercuric Chloride	A	E	B	A
Mercuric Cyanide	A	A	–	A
Mercury	A	A	A	A
Methyl Alcohol	C	A	A	A
Methyl Chloride	E	A	B	A
Methyl Ethyl Ketone	E	A	A	A
Methyl Isobutyl Ketone	E	A	A	A
Methylene Chloride	E	A	A	A
Naphtha	C	A	A	A
Naphthalene	E	A	A	A
Nickel Chloride	A	D	A	A
Nickel Sulfate	A	B	B	A
Nitric Acid, 10%	B	A	A	A
Nitric Acid, 20%	B	A	B	A
Nitric Acid, 50%	B	B	B	A
Nitric Acid, anhydrous	E	E	C, D	A
Nitro benzene	E	A	A	A
Oils and Fats	A	A	A	A
Oleic Acid	A	A	A	A
Oleum	E	A	A	A
Oxalic Acid	A	A	A, B	A
Phenol	C	A	A	A
Phosphoric Acid, 0-50%	B	A	A, B	A
Phosphoric Acid, 50-100%	B	B	A, B	A
Potassium Bicarbonate	A	A	A	A
Potassium Bromide	A	A	A	A
Potassium Carbonate	A	A	A	A
Potassium Chlorate	A	A	–	A
Potassium Chloride	A	A	A, B	A
Potassium Cyanide	A	A	B	A
Potassium Dichromate	A	A	B	A
Potassium Hydroxide	A	B	B	A
Potassium Nitrate	A	A	B	A
Potassium Permanganate	A	B	A, B	A
Potassium Sulfate	A	B	B	A
Propyl alcohol	C	A	A	A
Soaps	A	A	A	A
Sodium Acetate	A	A	B	A
Sodium Bicarbonate	A	A	B	A
Sodium Bisulfate	A	A	–	A
Sodium BiSulfite	A	A	A	A
Sodium Carbonate	A	B	A	A
Sodium Chlorate	A	A	A	A
Sodium Chloride	A	A	A, B	A
Sodium Cyanide	A	A	–	A
Sodium Hydroxide, 20%	A	B	A, B	A
Sodium Hydroxide, 50%	A	E	A, B	A
Sodium Nitrate	A	A	A, B	A
Sodium Silicate	A	A	B	A
Sodium Sulfate	A	A	A	A
Sodium Sulfide	A	A	–	A
Stannic Chloride	A	E	B	A
Stearic Acid	A	A	A	A
Stoddard's Sulfuric	E	A	A	A
Sulfuric Solvent	B	D	A, B	A
Sulfuric Acid, 0-10%	B	E	B, C	A
Sulfuric Acid, 10-75%	C	E	B,C	A
Sulfuric Acid, 75-100%	A	A	B	A
Tannic Acid	A	D	A	A
Tanning Liquors	A	A	A	A
Tartaric Acid	A	B	B	A
TetrahydroFurane	E	A	A	A
Toluene (Toluol)	E	A	A	A
Trichloroethylene	E	A	A	A
Tricresylphosphate	E	A	A	A
Turpentine	C	A	A	A
Urea	A	A	A	A
Vinegar	A	A	A	A
White Liquor	A	A	A	A
Xylene (Xylol)	E	A	A	A
Zinc Chloride	A	B	B, C	A
Zinc Sulfate	A	B	A	A

TABLE 7.13: STEEL, TITANIUM, ZIRCONIUM, COLUMBIUM AND TANTALUM HEATING AND COOLING COILS—VULCANIUM

Selection of the proper material for your heating or cooling coil requires that three factors be considered: 1) the solution; 2) the desired life of the coil; 3) the coil's cost. To assist you in making the proper selection, we have developed the following table.

To use this table, follow these steps:

1. From the column on the left, select the solution into which the coil will be placed.
2. Scan to the right and locate the column with a checkmark (✓)
3. Move up that column to find the material which Vulcanium recommends as being best suited for use.

