GUIDE TO USING LIQUIDS DIRECTORY

This section contains reference material concerning the physical characteristics of many of the industrial chemicals commonly encountered in pumping applications. It can be useful in preparing quotations and in analyzing your customer's information.

The basic data are drawn from a number of sources, including standard technical handbooks, chemical producer's product literature, and various Pulsafeeder reference and personal files. In some cases, they represent our best judgment where minor disagreements exist among these sources.

Bear in mind, however, that we do not guarantee their accuracy. The final responsibility for providing actual values lies with the customer, just as with all specified job conditions.

CORROSION GUIDE:

The data covering corrosion resistance of various materials are offered as a guide only for Pulsafeeder users in selection of a material for liquid end pump parts. They are based on commercially available corrosion guides together with experience from thousands of installations worldwide. The mechanism of corrosion, however, is so complex and the conditions affecting the ability of a material to prove economic or suitable are so variable, that **no recommendation of guarantee of resistance is made or implied. The user, with knowledge of both chemical and operating conditions, must be responsible for the final selection of materials.**

Parts exposed to the pumped product include the front cover, center housing, bearings, shafts, gears, O-rings, housing liner, driven magnet and containment can.

Front cover, center housing and containment can:
PVDF, 316LSS, or Alloy C. PVDF is a fluoropolymer resin, with well documented success in the chemical and petrochemical industries. For more information on these materials, see the Materials section of this manual.

To meet United States Export Regulations, Polypropylene (PPL) housing materials are also available for sale in countries outside the United States. This is further explained in the Materials section.

Shafts	Alumina Ceramic, 316LSS, Alloy C	**O-Rings**	FKM (Viton®), EPDM, Kalrez,® PTFE
Bearings	Carbon-Graphite or Graphite-impregnated Silicon-Carbide	**Gears:**	Carbon Reinforced PTFE

Physical Properties:
The material in this portion is fully described in its "Introduction, Definition of Terms," Page 12.

Vapor Pressure:
At any temperature, a pure liquid exerts a pressure of vapor, called the vapor pressure, which is characteristic of that liquid. The normal "boiling point" of the liquid is that temperature at which its vapor pressure equals the standard external atmospheric pressure at sea level, 14.7 psia (760 mm Hg.) At any given external pressure, the boiling point at that pressure is the temperature at which the vapor pressure equals the given pressure.

The vapor pressure **must** be taken into account for any pump selection, particularly for NPSH calculations and services that see major changes in process temperature.

The vapor pressure data in this section are presented in graphical form versus temperature for over 100 liquids. (Please note that the scales are logarithmic for vapor pressure, and custom designed reciprocal absolute temperature intervals on the temperature scale. Interpolations may require careful attention.) The graph numbers listed in the Graph Index appear at the lower left corner of each graph, with the curve number in the internal block.

All values given are for the pure liquid, except as noted for commonly encountered concentrations of water solutions of ammonia, hydrogen peroxide and major acids.

Curves which end before reaching the grid limits do so for either of two basic reasons:

a) The material is no longer liquid beyond the limit shown (below the freezing point or above the critical point)

Or

b) In our opinion, reliable data were not available.

In either case, please contact the factory rather than extrapolate the curve.

Tip:
For water solutions of nearly all dry inorganic salts and alkalies, their vapor pressures are less than that of water at the same temperature. As an initial conservative estimate, NPSH calculations can thus be based on the vapor pressure of water at the desired temperatures. This assumption should be clearly stated in your communications with the customer, pending more specific information.

Viscosity:
Viscosity is a measure of frictional resistance to flow by a given fluid. Many common fluids are simple, or Newtonian fluids, whose viscosity is not affected by shear – and very little by pressures below several thousand psi. Temperature, however, has a marked effect.

The graphs in this section are limited to Newtonian fluids, and are generally reliable within ± 10% or better. All are for pure liquids unless otherwise noted, such as various commonly encountered concentrations of major alkalies, acids and hydrogen peroxide.

Some curves have been terminated within the grids, for the same reasons as described above for the vapor pressure curves. Here again, please contact the factory rather than extrapolate the curves.

Note:
Further descriptions of these and other fluid properties are located in the Applications Engineering section of this manual.

