

A close-up photograph of a scientist in a laboratory. The scientist is wearing a white lab coat, a white hairnet, and clear safety goggles. They are looking intently at a red Erlenmeyer flask held in their gloved hand. The background is a blurred laboratory setting.

SCHOTT
glass made of ideas

KIMAX®

Corrosion Resistance
of Acid Waste Drainline
Piping and Vent Materials

Corrosion Resistance of Acid Waste Drainline Piping and Vent Materials

Maximum Operating Temperature¹

Materials:

- A – Very Good Service to oper. limit of material. (see table)
- B – Moderate Service
- C – Limited or Variable Service
- F – Unsatisfactory

Chemicals:

Solids assumed in solution.
 Room temperatures assumed unless otherwise stated.
 Data represented is to be used as a guide only. For specific information, test under actual operating conditions.

250°F
 250°F
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 250°F
 150°F
 150°F
 180°F

KIMAX® Borosilicate Glass
 High Silicon Iron
 304 Stainless Steel; Fe, 18 Cr, 8 Ni
 Teflon®
 Polyethylene
 Polyvinyl Chloride rigid or unplasticized
 Polypropylene

	250°F	250°F	250°F	250°F	150°F	150°F	180°F
	KIMAX® Borosilicate Glass	High Silicon Iron	304 Stainless Steel; Fe, 18 Cr, 8 Ni	Teflon®	Polyethylene	Polyvinyl Chloride rigid or unplasticized	Polypropylene
Acetaldehyde CH ₃ CHO	A	A	A	A	F	A	B
Acetic Acid, 100%, CH ₃ COOH	A	A	F	A	F	A	C
Acetic Acid, (Dilute) 50%	A	A	B	A	C	C	A
Acetic Anhydride, (CH ₃ CO) ₂ O	A	A	B	A	B	F	C
Acetone, CH ₃ COCH ₃	A	A	A	A	F	F	B
Alcohol, Amyl CH ₃ (CH ₂) ₄ OH	A	B	B	A	C	F	C
Alcohol, Butyl C ₄ H ₉ OH	A	A	A	A	B	F	B
Allyl Chloride CH ₂ CHCH ₂ CL	A	A	B	A	F	F	F
Aluminium Chloride, AlCl ₃	A	B	F	A	A	A	A
Aluminium Hydroxide, AL(OH) ₃	A	B	A	A	B	A	A
Aluminium Sulfate, Al ₂ (SO ₄) ₃	A	B	F	A	A	A	A
Alums, Conc., Al ₂ (SO ₄) ₃ · K ₂ SO ₄ , etc.	A	A	F	A	A	F	A
Ammonium Carbonate, (NH ₄) ₂ CO ₃	A	B	B	A	A	A	A
Ammonium Chloride, NH ₄ Cl	A	B	F	A	A	A	A
Ammonium Fluoride NH ₄ F 25%	F	F	C	A	A	A	A
Ammonium Hydroxide, NH ₄ OH	A	B	A	A	A	A	A
Amyl Acetate, C ₅ H ₁₁ COOCH ₃	A	A	A	A	F	F	F
Amyl Chloride, C ₅ H ₁₁ Cl	A	B	A	A	F	F	F
Antimony Trichloride, SbCl ₃	A	B	F	A	A	A	B
Aniline C ₆ H ₅ NH ₂	A	B	A	A	F	F	B
Aniline Hydrochloride C ₆ H ₅ NH ₂ · HCl	A	B	F	A	B	F	F
Ammonia (Gas), (Moist), NH ₃	A	B	A	A	A	A	B
Arsenic Acid, HAsO ₃	A	B	F	A	A	A	C
Barium Carbonate, BaCO ₃	A	B	B	A	A	A	A
Barium Chloride, BaCl ₂	A	B	C	A	A	A	A
Barium Hydroxide, Ba(OH) ₂	A	B	B	A	A	A	A
Barium Sulfate, BaSO ₄	A	B	B	A	A	A	A
Barium Sulfide, BaS	A	B	B	A	A	A	A
Benzaldehyde, C ₆ H ₅ CHO 100%	A	B	B	A	F	F	C
Benzene, C ₆ H ₆	A	A	B	B	F	F	F
Benzoic Acid, C ₆ H ₅ COOH	A	B	B	A	A	A	B
Borax, Na ₂ B ₄ O ₇ · 10H ₂ O	A	B	B	A	A	A	A
Boric Acid, H ₃ BO ₃	A	B	B	A	A	A	A
Bromine, (Wet), Br ₂	A	F	F	A	F	F	F
Butane C ₄ H ₁₀	A	A	A	A	F	F	F
Butyl Acetate, C ₄ H ₉ COOCH ₃	A	B	B	A	F	F	F
Butyric Acid, C ₃ H ₇ COOH	A	A	F	A	F	F	A
Calcium Bisulfite, Ca(HSO ₃) ₂	A	F	B	A	A	A	A
Calcium Carbonate, CaCO ₃	A	B	A	A	A	A	A
Calcium Chlorate, CaClO ₃	A	B	B	A	A	A	A
Calcium Chloride, CaCl ₂	A	B	F	A	A	A	A
Calcium Hydroxide, Ca(OH) ₂	A	C	B	A	A	A	A
Calcium Hypochlorite, Ca(OCl) ₂	A	B	F	A	A	C	B
Carbon Disulfide, CS ₂	A	A	B	A	F	F	F
Carbon Tetrachloride (Moist) CCl ₄	A	A	F	A	F	F	F
Chloracetic Acid, ClCH ₂ CO ₂ H	A	B	F	A	F	F	F
Chloralhydrate CCl ₃ CH(OH) ₂	A	A	F	A	F	A	F
Chloric Acid, HClO ₃	A	B	F	A	C	A	F