	Mild Steel	304 Stainless	316 Stainless	Titanium	Zirconium	Columbium	Tantalum
1. Acetic Acid				✓			
2. Alkaline Cleaning (low conc.)	✓*						
3. Alkaline Cleaning (high conc.)		✓					
4. Aluminum Anodizing Hot Seal Tank			✓				
5. Aluminum Bright Dip			✓				
6. Antimony Plating			✓				
7. Brass Plating	✓*						
8. Bronze Plating	✓*						
9. Cadmium Plating/Cyanide Type	✓*						
10. Cadmium Plating/Fluoborate Type			✓				
11. Caustic Lime of Soda			✓				
12. Chlorine Gas Moist				✓			
13. Chromic Acid 10%				✓			
14. Chromic Acid 50%						✓	
15. Chromium Plating/Fluoride Type						✓	
16. Chromium Plating/Sulphate Type				✓			
17. Citric Acid 15%			✓				
18. Copper Plating/Sulfate Type				✓			
19. Copper Plating/Cyanide Type	✓*						
20. Copper Plating/Pyrophosphate Type			✓				
21. Dichromate Seal	✓*						
22. Dye for Coloring Anodized Aluminum			✓				
23. Dye Seal			✓				
24. Hydrochloric Acid (No iron)					✓		
25. Hydrochloric Acid Pickling							✓
26. Nickel Plating/Non-Fluoride Type				✓			
27. Nitric Acid (to 65%)				✓			
28. Phosphatizing			✓				
29. Phosphoric Acid 10%			✓				
30. Salt Brine or Brackish Water				✓			
31. Sulfuric Acid Anodizing					✓		
32. Sulfuric Acid Pickling					✓		
33. Tin Plating					✓		
34. Zinc Plating/Acid Non-fluoride				✓			
35. Zinc Plating/Cyanide Type	✓*						
36. Other Solutions Not Listed Above	Call Vulcanium for Recommended Material						

*In many applications where mild steel coils give adequate service, a 304 stainless steel coil will give better service at a modest increase in cost.

SPECIAL NOTE ON MATERIALS: Vulcanium can fabricate coils from materials other than those listed above, including Carpenter 20, Hastelloy and Inconel.

Company Name and Address Listing

The editor is indebted to the organizations listed below for supplying the data used in the preparation of this book.

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P.O. Box 38
State Road 13 North
Urbana, IN 46990

Acme-Fisher Division
Broadway Rubber Corp.
P.O. Box 1135
Louisville, KY 40201

Allegheny Ludlum Steel Corp.
Division of Allegheny Ludlum Industries, Inc.
2000 Oliver Building
Pittsburgh, PA 15222

Allied Engineered Plastics
P.O. Box 2332R
Morristown, NJ 07960

Aluminum Association, Inc.
818 Connecticut Ave., N.W.
Washington, DC 20006

Aluminum Company of America
1501 Alcoa Building
Pittsburgh, PA 15219

American Cyanamid Company
Organic Chemical Division
Wayne, NJ 07470

American Iron and Steel Institute
1000 16th Street NW
Washington, DC 20036

Ameron
Corrosion Resistant Piping Division
595 West Lambert Rd.
Brea, CA 92621

Ametek, Haveg Division
900 Greenbank Rd.
Wilmington, DE 19808

Amoco Chemicals Corp.
200 East Randolph Drive
Chicago, IL 60601

Ampco Metal
Division of Ampco-Pittsburgh Corp.
P.O. Box 2004
Milwaukee, WI 53201

Arco Metals Co.
American Brass
Two Continental Towers
1701 Golf Rd.
Rolling Meadows, IL 60008

Armco Stainless Steel Products
P.O. Box 600
Middletown, OH 45043

Ashland Chemical Co.
Division of Ashland Oil, Inc.
P.O. Box 2219
Columbus, OH 43216

Astro Metallurgical Corporation
Division of Harsco Corp.
3225 Lincoln Way West
Wooster, OH 44691

Atlas Minerals & Chemicals, Inc.
Farmington Road
Mertztown, PA 19539

Barnant Co.
28 W 092 Commercial Ave.
Barrington, IL 60010

Bethlehem Steel Corp.
Bethlehem, PA 18016

Brush Wellman Inc.
17876 St. Clair Avenue
Cleveland, OH 44110

Cabot KBI Division
Cabot Corporation
P.O. Box 1462
Reading, PA 19603

Cabot Stellite Division
Cabot Corporation
1020 West Park Avenue
Kokomo, IN 46901

Cabot Wrought Products Division
Cabot Corporation
1020 West Park Avenue
Kokomo, IN 46901

Carpenter Technology Corporation
Carpenter Steel Division
P.O. Box 662
Reading, PA 19603

