

Pumping Fluids	General Hazards & Concerns	UL Allowed for HazLoc	Corrosion Issues	Seal Compatibility Issues	References
Chlorinated Organic (Hydrocarbon) Solvents, e.g. Methylene Chloride, Chloroform, Methyl Chloride, Tetrachloroethane...	Toxic & Environmentally Unfriendly; Recommend operating under venthood.		OK	OK	Kenneth M. Pruetz, <i>Chemical Resistance Guide for Metals and Alloys</i> (Compass Publications: 1995)
Alcohols, e.g. Methanol (Wood Alcohol), Ethanol (Grain Alcohol), Propanol (Rubbing Alcohol)	Flammable & Possibly Toxic; Recommend operating in well ventilated area.	Methanol, Isopropanol (sic)	OK	OK	UL HazLoc, UL File# E221183 (for USA only)
Liquid Organic Amines, e.g. Aniline, Triethylamine (TEA)...	Obnoxious, Toxic & Flammable; Recommend operating under a venthood.		OK	OK	
Polar Organic Solvents, e.g. Acetonitrile, Ethyl Acetate, Acetone, Methyl Ethyl Ketone (MEK), Acetophenone, Cyclohexanone...	Flammable & Toxic; Recommend operating in well ventilated area.	Acetone, Acetonitrile	OK	OK	UL HazLoc
Acrylic acid (2-Propenoic acid), Methacrylic acid, Methyl Methacrylate	Flammable, Toxic, Corrosive & Obnoxious; Easily Polymerizes		OK	OK	
Solids Hydrocarbons, e.g. Naphthalene	Flammable & Toxic; Recommend operating in well ventilated area; Must heat all lines, cylinder and cap above melting point; 85C for Naphthalene.		OK	OK	
Liquid Hydrocarbons, e.g. Benzene, Toluene, Xylenes, Hexane, Gasoline, Diesel fuel & Kerosene...	Flammable & Toxic; Recommend operating in well ventilated area.	Benzene, Ethylbenzene, Hexane, Heptane, Gasoline, Diesel fuel & Jet fuel	OK	OK	UL HazLoc
LP (Liquified-Gas) Hydrocarbons, e.g. Methane, Ethane, Ethylene, Propane, Propylene, Butane, Isobutylene & Butadiene...	Very Flammable & Explosive; Gases generally have poor refill efficiencies; Recommend operating under venthood & purging behind piston seals with Nitrogen or Argon gas.	Methane, Ethane, Ethylene, Propane, Propylene, Butane, Isobutylene & Butadiene	OK	OK	UL HazLoc
Carbon Dioxide (Supercritical)	Generally safe, nonflammable and not corrosive but possible Asphyxiate.		OK	OK	
Aqueous Sodium Chloride solutions, e.g. Saline & Brine	Generally safe but corrosive; See Technical Bulletin TB04.		Cylinder wall may suffer damage on long term. Recommend frequent rinsing with distilled water, especially before dormant periods (e.g. weekends, holidays, vacation...) and after use. Titanium is OK with Sodium Chloride up to saturation & 60C.	Recommend wash gland with water.	Teledyne Isco Syringe Pump Technical Bulletin TB04, "Pumping Salt Solutions and Brines with Teledyne Isco Syringe Pumps" & Compass
Hydrogen Sulfide (Liquified-Gas) or Aqueous Solutions	Obnoxious, Toxic & Flammable; Recommend pumping under a venthood; Gases generally have poor refill efficiencies.		OK	Can form Sulfur passed piston seal due to normal leakage and exposure to air; Sulfur will eventually erode the seal; Recommend purging behind piston seal with Nitrogen or Argon gas.	
Titanium Tetrachloride (liquid)	Avoid exposure to water and water vapor; Highly reactive to water and air; Highly Toxic vapors; Recommend pumping under a venthood.		OK with Stainless Steels, e.g. 304 and Nitronics 50; Recommend purging behind piston seal with dry Nitrogen or Argon gas.	Recommend wash gland with clean, fresh, anhydrous Hexanes; Can attack Chemraz and Kalrez through swelling; OK with Viton & PTFE.	