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Chlorine (Dry), Cl ₂	A	B	B	A	F	F	F
Chlorine (Wet), Cl ₂ +H ₂ O	A	B	F	A	F	F	F
Chlorobenzene, C ₆ H ₅ Cl	A	B	B	A	F	F	F
Chloroform, CHCl ₃	A	B	A	A	F	F	F
Chlorosulfonic Acid, 100% ClSO ₃ OH	A	A	B	A	F	F	F
Chlorox® Bleach, SOL, 5,5% Cl ₂	A	A	A	A	F	F	F
Chromic Acid, CrO ₃ sol'n	A	B	F	A	C	F	B
Copper Chloride, CuCl ₂	A	B	F	A	A	A	B
Copper Nitrate Cu(NO ₃) ₂	A	A	A	A	A	A	B
Copper Sulfate CuSO ₄	A	A	B	A	A	A	B
Cresol	A	B	A	A	F	F	B
Cyclohexanone	A	B	B	A	F	F	F
Dimethylamine (CH ₃) ₂ NH	A	A	A	A	F	F	B
Diocetyl Phthalate	A	A	A	A	F	F	F
Dioxane	A	B	B	A	F	F	F
Ethers (Various)	A	A	B	A	F	F	F
Ethyl Acetate, C ₂ H ₅ COOCH ₃	A	A	B	A	F	F	F
Ethylene Bromide, C ₂ H ₄ Br ₂	A	B	A	A	F	F	F
Ethyl Chloride, C ₂ H ₅ Cl	A	A	A	A	F	F	F
Ethyl Ether (C ₂ H ₅) ₂ O	A	A	B	A	F	F	F
Ethylene Chlorohydrin, Cl(C ₂ H ₄)OH	A	B	B	A	F	F	C
Ethylene Dichloride, C ₂ H ₄ Cl ₂	A	B	B	A	F	F	F
Ethylene Glycol, CH ₂ OHCH ₂ OH	A	B	B	A	A	A	A
Ethylene Oxide, CH ₂ OCH ₂	A	A	B	A	F	F	F
Fatty Acids (Various)	A	A	B	A	F	A	B
Ferric Chloride, FeCl ₃	A	C	F	A	A	A	A
Ferrous Chloride, FeCl ₂	A	B	F	A	A	A	A
Ferrous Sulfate FeSO ₄	A	B	B	A	A	A	A
Fluorine, F ₂	F	F	A	A	F	B	F
Formaldehyde, CH ₂ O 37%	A	A	A	A	A	A	B
Formic Acid, HCOOH	A	A	C	A	C	F	B
Fuel Oil	A	A	A	A	F	A	F
Furfural, C ₄ H ₃ OCHO	A	B	B	A	F	F	F
Gallic Acid, (OH) ₃ C ₆ H ₂ COOH	A	A	B	A	A	A	A
Gasoline (Refined)	A	A	A	A	F	A	F
Glycerol, CH ₂ OH.CHOHCH ₂ OH	A	A	A	A	A	A	A
Heptane, CH ₃ (CH ₂) ₅ CH ₃	A	A	A	A	F	C	C
Hexane, C ₆ H ₁₄	A	A	A	A	F	F	C
Hydrobromic Acid, HBr	A	F	F	A	A	A	C
Hydrocarbons (Aliphatic)	A	A	A	A	F	F	C
Hydrocarbons (Aromatic)	A	A	A	A	F	F	F
(Check individual listing)							
Hydrochloric Acid (Conc.), HCl	A	F	F	A	A	F	C
Hydrochloric Acid (Dilute)	A	F	F	A	A	A	B
Hydrofluoric Acid (Conc.), HF	F	F	F	A	B	C	C
Hydrofluoric Acid (Dilute)	F	F	F	A	A	C	B
Hydrofluosilicic Acid, H ₂ SIF ₆	C	F	F	A	A	A	C
Hydrogen Peroxide (Conc.), H ₂ O ₂	A	B	B	A	C	F	C