CEEL-CO
12990 West Cedar Drive
Lakewood, CO 80228

Celanese Plastics Co.
Division of Celanese Corp.
26 Main St.
Chatham, NJ 07928

Climax Molybdenum Co.
Division of Amax Inc.
One Greenwich Plaza
Greenwich, CT 06830

Colt Industries
Trent Tube Division
2188 Church St.
East Troy, WI 53120

Corning Glass Works
Corning, NY 14831

Cyclops Corporation
Universal-Cyclops Specialty Steel Division
650 Washington Rd.
Pittsburgh, PA 15228

Dart Industries Inc.
Special Projects Division
P.O. Box 37
Paramus, NJ 07652

Dayco Corp.
333 W. First St.
Dayton, OH 45401

Devcon Corp.
Subsidiary of Illinois Tool Works, Inc.
30 Endicott St.
Danvers, MA 01923

Dow Chemical USA
The Dow Center
Midland, MI 48640

Dow Corning Corp.
Midland, MI 48640

E.I. du Pont de Nemours & Co., Inc.
1007 Market St.
Wilmington, DE 19898

Duriron Co. Inc.
Box 1145
Dayton, OH 45401

Eastman Chemical Products, Inc.
P.O. Box 431
Kingsport, TN 37662

Elkhart Rubber Inc.
Lois Lane
Randolph Industrial Park
P.O. Box 7385
High Point, NC 27264

Everflex Products, Inc.
Artell Road at Holyoke St.
Ludlow, MA 01056

Exxon Chemical Americas
P.O. Box 3272
Houston, TX 77001

Fabrico
4222 South Pulaski Rd.
Chicago, IL 60632

Gates Rubber Co.
999 South Broadway
P.O. Box 5887
Denver, CO 80217

General Electric Co.
Noryl Ave.
Selkirk, NY 12158

General Metals Technologies Corp.
8800 Metro Court
Richmond, VA 23234

B.F. Goodrich Chemical Co.
6100 Oak Tree Blvd.
Cleveland, OH 44131

Haysite Reinforced Plastics
5599 New Perry Highway
Erie, PA 16509

Himont USA, Inc.
1313 N. Market St.
Wilmington, DE 19894

Huntington Alloys, Inc.
Division of the International Nickel Co., Inc.
Huntington, WV 25720

Huntsman Chemical Co.
Business Technology Center
1445 Summit St.
Columbus, OH 43201

Huron Chemicals Ltd.
Casson Crane Division
P.O. Box 308
Alexandria Bay, NY 13607

Industrial Titanium Corp.
3041 Commercial Ave.
Northbrook, IL 60062

Interplastic Corporation
2015 N.E. Broadway
Minneapolis, MN 55413

ITT Jabsco
1485 Dale Way
Costa Mesa, CA 92626

Janney Cylinder Company
An Ampco-Pittsburgh Company
7401 State Road
Philadelphia, PA 19136

Jessop Steel Co.
Jessop Place
Washington, PA 15301

Kennametal Inc.
Latrobe, PA 15650

Koch Engineering Co. Inc.
M.A. Knight Division
P.O. Box 109
Akron, OH 44309

Lead Industries Association, Inc.
292 Madison Ave.
New York, NY 10017

Minor Rubber Company, Inc.
49 Ackerman Street
Bloomfield, NJ 07003

Mobay Chemical Corp.
Plastics and Coatings Division
Pittsburgh, PA 15205

Monsanto Polymer Products Co.
800 N. Lindbergh Blvd.
St. Louis, MO 63166

Morrison Molded Fiber Glass Co.
400 Commonwealth Ave.
Bristol, VA 24203

Morton Thiokol, Inc.
Morton Chemical Division
930 Lower Ferry Rd.
Trenton, NJ 08650

Nalge Co.
Division of Sybron Corp.
75 Panorama Creek Dr.
Rochester, NY 14602

New Jersey Zinc Company, Inc.
Palmerton, PA 18071

Nibco Inc.
500 Simpson Ave.
Elkhart, IN 46515

NRC Inc.
45 Industrial Place
Newton, MA 02164

Oberdorfer Pump Division
Syracuse, NY 13221

Occidental Chemical Corp.
Walck Rd.
North Tonawanda, NY 14120

O-I/Schott Process Systems, Inc.
1640 S.W. Boulevard
P.O. Box T
Vineland, NJ 08360