Key:

E	Good Resistance
F	Moderate Resistance
P	Poor Resistance

Key: E: Good Resistance F: Moderate Resistance P: Poor Resistance

Eclipse Series Wetted Parts

	ETFE	PVDF (Note 2)	PPL	Alumina Ceramic	Carbon	Silicon Carbide	PTFE	Viton®	EPDM	Kalrez®
Acetaldehyde	95 C	P	E		E	E	E	P	E	E
Acetamide	E	F	E		E	E	E	E	E	E
Acetic Acid (Glacial: 99.5 -	65 C	E	E	E	E	E	E	P	E	E
Acetic Acid, Dilute (50% H_2O)	E	E	E	E	E	E	E	P	E	E
Acetone	50 C	P	E	E	E	E	E	P	E	E
Acetonitrile	65 C				E	E	E	P	E	E
Acetylene Tetrachloride	E				E	E	E	P	P	E
Acrylonitrile	65 C	22 C	E		E	E	E	P	P	E
Adipic Acid	E	66 C	F		E	E	E	P	P	E
Allyl Chloride	100 C				E	E	E	P	P	E
Aluminum Ammonium Sulfate	E	--			E	E	E	E	E	E
Aluminum Chloride	E	E	E	E	E	E	E	E	E	E
Aluminum Fluoride	E	E	E		E	E	E	E	E	E
Aluminum Hydroxide	E	E	E		E	E	E	P	E	E
Aluminum Nitrate	E	48 C	E		E	E	E	E	E	E
Aluminum Potassium Sulfate	E		E		E	E	E	E	E	E
Ammonia (Anhydrous)	E	P	E		E	E	E	P	E	E
Ammonia (Aqueous 30%)	E	P	E	E	E	E	E	P	P	E
Ammonium Chloride	E	E	E	E	E	E	E	E	E	E
Ammonium Fluoride	E				E	E	E	E	E	E
Ammonium Hydroxide	E	E	E	E	E	E	E	E	E	E
Ammonium Sulfate	E	E	E	E	E	E	E	P	E	E
Ammonium Sulfide	E	52 C	E		E	E	E	P	E	E
Aniline	65 C	38 C	E	E	E	E	E	P	E	E
Anthraquinone	E				E	E	E	E	E	E
Barium Chloride	E	E	E	E	E	E	E	E	E	E
Barium Hydroxide	E	E	F	E	E	E	E	E	E	E
Barium Sulfate	E	E	F	E	E	E	E	E	E	E
Barium Sulfide	E	E	F	E	E	E	E	E	E	E
Benzene	100 C	48 C	P	E	E	E	E	E	P	E
Benzene Sulfonic Acid	100 C		P	E	E	E	E	E	P	E
Benzoic Acid	E	E	F	E	E	E	E	E	P	E
Benzyl Alcohol	E			E	E	E	E	E	E	E
Benzyl Chloride	65 C		P		E	E		E	P	E
Borax	E	E	F	E	P	E	E	E	E	E
Boric Acid	E	E	E	E	E	E	E	E	E	E
Brine	E		E		P	E	E	E	E	E
Bromic Acid	E				P	E	E	P	P	E