¹⁾ For operating pressures see Drainline Catalog.
 See back page for Physical and Chemical Data of KIMAX® Glass Drainline.

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Corrosion Resistance of Acid Waste Drainline Piping and Vent Materials

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	250°F	250°F	250°F	250°F	150°F	150°F	180°F
	KIMAX® Borosilicate Glass	High Silicon Iron	304 Stainless Steel; Fe. 18 Cr, 8 Ni	Teflon®	Polyethylene	Polyvinyl Chloride rigid or unplasticized	Polypropylene
Iodine, I ₂ (Wet)	A	F	F	A	F	F	C
Isopropyl Ether (CH ₃) ₂ CHOCH(CH ₃) ₂	A	A	A	A	F	F	C
Kerosene	A	A	A	A	F	A	F
Ketones (Various), RCOR'	A	A	A	A	F	F	C
Lauryl Chloride	A	A	A	A	F	A	C
Lead Acetate, Pb(CH ₃ COO) ₂	A	B	B	A	A	A	A
Magnesium Chloride, MgCl ₂	A	B	C	A	A	A	A
Magnesium Hydroxide, Mg(OH) ₂	A	B	A	A	A	A	A
Magnesium Sulfate, MgSO ₄	A	A	B	A	A	A	A
Mercury, Hg	A	A	A	A	A	A	A
Methanol (Conc.), CH ₃ OH	A	A	A	A	A	A	B
Methyl Chloride, CH ₃ Cl	A	A	A	A	F	F	F
Methylene Chloride, CH ₂ Cl ₂	A	A	B	A	F	F	F
Methyl Ethyl Ketone, CH ₃ COC ₂ H ₅	A	B	B	A	F	F	C
Methyl Isobutyl Ketone, C ₆ H ₁₂ O	A	B	B	A	F	F	C
Naphtha	A	B	A	A	F	A	C
Nickel Chloride, NiCl ₂	A	B	C	A	A	A	A
Nickel Sulfate, NiSO ₄	A	B	B	A	A	A	A
Nitric Acid (Conc.), HNO ₃	A	A	F	A	F	F	F
Nitric Acid (Dilute)	A	A	A	A	A	C	B
Nitrobenzene, C ₆ H ₅ NO ₂	A	A	B	A	F	F	C
Nitrous Oxide	A	B	B	A	F	A	C
Oleum	A	F	B	A	F	F	F
Oxalic Acid, CO ₂ HCO ₂ H	A	B	F	A	A	A	C
Perchloric Acid 70% HClO ₄	A	A	F	A	A	F	C
Phenylhydrazine C ₆ H ₅ NHNH ₂	A	A	A	A	F	F	C
Phosphoric Acid (100%), H ₃ PO ₄	A	B	F	A	A	A	B
Phosphoric Acid (> 45% Cold) 80°F	A	B	F	A	A	A	A
Phosphoric Acid(< 45% Cold) 80°F	A	A	B	A	A	A	A
Phosphorus, Trichloride, PCl ₃	A	A	B	A	B	F	C
Picric Acid, (Sol'n.), HO. C ₆ H ₂ (NO ₂) ₃	A	B	B	A	C	F	C
Potassium Bromide, KBr	A	B	B	A	A	A	A
Potassium Carbonate, K ₂ CO ₃	A	B	A	A	A	A	A
Potassium Chlorate, KClO ₃	A	B	B	A	A	A	A
Potassium Chloride, KCl	A	A	B	A	A	A	A
Potassium Cyanide, KCN	A	B	B	A	A	A	A
Potassium Dichromate, K ₂ Cr ₂ O ₇	A	A	A	A	A	A	A
Potassium Ferrocyanide, K ₄ Fe(CN) ₆	A	A	A	A	A	A	A
Potassium Hydroxide, KOH	A	F	B	A	A	A	A
Potassium Nitrate, KNO ₃	A	A	A	A	A	A	A
Potassium Permanangate, KMnO ₄	A	B	B	A	B	B	C
Potassium Sulfate, K ₂ SO ₄	A	A	B	A	A	A	A
Potassium Sulfide, K ₂ S	A	A	B	A	A	A	A
Propylene Dichloride	A	A	A	A	F	F	F
Silver Nitrate, Ag NO ₃	A	A	B	A	A	A	A
Sodium Acetate, CH ₃ COONa	A	B	B	A	A	A	A
Sodium Azide NaN ₃	A	A	A	A	A	A	A
Sodium Bicarbonate, NaHCO ₃	A	A	A	A	A	A	A