Peabody TecTank Inc.
South Industrial Park
P.O. Box 996
Parsons, KS 67357

Pennwalt Corporation
Three Parkway
Philadelphia, PA 19102

Pfaudler Co.
Division of Sybron Corporation
Rochester, NY 14603

Phillips Chemical Co.
Subsidiary of Phillips Petroleum Co.
Bartlesville, OK 74004

Plastonics International Inc.
951 Jaycox Rd.
Avon, OH 44011

Quaker Oats Chemicals, Inc.
Merchandize Mart Plaza
Chicago, IL 60654

Radiation Technology, Inc.
108 Lake Denmark Rd.
Rockaway, NJ 07866

Resistoflex Corporation
Subsidiary of UMC Industries, Inc.
Roseland, NJ 07068

Resolite
Division of H.H. Robertson Co.
P.O. Box 338
Zelienople, PA 16063

Revere Copper Products Inc.
Subsidiary of Revere Copper and Brass, Inc.
P.O. Box 300
Rome, NY 13440

Rilsan Corp.
Subsidiary of ATOCHEM
139 Harristown Rd.
Glen Rock, NJ 07452

Rohm and Haas Co.
Independence Mall West
Philadelphia, PA 19105

A. Schulman Inc.
3550 West Market St.
P.O. Box 1710
Akron, OH 44309

Schwarzkopf Development Corp.
140 Lowland St.
Holliston, MA 01746

Sethco Division
Met Pro Corp.
70 Arkay Dr.
Hauppauge, NY 11788

Shell Chemical Co.
P.O. Box 1422
Houston, TX 77001

A.O. Smith-Inland Inc.
Reinforced Plastics Division
2700 West 65th St.
Little Rock, AR 72209

Sohio Chemical Co.
Midland Bldg.
Cleveland, OH 44115

Stainless Foundry & Engineering, Inc.
5150 North 35th Street
Milwaukee, WI 53209

Sternson Limited
22 Mohawk St.
Brantford, Ont., Canada N3T 5NI

Stonhard, Inc.
Park Avenue
P.O. Box 308
Maple Shade, NJ 08052

Sulcon Systems
P.O. Box 427
Champaign, IL 61820

Teledyne Allvac
P.O. Box 759
Monroe, NC 28110

Teledyne Wah Chang Albany
P.O. Box 460
Albany, OR 97321

Thermoplastic Processes Inc.
1268 Valley Road
Stirling, NJ 07980

Thermoplastic Scientifics, Inc.
Affiliate of Thermoplastic Processes, Inc.
57 Stirling Rd.
Warren, NJ 07060

Thompson-Chemtrol
Division of Finish Engineering Co.
921 Greengarden Rd.
Erie, PA 16501

3M
Ceramic Materials Department
3M Center
St. Paul, MN 55144

Timet
400 Rouser Rd.
P.O. Box 2824
Pittsburgh, PA 15230

Union Carbide Engineering Polymers
P.O. Box 446
Marietta, OH 45750

U.S. Graphite, Inc.
1621 East Holland
Saginaw, MI 48601

U.S. Industrial Chemicals Co.
Division of National Distillers and
Chemical Corp.
99 Park Ave.
New York, NY 10016

Vulcanium Corporation
3045 Commercial Avenue
Northbrook, IL 60062

Wall Colmonoy Corporation
19345 John R Street
Detroit, MI 48203

Walworth Co.
P.O. Box 873
Valley Forge, PA 19482

Watersaver Company, Inc.
P.O. Box 16465
Denver, CO 80216

Westlake Plastics Co.
Distributor for Mitsui Petrochemical
Industries, Ltd.
P.O. Box 127
Lenni, PA 19052

Trade Name Index

Trade name designations of the materials for which corrosion resistance data are given in the tables are listed in this index.

Corrosive Material Index

This Index relates to the chemicals listed by manufacturers in the main portion of the book. Indexing in a book of this nature is complicated by the fact that different nomenclature is used by different firms for the same chemical. For example, most of the tin chemicals are listed under stannic or stannous; however, there are also headings for tin chemicals and tin salts. As another example, the reader will find information regarding HCl listed under Hydrochloric acid, Muriatic acid and Hydrogen chloride. The user of this Index should utilize as many synonyms and group designations as possible for the particular substance in which he is interested, in order to obtain as much pertinent information as possible.

Some of the products listed are registered trademarks; however for purposes of this Index, trademarks have not been differentiated from generic names. Absence of trademark indication does not exclude the possibility that the name may be a proprietary name or the subject of proprietary rights.