Key: E: Good Resistance F: Moderate Resistance P: Poor Resistance

Eclipse Series Wetted Parts

Liquid	ETFE	PVDF (Note 2)	PPL	Alumina Ceramic	Carbon	Silicon Carbide	PTFE	Viton®	EPDM	Kalrez®
Bromine (Dry)	P	E	P	E	P	E	E	E	P	E
Butadiene	E	E	P	E	E	E	E	E	E	E
Butane	E	E	E	E	E	E	E	E	P	E
Butanediol	E				E	E	E	E	E	E
n-Butyl Alcohol	E	E	E		E	E	E	E	E	E
Butyl Bromide	E				P	E	E	E	P	E
Butyl Chloride	E				E	E	E	E	P	E
Butyl Phenol	E				E	E	E	E	E	E
Calcium Bisulfate	E		E		E	E		E	E	E
Calcium Bisulfide	E	E	E		E	E	E	E	E	E
Calcium Carbonate	E	E	E	E	E	E	E	E	E	E
Calcium Chlorate	E	E	E	E	P	E	E	E	E	E
Calcium Chloride	E	E	E	E	E	E	E	E	E	E
Calcium Hydroxide	E	48°C	E	E	E	E	E	E	E	E
Calcium Hypochlorite	E	E	E	E	P	E	E	E	E	E
Calcium Nitrate	E	E	E	E	E	E	E	E	E	E
Calcium Oxide	E	E	E		E	E	E	E	E	E
Calcium Sulfate	E	E	E	E	E	E	E	E	E	E
Carbon Disulfide	65°C	48°C	P		E	E	E	E	P	E
Carbon Tetrachloride	65°C	48°C	P	E	E	E	E	E	E	E
Carbonic Acid	E	E	E		E	E	E	E	P	E
Caustic Potash (10 and 50%)	100°C	E	E	E	E	E	E	P	E	E
Caustic Soda (10 and 50%)	100°C	E	E	E	E	E	E	P	E	E
Chlorinated Brine	E				P	E	E	E	E	E
Chlorinated Phenol	100°C		P		P	E	E	E	E	E
Chlorine (Dry)	100°C	E	P		P	E	E	E	P	E
Chlorine (Wet)	E	E	P	E	P	E	E	E	P	P
Chlorine Dioxide	E				E	E	E	E	P	P
Chloroacetic Acid (5-1/2 Cl_2)	E	22°C	P	E	E	E	E	E	E	P
Copper Chloride	E	E	E	E	E	E	E	E	E	E
Copper Cyanide	E	E	E	E	E	E	E	E	E	E
Copper Fluoride	E		E	P	E	E	E	E	E	E
Copper Nitrate	E	E	E	E	E	E	E	E	E	E
Copper Sulfate	E	E	E	E	E	E	E	E	E	E

Key: E: Good Resistance F: Moderate Resistance P: Poor Resistance

Eclipse Series Wetted Parts

Liquid	ETFE	PVDF (Note 2)	PPL	Alumina Ceramic	Carbon	Silicon Carbide	PTFE	Viton®	EPDM	Kalrez®
Cyclohexane	E	E	P	E	E	E	E	E	P	E
Cyclohexanol	E		P		E	E	E	E	P	E
Cyclohexanone	E	P	P	E	E	E	E	P	P	E
Dichloroacetic Acid	65°C				E	E	E	P	E	E
Dichloroethylene	65°C		P		E	E	E	E	P	E
Dichloropropionic Acid	65°C				E	E	E	E	E	E
Diethyl Benzene	E				E	E	E	E	P	E
Diethyl Ether	100°C		E		E	E	E	P	P	E
Diisobutylene	E				E	E	E	E	E	E
Dimethylamine	50°C	22°C		E	E	E	E	P	P	E
Epichlorhydrin	65°C	P			E	E	E	P	E	E
Ethyl Acetate	65°C	P	E	E	E	E	E	P	E	E
Ethyl Alcohol (Ethanol)	E		E	E	E	E	E	E	E	E
Ethylamine	40°C			E	E	E	E	P	E	P
Ethyl Chloride	E	E	P	E	E	E	E	E	P	E
Ethyl Chloroacetate	100°C				E	E	E	E	E	E
Ethylene Bromide	E	E	P		E	E	E	E	P	E
Ethylene Chlorohydrin	65°C	E	P		E	E	E	E	E	E
Ethylene Glycol	E	E	E	E	E	E	E	E	E	E
Ethylene Oxide	E	E	P	E	E	E	E	P	P	E
Ferric Chloride	E	E	E	E	P	E	E	E	E	E
Ferric Hydroxide	E				E	E	E	P	E	E
Ferric Nitrate	E	E	E	E	E	E	E	E	E	E
Ferric Sulfate	E	E	E	E	E	E	E	E	E	E
Ferrous Chloride	E	E	E	E	E	E	E	E	E	E
Ferrous Hydroxide	E				E	E	E	P	E	E
Ferrous Nitrate	E				E	E	E	E	E	E
Ferrous Sulfate	E	E	E	E	E	E	E	E	E	E
Fluorine (Gaseous)	40°C	22°C	P		P	E	P	P	P	E
Formaldehyde (37% in H_2O)	65°C	52°C	E	E	E	E	E	E	E	P
Freon 11	E			E	E	E	E	E	P	E
Freon 12	E	E	E		E	E	E	E	E	E
Freon 22	E	E	F		E	E	E	P	P	P
Furmaric Acid	95°C				E	E	E	E	E	E
Gasoline-Unleaded	E	E	F	E	E	E	E	E	P	E
Glycerol	E				E	E	E	E	E	E
Glycolic Acid	E	E	E		E	E	E	E	E	E