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	250°F	250°F	250°F	250°F	150°F	150°F	180°F
	KIMAX® Borosilicate Glass	High Silicon Iron	304 Stainless Steel; Fe. 18 Cr, 8 Ni	Teflon®	Polyethylene	Polyvinyl Chloride rigid or unplasticized	Polypropylene
Sodium Bisulfate, NaHSO ₄	A	A	F	A	A	A	A
Sodium Bisulfite, NaHSO ₃	A	F	C	A	A	A	A
Sodium Bromide, NaBr	A	B	F	A	A	A	A
Sodium Carbonate, Na ₂ CO ₃	A	B	B	A	A	A	A
Sodium Chlorate, NaClO ₃	A	A	B	A	A	C	A
Sodium Chloride, NaCl	A	B	F	A	A	A	A
Sodium Cyanide, NaCN	A	A	A	A	A	A	A
Sodium Fluoride, NaF	B	F	F	A	A	A	A
Sodium Hydroxide, NaOH < 85°F	A	F	C	A	A	A	A
Sodium Hydroxide NaOH < 140°F	B	F	C	A	A	A	A
Sodium Hydroxide NaOH, > 160°F	F	F	A	A	A	A	A
Sodium Hypochlorite, NaOCl	A	B	F	A	C	A	B
Sodium Hyposulfate, Na ₂ S ₂ O ₄	A	B	B	A	A	A	B
Sodium Nitrate, NaNO ₃	A	A	A	A	A	A	A
Sodium Sulfate, Na ₂ SO ₄	A	A	A	A	A	A	A
Sodium Sulfide, Na ₂ S	F	B	F	A	A	A	A
Sodium Sulfite, Na ₂ SO ₃	A	F	B	A	A	A	A
Stannic Chloride, SnCl ₄	A	A	F	A	A	A	A
Stannous Chloride, SnCl ₂	A	B	F	A	A	A	A
Stearic Acid, CH ₃ (CH ₂) ₁₆ COOH	A	B	B	A	F	A	B
Sulfur, (Molten), S	A	A	A	A	C	A	B
Sulfur Chloride (Wet), S ₂ Cl ₂	A	F	F	A	F	F	F
Sulfur Dioxide (Wet), SO ₂ +H ₂ O	A	F	F	A	C	F	C
Sulfur Trioxide, SO ₃	A	F	B	A	A	A	F
Sulfuric Acid (Fuming to 98%)	A	F	A	A	F	F	F
Sulfuric Acid (Hot Conc.) H ₂ SO ₄	A	A	F	A	F	F	F
Sulfuric Acid (Cold Conc.)	A	A	F	A	F	F	C
Sulfuric Acid (75% – 95%)	A	A	F	A	F	F	F
Sulfuric Acid (10% – 75%)	A	A	F	A	C	A	C
Sulfuric Acid (> 10%)	A	A	F	A	A	A	C
Sulfurous Acid, H ₂ SO ₃	A	F	F	A	A	A	B
Sulfuryl Chloride, SO ₂ Cl ₂	A	B	B	A	F	F	F
Tetrahydrofuran (75%)	A	A	A	A	F	F	F
Tetralin	A	B	A	A	F	F	F
Thionyl Chloride, SOCl ₂	A	B	B	A	F	F	C
Toluene, CH ₃ C ₆ H ₅	A	A	A	A	F	F	F
Tributyl Phosphate (C ₄ H ₉) ₃ PO ₄	A	B	A	A	F	C	F
Trichlorethylene, (Dry), Cl ₂ C.CHCl	A	A	B	A	F	F	F
Tricresylphosphate, (CH ₃ C ₆ H ₄ O) ₃ PO	A	A	A	A	F	F	C
Turpentine	A	B	B	A	F	F	F
Vinyl Acetate, C ₄ H ₆ O ₂	A	B	B	A	F	F	F
Water, (Distilled Lab)	A	A	A	A	A	A	A
Xylene, C ₈ H ₁₀	A	B	B	A	F	F	F
Zinc Phosphate, Zn ₃ (PO ₄) ₂	A	B	B	A	A	A	A
Zinc Sulfate, ZnSO ₄	A	A	B	A	A	A	A