Quarternary Ammonium Salt Solutions	Toxic & Corrosive.		Recommend frequent rinsing with distilled water, especially before dormant periods or after use.	Recommend wash gland with fresh water.	
Sodium Hydroxide (Aqueous) Solution, 50% w/w, Saturated, (19M) 50C	Toxic & Corrosive.		Recommend frequent rinsing with distilled water, especially before dormant periods or after use.		
Aqueous Ammonium Hydroxide	Highly Obnoxious, Corrosive and Toxic; Recommend pumping under a venthood.		Recommend frequent rinsing with distilled water, especially before dormant periods or after use.	?????	?????
Anhydrous Ammonia	Highly Obnoxious, Flammable and Toxic; Recommend pumping under a venthood.		OK	Recommend virgin, i.e. no carbon fiber fillers, PTFE seals.	Teledyne Isco Syringe Pump Manual & UL HazLoc
Sulfuric Acid (Aerated), 96% (18M) 50C	Toxic & Corrosive.		OK with 304, 316 & Nitronics 50; OK with Hastelloy up to 60C; OK with Titanium only up to 5% 35C.	OK	HPAlloys Nitronics 50 Data Bulletin & Compass
Nitric Acid, 68% (15M) 45C	Toxic & Corrosive.		OK with 304, 316, Nitronics 50 & Titanium; OK with Hastelloy C up to 55C .	OK	HPAlloys & Compass
Hydrochloric Acid, 2% (0.5M) 35C	Toxic, Obnoxious & Corrosive.		OK with Nitronics 50; OK with Hastelloy C up to 14% (4M) 60C.	OK	HPAlloys & Compass
Phosphoric Acid (Aerated), 85% (14.7M) 55C	Toxic & Corrosive.		OK with 304, 316 & Nitronics 50; OK with Hastelloy C up to 90C; OK with Titanium only to 35% 20C.	OK	HPAlloys & Compass
Acetic Acid (Aerated), 100% (17.4M) 50C	Toxic, Obnoxious & Corrosive.		OK with 316 & Nitronics 50; OK with Hastelloy C up to 150C; OK with Titanium only to 20C.	OK	HPAlloys & Compass
Formic Acid, 40% (12M) 50C	Toxic, Obnoxious & Corrosive.		OK with 304, 316 & Nitronics 50; OK with Hastelloy C up to 90% 90C; OK with Titanium at 90% 60C.	OK	HPAlloys & Compass
Ferric Chloride (FeCl ₃) solution, 10% 25C	Toxic, Obnoxious & Corrosive.		OK with Nitronics 50.	OK	HPAlloys
Chlorinated Bleach, 6.25% Sodium Hypochlorite solution, 25C	Toxic & Corrosive; Liberated Chlorine Cl ₂ gas can be obnoxious.		OK with 316 & Nitronics 50; OK with Hastelloy C up to 50% 45C; Titanium unknown.	OK	Compass
Boron Trifluoride, BF ₃ , dry at 100% 150C, or wet at 100% 100C, or liquid 100% 45C	Very Toxic. Strong fluorinating agent.		OK with 304, 316 & Nitronics 50; OK with Hastelloy C at only 45C; Titanium unknown.	OK	Compass
Nitrogen Tetraoxide, N ₂ O ₄ , 20C	Extremely Toxic! Strong oxidizing agent; Recommend pumping under a venthood.		OK with 316 , 304 & Nitronics 50; Titanium unknown.	OK	Compass
Hydrazine, N ₂ H ₄ , 100% 60C	Extremely Toxic! Rocket monopropellant fuel; Recommend pumping under a venthood.		OK with 316 & Nitronics 50; OK with 304 at 20C; Titanium unknown.	OK	Compass