Key: E: Good Resistance F: Moderate Resistance P: Poor Resistance

Eclipse Series Wetted Parts

Liquid	ETFE	PVDF (Note 2)	PPL	Alumina Ceramic	Carbon	Silicon Carbide	PTFE	Viton®	EPDM	Kalrez®
Glycol	E				E	E	E	E	E	E
Heptane	E	E	P	E	E	E	E	E	P	E
Hexane	E	E	F	E	E	E	E	E	P	E
Hydrobromic Acid (50%)	E		P	F	E	E	E	E	E	E
Hydrochloric Acid (20%)	E	E	F	F	E	E	E	E	E	E
Hydrochloric Acid (Conc.)	E	66°C	F	80C	E	E	E	E	P	E
Hydrochloric Acid (Gas)	E	E	F		E	E	E	E	P	E
Hydrocyanic Acid	E	E	E		E	E	E	E	E	E
Hydrofluoric Acid (35%)	E	E	E	P	P	E	E	P	E	E
Hydrofluoric Acid (70%)	E	E	F	P	P	E	E	P	P	E
Hydrofluoric Acid (100%)	E	E	P	P	P	E	E	P	P	E
Hydrogen Cyanide	E	E		E	E	E	E	E	E	E
Hydrogen Peroxide (30%)	E	E	F	E	P	E	E	E	E	E
Hydrogen Peroxide (90%)	65°C	22°C	F	E	P	E	E	E	P	E
Hydrogen Sulfide (Dry)	E	E	E		E	E	E	P	E	E
Hydrogen Sulfide (Wet)	E	E	E	E	E	E	E	P	E	E
Hypochlorous Acid	E				P	E	E	E	E	E
Iodine (Dry)	E	66°C	P		P	E	E	P	E	E
Iodine (Wet)	E	66°C		E	P	E	E	E	E	E
Isobutyl Alcohol	E				E	E	E	E	E	E
Isopropylamine	50°C		F		E	E	E	P	P	E
Jet Fuel - JP4	E	E	E		E	E	E	E	P	E
Lactic Acid	E	53°C	F	E	E	E	E	E	E	E
Lauric Acid	E			E	E	E	E	E	E	E
Lauryl Chloride	E				E	E	E	E	E	E
Lauryl Sulfate	E				E	E	E	E	E	E
Linseed Oil	E	E			E	E	E	E	E	E
Lithium Bromide	E				P	E	E	E	P	E
Lithium Hydroxide	E				P	E	E	P	E	E
Lubricating Oil	E	E	E		E	E	E	E	P	E
Magnesium Carbonate	E	E	E	E	E	E	E	E	P	E
Magnesium Chloride	E	E	E	E	E	E	E	E	E	E
Magnesium Hydroxide	E	E	E	E	E	E	E	E	E	E
Magnesium Nitrate	E	E	E	E	E	E	E	E	E	E
Magnesium Sulfate	E	E	E	E	E	E	E	E	E	E
Maleic Acid	E	E	E	E	E	E	E	E	P	E
Maleic Anhydride	95°C	E	P		E	E	E	E	P	E