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Summary of Tests

	KIMAX®	Duriron	Polypropylene
A	179	81	72
B	2	81	27
C	1	2	35
F	6	24	54
Total Chem. Tested	188	188	188

References:

- Corrosion Data Survey, 1969 edition, Nace
- Corrosion Data Survey – Nonmetals, 1975, Nace
- Chemical Engineering Handbook, Perry & Chilton, 5th edition, McGraw Hill, 1973
- "Super Corrosion Control", The Carpenter Steel Company, 1965
- "A Guide to the Selection of Durco Corrosion Resisting Materials for Process Industries Service", The Duriron Company, Inc., 1964
- "Corrosion Resistant Lined Pipe and Fittings", Corrosion Resistance Rating, Resistoflex Corporation, 1975
- "Chemical Resistance Guide", Asahi/America, 1977
- "Chemical Resistance of Plastic Piping Materials", Cabot Corporation, 1971

Physical and Chemical Properties of KIMAX® Piping Systems

Chemical Durability: KIMAX® Glass Pipe is measureably affected by only one acid, hydrofluoric, or strong caustics such as sodium or potassium hydroxide.

Under continuous exposure of 1 % hydrofluoric acid at 70°F will require approximately 30 to 35 years to destroy one-half the wall thickness of KIMAX® pipe. Ten percent HF at 70°F will require approximately five years of continuous exposure to destroy one-half the wall thickness.

When KIMAX® Glass is exposed to NaOH or KOH in concentrations up to 50% at room temperature, the pipe should last from 90 to 100 years. All other chemicals exhibit little or no effect on KIMAX® Piping Systems.

General Chemical Composition	Approximate Percentage
Silica (SiO ₂)	80.5%
Boric Acid (B ₂ O ₃)	13.0%
Sodium Oxide (Na ₂ O)	4.0%
Aluminium Oxide (Al ₂ O ₃)	2.0%
Potassium Oxide (K ₂ O)	0.5%

Chemical Properties

Thermal Coefficient of Linear Expansion	18 x 10 ⁻⁷ in/in/°F
Thermal Expansion	KIMAX® brand drainline will expand only 0.22" per 100 ft. of length when temperature increases 100°F
Thermal Shock (Instantaneous)	1½" to 3" pipe – 200°F 4" pipe – 175°F 6" pipe – 160°F

Tubing
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