Key: E: Good Resistance F: Moderate Resistance P: Poor Resistance

Eclipse Series Wetted Parts

Liquid	ETFE	PVDF (Note 2)	PPL	Alumina Ceramic	Carbon	Silicon Carbide	PTFE	Viton®	EPDM	Kalrez®
Malic Acid	E	E	E		E	E	E	E	P	E
Mercuric Chloride	E	E	F	E	E	E	E	E	E	E
Methacrylic Acid	95°C				E	E	E	P	E	E
Methyl Alcohol (Methanol)	E	E	E	E	E	E	E	P	E	E
Methyl Benzoate	E				E	E	E	E	P	E
Methyl Bromide	E	E	P		E	E	E	E	E	E
Methyl Chloride	100°C	E	P		E	E	E	E	P	E
Methyl Chloroform	65°C				E	E	E	P	E	E
Methyl Ethyl Keytone (MEK)	100°C	P	F	E	E	E	E	P	P	E
Methyl Sulfuric Acid	100°C				E	E	E	E	E	E
Methylene Bromide	100°C				E	E	E	E	P	E
Methylene Chloride	100°C	53°C	F	E	E	E	E	E	P	E
Methylene Iodide	100°C				E	E	E	E	P	E
Methyl Methacrylate	80°C	53°C			E	E	E	P	P	E
Monochlorobenzene	E				E	E	E	E	P	E
Monoethanolamine	65°C	F	F		E	E	E	P	E	E
Nickel Chloride	E	E	E	E	E	E	E	E	E	E
Nickel Nitrate	E	E	E	E	E	E	E	E	E	E
Nickel Sulfate	E	E	E	E	E	E	E	E	E	E
Nitric Acid (Conc. 70%)	25°C	P	P	E	P	E	E	E	P	E
Nitric Acid (50%)	65°C	53°C	F	E	P	E	E	E	P	E
Nitrous Acid	100°C	E	E	E	P	E	E	E	P	E
Oleic Acid	E	E	F	E	E	E	E	E	E	E
Oleum	50°C		P	E	P	E	E	E	P	E
Oxalic Acid	E	E	E	E	E	E	E	P	E	E
Perchloric Acid (72%)	65°C		P	E	E	E	E	E	P	E
Perchloric Acid (10%)	E		F	E	E	E	E	E	P	E
Perchloroethylene	E	E	P	E	E	E	E	E	P	E
Phenol (100%)	100°C	22°C	F	E	E	E	E	E	P	E
Phenol (10%)	E	E	F	E	E	E	E	E	P	E
Phosphoric Acid (30%)	E		E	E	E	E	E	E	E	E
Phosphoric Acid (85%)	E	E	F	E	E	E	E	E	E	E
Phosphorus Oxychloride	100°C			E	E	E	E	E	E	E
Phosphorus Pentachloride	100°C				E	E	E	E	E	E
Phosphorus Trichloride	E	48°C		E	E	E	E	E	E	E
Phthalic Anhydride	100°C	E	P	E	E	E	E	P	E	E
Potassium Aluminum Chloride	E				E	E	E	E	E	E

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Eclipse Series Wetted Parts

Liquid	ETFE	PVDF (Note 2)	PPL	Alumina Ceramic	Carbon	Silicon Carbide	PTFE	Viton®	EPDM	Kalrez®
Potassium Bicarbonate	E	E	E	E	E	E	E	E	E	E
Potassium Bromate	E				E	E	E	E	E	E
Potassium Bromide	E	E	E	F	E	E	E	E	E	E
Potassium Carbonate	E	E	E	P	E	E		E	E	E
Potassium Chlorate	E	E	E	F	E	E	E	E	E	E
Potassium Chloride	E	E	E	E	E	E	E	E	E	E
Potassium Cyanide	E	E	E	P	E	E	E	E	E	E
Potassium Fluoride	E				E	E	E	E	E	E
Potassium Hydroxide (25%)	100°C	66°C	E	P	P	E	E	P	E	E
Potassium Hypochlorite	E	22°C		P	P	E	E	E	P	E
Potassium Nitrate	E	E	E	F	E	E	E	E	E	E
Potassium Perchlorate	100°C				P	E	E	E	P	E
Potassium Permanganate	E	E	E	E	E	E	E	E	E	E
Potassium Sulfate	E	E	E	E	E	E	E	E	E	E
Propionic Acid	100°C				E	E	E	E	E	E
Propyl Alcohol	100°C				E	E	E	E	E	E
Propylene Dichloride	100°C	E		E	E	E	E	E	P	E
Propylene Oxide	65°C	P		E	P	E	E	E	E	E
Salicylic Acid	E	E	E		E	E	E	E	E	E
Salt Brine	E	E	E		P	E	E	E	E	E
Sea Water	E	E	E	E	E	E	E	E	E	E
Silicon Tetrachloride	E				E	E	E	E	E	E
Silver Cyanide	E			E	E	E	E	P	E	E
Silver Nitrate	E	E	E		E	E	E	E	E	E
Sodium Acetate	E	E	E	E	E	E	E	P	E	E
Sodium Bicarbonate	E	E	E	E	E	E	E	E	E	E
Sodium Bisulfate	E	E	E	E	E	E	E	E	E	E
Sodium Borate (Borax)	100°C	E	E	E	E	E	E	E	E	E
Sodium Bromide	E	E		E	E	E	E	E	E	E
Sodium Carbonate	E	E	E	E	E	E	E	E	E	E
Sodium Chlorate	E	E	E	E	E	E	E	E	E	E
Sodium Chloride	E	E	E	E	E	E	E	E	E	E
Sodium Chromate	E	E		E	P	E	E	E	E	E
Sodium Cyanide	E	E	E	E	E	E	E	E	E	E
Sodium Dichromate	100°C	E		E	E	E	E	E	E	E
Sodium Ferrocyanide	E	E	E	E	E	E	E	E	E	E
Sodium Fluoride	E	E	E	P	E	E	E	E	E	E

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Eclipse Series Wetted Parts

Liquid	ETFE	PVDF (Note 2)	PPL	Alumina Ceramic	Carbon	Silicon Carbide	PTFE	Viton®	EPDM	Kalrez®
Sodium Glutamate	E				E	E	E	E	E	E
Sodium Hydroxide	E	Note 1	E	E	E	E	E	P	E	E
Sodium Hypochlorite	E	E	E	E	P	E	E	E	P	E
Sodium Hyposulfite	E				E	E	E	E	E	E
Sodium Iodide	E				E	E	E	E	P	E
Sodium Metasilicate	E		E		E	E	E	E	E	E
Sodium Nitrate	E	E	E	E	E	E	E	E	E	E
Sodium Nitrite	E	E		E	E	E	E	E	E	E
Sodium Perchlorate	65°C				E	E	E	E	E	E
Sodium Peroxide	E	E	F	E	P	E	E	E	E	E
Sodium Persulfate	80°C				E	E	E	E	E	E
Sodium Phosphate	E	E		E	E	E	E	E	E	E
Sodium Silicate	E	E	E	E	E	E	E	E	E	E
Sodium Sulfate	E	E	E	E	E	E	E	E	E	E
Sodium Sulfide	E	E	E	E	E	E	E	E	E	E
Sodium Sulfite	E	E	E	E	E	E	E	E	E	E
Sodium Thiosulfate	E	E		E	E	E	E	E	E	E
Stannous Chloride	E	E	E	E	E	E	E	E	E	E
Stannous Fluoride	E		E		P	E	E	E	E	E
Stearic Acid	E	E	E	E	E	E	E	E	E	E
Styrene Monomer	100°C				E	E	E	E	P	E
Succinic Acid	E				E	E	E	P	P	E
Sulfamic Acid	100°C				P	E	E	E	P	E
Sulfur (Molten)	E				P	E	E	E	P	E
Sulfur Dioxide	E	E	E	E	P	E	E	E	E	E
Sulfuric Acid (60%)	E	66°C	E	E	E	E	E	E	E	E
Sulfuric Acid (Conc.)	E	66°C	P	E	E	E	E	E	P	E
Sulfuric Acid (Fuming-Oleum)	50 C	P	P		P	E	E	E	P	E
Sulfurous Acid	E	E	E	E	E	E	E	E	P	E
Tannic Acid	E	E	E	E	E	E	E	E	P	E
Tartaric Acid	E	E	E	E	E	E	E	E	E	E
Tetrahydrofuran	100C	22°C	P	E	E	E	E	P	P	E
Thionyl Chloride	100C				E	E	E	E	P	E
Tin Tetrachloride	E				P	E	E	E	P	E
Titanium Tetrachloride	100C				E	E	E	E	P	P
Toluene	E	79°C	P	E	E	E	E	E	P	E
Tributyl Phosphate	65°C	F		E	E	E	E	P	P	E

Key: E: Good Resistance F: Moderate Resistance P: Poor Resistance

Eclipse Series Wetted Parts

Liquid	ETFE	PVDF (Note 2)	PPL	Alumina Ceramic	Carbon	Silicon Carbide	PTFE	Viton®	EPDM	Kalrez®
Trichloroacetic Acid	100C	E	E		E	E	E	E	E	E
Trichloroethylene	E	E	P	E	E	E	E	E	P	E
Trichloromethane	100C				E	E	E	E	P	E
Triethylamine	E	48°C	P	E	E	E	E	E	E	E
Trioxane	50C				E	E	E	P	P	P
Turpentine	E	E	P	E	E	E	E	E	P	E
Urea (50% H2O)	E	E	E	F	E	E	E	P	P	E
Vinyl Acetate	E	E	F	F	E	E	E	P	P	E
Vinyl Chloride (Monomer)	65C	22°C		E	E	E	E	E	P	E
Water	E	E	E	E	E	E	E	E	E	E
Wax (Paraffin)	E				E	E	E	E	P	E
Xylene	E	E	F	E	E	E	E	E	P	E
Zinc Acetate	E				E	E	E	P	E	E
Zinc Chloride	E	E	E	F	E	E	E	E	E	E
Zinc Hydrosulfite (10%)	E				E	E	E	E	E	E
Zinc Nitrate	E				E	E	E	E	E	E
Zinc Sulfide	E				E	E	E	E	E	E
Zinc Sulfate	E	E	E	F	E	E	E	E	E	E

Notes:

1. Recommendations for Kynar ® (PVDF) in Sodium Hydroxide (NaOH) services:

NaOH Concentration	Continuous Service	Intermittent Service	Water Flush Between Runs
x <=4%	X	-	-
4%< x <50%	-	X	X
x >=50%	N/R		

N/R – PVDF Not Recommended
For best overall results, use 316 stainless steel.

2. For PVDF in base chemicals above 12 pH, run pump intermittent with flush between runs. For base chemical less than 12 pH, PVDF is suitable for continuous service, no flush required

GUIDE TO USING LIQUIDS DIRECTORY

The following tables contain a listing of some 300 common industrial chemicals. The list includes major physical properties and brief comments on specific hazards and commercial applications of these materials.

Symbols and notations used under each heading are as follows:

Column	Format
Name of Compound	Alphabetical, by chemical name. Unless otherwise stated, properties given are for the pure compound. Chemical synonyms, common names and crystal form follow in parenthesis. Standard commercial forms are used where a crystal form is listed, rather than the anhydrous material. Similarly, common commercial concentrations are listed for the major acids and alkalies.
Chemical Formula	As listed in standard chemistry and chemical engineering reference handbooks. For organic compounds, condensed structural formulas are given where feasible.
Physical Form	Normal state at ambient conditions. 77ºF and sea level atmospheric pressure (14.7psia): G = Gas, L = Liquid, S = Solid
Specific Gravity	Ratio of the density of the material to that of water, both at room temperature. For liquefied gasses, an asterisk indicates that the specific gravity given is measured at the normal boiling point.

Tip: For water solutions of most dry inorganics, an estimate of specific gravity based on % concentration, C is:

$$S.G. = 1 + C/100$$

INTRODUCTION, DEFINITION OF TERMS

Melting Point

At atmospheric pressure, the maximum temperature (ºF or ºC) at which the material exists as a solid, and begins to form a liquid. A notation "d" indicates at least some degree of decomposition, either at the melting point shown, or if no value is given, before melting occurs.

"Subl." Means sublimes, a direct transition from solid to gas without melting. An asterisk in this column is a warning to check the special comments column for more details.

Boiling Point

At atmospheric pressure, the maximum temperature (ºF or ºC) at which the material exists as a liquid, and begins to form a gas. As with the melting point, a notation "d" indicates at least partial decomposition, either at the temperature shown or before boiling occurs.

Solubility, Wt. %
(Water or Alcohol)

The maximum concentration of the solution, at room temperature, which the material will form in either water or alcohol. Notations here are:

Insol.	=	Insoluble, for practical purposes
V.S1.S.	=	Very slightly soluble, below 0.1%
S1.S.	=	Slightly soluble, below 1%
Sol.	=	Soluble, no further details available

V.S.	=	Very soluble, no further details
Inf.	=	Infinite, or completely miscible

Here again, an asterisk is a cautionary note to check the Special Comments column – usually indicating a violent reaction when in contact with the solvent.

Flash Point (ºF or ºC)

Under defined test conditions (open cup), the temperature at which a liquid gives off enough vapor to form an ignitable mixture with the air contained in the test vessel.

As a practical matter, flash points far below room temperature constitute an acute fire and explosion hazard. Flash points from slightly below room temperature to about 120ºF still present a fire hazard. The Special Comments column carries notations based on these two assumptions.

Special Comments

In addition to the fire and explosion hazards noted above, bold face notes indicate particular hazards of toxicity, skin and eye irritants, etc. **These are merely warning signals in brief form;** further details should be developed when the job involves these materials.

Also included is an abstract of major known uses and applications. Even in very general form, they may provide useful hints in developing sales prospects.

Toughest Chemicals

Hydrochloric Acid: (HCl); a.k.a Hydrogen Chloride or Muriatic Acid
Can be in the form of a thin, colorless liquid with a pungent odor, or a colorless to slightly yellow gas which can be shipped in the form of a liquefied compressed gas. HCl is used in the production of phosphoric acid, chlorine dioxide, fertilizers, dyes and paint pigments. It is also used in the steel pickling industry to remove scale, to clean membranes in desalination plants, neutralization of waste streams, sugar refining, electroplating, and soap refining among many other practical uses.

HCl is one of the most corrosive of the nonoxidizing acids when in contact with copper bearing alloys. Aqueous solutions of HCl attack and corrode nearly all metals, except mercury, silver, gold, platinum, tantalum and certain alloys. Although not typically handled in solutions of greater than 37% concentrations, HCl can corrode and damage alloys like Hastelloy-B and Hastelloy-C.

The materials of construction of the Eclipse series pumps are ideal for use with HCl of any concentration. ETFE, PVDF, PTFE, FKM (Viton®), Carbon and Alumina Ceramic are all well documented as being compatible with HCl. Non-metallic pumps are widely used for handling this chemical.

Sulfuric Acid: (H_2SO_4); a.k.a Hydrogen Sulfate or Battery Acid
Sulfuric acid is a clear, heavy (dense), oily and odorless liquid. It is used in the production of phosphate fertilizers, explosives, paper, glue, batteries, paints, and in the production of many other chemicals.

Sulfuric acid, although able to be mixed with water at all concentrations, produces an exothermic reaction which generates a great deal of heat depending on the concentration of acid being mixed. Caution must be taken when mixing sulfuric acid with water and/or other chemicals.

A very strong and corrosive oxidizing acid, sulfuric acid will react with and dissolve most metals, including 316SS, Hastelloy-B and C and Titanium. Industry corrosion guides suggest Hastelloy-B and C as having a "Moderate" or "Limited" resistance to this chemical with an estimated penetration of 0.020" or more per year. The useful life of these materials for pump applications are heavily dependant on temperature and the concentration of the acid.

The materials of construction of the Eclipse series pumps are ideal for use with Sulfuric acid. Non-metallic pumps are widely used for handling this chemical.

Sodium Hydroxide: (NaOH); a.k.a Caustic, Caustic soda, Lye
Specific gravity is 1.1-1.5, based on concentration. Viscosity from water-like to 40cps.
Sodium Hydroxide is a white, crystalline substance that is soluble in water, alcohol and glycerin. It is a very strong caustic and base, which is commercially available in numerous solid forms, but mostly in water solutions of varying concentrations.

Sodium hydroxide is used in the production of other chemicals, rayon and other textiles, pulp and paper, petroleum refining, soaps and detergents, and aluminum etching.
Because it is fairly inexpensive, sodium hydroxide is widely used whenever a strong base is required.

Pumping sodium hydroxide can cause problems for sealed pumps (particularly pumps with single mechanical seals) because the fluid will crystallize when it contacts oxygen at the atmospheric side of the seal. These "crystals" can build up on the seal faces and eventually wear them to the point of leaking. For this reason, double mechanical seals are required with a buffer fluid to keep the caustic fluid from the environment. This can be a very expensive solution to the sealing problem.

Because of the sealing issue described above, handling sodium hydroxide with magnetically driven (sealless) pumps has become a great solution.

Regardless of the type pump used to handle this liquid, something that must be noted is the concentration of sodium hydroxide in the solution and temperature. The properties of this fluid, (specific gravity and viscosity) change with different temperatures. A sealless pump can easily handle 40% sodium hydroxide at 100ºF, but if the temperature dropped to 40ºF for some reason, the product will solidify (freeze) and become extremely abrasive and viscous.

Nitric Acid: (HNO_3);
Specific gravity of approximately 1.4, based on concentration. Nitric acid is a thin and very strong acid, a powerful oxidizing agent and has the ability to nitrate organic materials, thus making it essential for the production of numerous chemicals. Its main use however remains the production of ammonium nitrate in the fertilizer industry. It will react with water or steam to produce heat and toxic, corrosive, and flammable vapors.

Nitric acid is extremely corrosive to metals such as Alloy-20 and Hastelloy-C and plastics like PVC and Polypropylene when used in high concentrations or high temperatures.

The materials of construction of the Eclipse Series pump are ideal for use with Nitric Acid of all concentrations. Care must be taken on high temperature applications, as Nitric acid does become more aggressive at higher temperatures. Consult the Corrosion Guide in this section or consult the factory for any questionable applications. Test coupons are also available through the factory for customer testing.