LIQUIDS LIST

High-Viscosity

Toxic Liquids

Hot & Cold Liquids

Corrosive Liquids

Abrasive & Sanitary
Liquids List

Introduction

To make a good pump selection, information is needed about the items listed in the box at right.

Capacity, discharge pressure, suction, temperature, and duty cycle are determined by the application and or the installation. The remaining items – name, viscosity, abrasiveness specific gravity, vapor pressure and materials of construction – are properties of, or determined by the liquid.

This LIQUIDS LIST gives information on several hundred liquids. It is broad in scope and general in nature. It is meant to assist you in selecting the proper VICAN pump. We have attempted to be as accurate as possible, but the LIST is not infallible; use it wisely.

Guidelines Used in Compiling the LIQUIDS LIST

- **Liquid Name** – A listing by name in alphabetical order of some of the liquids that are handled by positive displacement pumps. The spelling is that shown in Chemical Dictionaries.
- **Chemical Formula** – As shown in Chemical Dictionaries.
- **Specific Gravity** – Values are for ambient conditions unless temperature given; only two significant figures are used.
- **Viscosity** – Stated in centipoises (cPs) and Seconds Saybolt Universal (SSU) where applicable. Water at room temperature is approximately 1 cPs or 30 SSU.

**Pump Construction** – Materials used in the various constructions are as listed here. Heavy Duty pumps are recommended except where noted.

A. Standard Construction – Externals (head, casing, and bracket) of cast iron, with internals (rotor and idler) as indicated in the Technical Data Sheets, normally cast iron or ductile iron (Ductalloy). Bushings are bronze or carbon graphite, depending on pump model. If a specific bushing material is recommended it will be indicated.
B. Steel Fitted – Externals of cast iron with rotor of steel or ductile iron for additional strength. Consult factory for details and availability.
C. Bronze Fitted – Cast iron externals with bronze rotor and idler. Consult factory for details and availability.
D. Stainless Steel – 316 series stainless externals and internals. Consult factory for details and availability.

- **Seal** – Mechanical Seal
  A. Standard – seal used in standard construction, normally Buna-N elastomer with steel or stainless metal parts, carbon rotating washer and Ni-Resist stationary seat.
  B. Viton fluorooelastomer – Viton elastomer, steel or stainless steel metal parts, carbon rotating washer and Ni-Resist stationary seat. Used in standard construction pumps for intermediate temperatures and some solvents.
  C. Teflon tetrafluoroethylene, TFE & Ni-Resist – Teflon secondary sealing elements, stainless metal parts, carbon rotating washer and Ni-Resist stationary seat. Used in standard construction pumps when Teflon required for higher temperatures or solvents.
  D. Teflon (tetrafluoroethylene, TFE) & Stellite – Teflon secondary sealing elements, stainless metal parts, carbon rotating washer and Stellite stationary seat. Used in some special pumps. Consult factory for details and availability.
  E. Special – Special design or arrangement, such as balanced or double seal. Consult factory for details and availability.
  F. Seal not recommended – For a few liquids, mechanical seals are not practical because of some condition of the application or property of the liquid. Consult factory for details and recommendations.

**Remarks** – Includes such items as additional physical properties, typical uses, health or safety hazards, applicable industry standards and precautions regarding pump operation.

New materials, manufacturing techniques, designs, standardization of products, etc., are constantly being considered. When the result of any of these considerations can be incorporated in the product line, it will be done. Check with your factory representative for details on current pump construction. Have a liquid not shown or an application with which you need help? Fill in the Application Data sheet at the back of the Engineering Manual and ask for factory assistance.

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1 In addition, information about such things as additives, flush liquids, ambient conditions, start-up tests, steam blow, operator training, installation procedures, etc., is of importance and will help your factory representative make a good recommendation.
2 For most liquids, pumps with packing can also be used. Standard construction packed pumps have C-1065 graphite/Teflon packing. C-1045 food grade packing and 1625-GF high temperature packing is also available.
Liquids List

ACETONE
Other Names: Dimethylketone
Formula: CH₃COCH₃
Sp. Gr.: 0.8
Viscosity: Water-thin
Remarks: Acetone is an extremely flammable, colorless
liquid, b.p. 56ºC / 133ºF; miscible with water, alcohol, ether,
chloroform, and most oils. Used in making acetic
anhydride; solvent for cellulose acetate; solvent in paints,
lacquers, and adhesives; also used as a solvent in epoxy
resins and pharmaceuticals; used in purest form to clean
and dry precision parts.
Pump Notes: Cast iron construction, Teflon®, Kalrez® or
EPR elastomers are recommended. Shaft sealing is critical
due to the hazardous nature of the liquid; use either a
mechanical seal or a sealless pump design.

ADHESIVE
A name for a group of substances capable of holding
materials together by surface attachment.
Other Names: Cement, glue, mucilage, paste
Remarks: Adhesives are made from many different basic
materials, among them dextrin, latex, liquid rubber, resin,
sodium silicate, and starch. Adhesives are used in the
manufacture of cardboard boxes, plywood, furniture, paper
bags, pressure sensitive tapes and many industries
including automotive, printing, manufacturing, etc.
Pump Notes: Pump construction varies from cast iron to
stainless steel depending on the corrosive nature of
individual adhesives. Elastomers also vary depending on
individual solvents used in the adhesive. Shaft sealing may
be packing or mechanical seals. Generally, adhesives are
very viscous and the pump design must be capable of
handling those viscosities. Adhesives may also contain
abrasives and the pump design must be capable of
handling particulate.

ALCOHOL
Normally considered to mean Ethyl Alcohol, q.v. For other
alcohols, see specific names, such as methyl alcohol, butyl
alcohol, isopropyl alcohol, etc.

ALKYD RESINS
Resins made by the union of dibasic acids, or anhydrides
such as phthalic anhydride with a polyhydric alcohol such as
glycerol.
Viscosity: May range from 100 cPs. to over 1000 cPs.,
depending on temperature and make-up of particular alkyd
resin.
Remarks: Alkyd resins may be varied or modified by the
use of other anhydrides, glycols, polyols, or other liquids,
the most common of which are natural oils. Alkyd resins are
easy to apply, retain their initial appearance after long
exposure to weather and have good heat resistance, color
retention, toughness, adhesion and flexibility. They are
used as protective and decorative coatings for metals,
wood, paper, textiles; are used in adhesives, printing inks,
floor coverings; as vehicles in automotive and industrial
finishes; and in oil and water paints, lacquers, and
enamels.
Pump Notes: Construction recommendations depend on
individual formulations. Mechanical shaft seals may be
used depending on viscosity and temperature.

AMMONIA
Other Names: Anhydrous Ammonia; see also Ammonium
Hydroxide
Formula: NH₃
Sp. Gr.: 0.64 @ 0ºC / 32ºF
Viscosity: 0.3 cPs. / 2.13 SSU
Remarks: Ammonia is a colorless gas or liquid, has a
pungent odor, is lighter than air as a gas, is easily liquefied
by pressure, is very soluble in water or alcohol and has a
b.p. -29ºC / -20ºF, freezing point -78ºC / -108ºF. The
largest volume of ammonia is used for fertilizers. Other
uses include production of nitric acid, urea, acrylonitrile;
refrigeration; solvent. Ammonia liquid causes burns; the
gas is extremely irritating, causing nausea and difficulty in
breathing.
Pump Notes: Cast iron construction, neoprene or buna n
elastomers are recommended. Double mechanical seals
with oil reservoir are normally used for shaft sealing. Pump
design should be suitable for a thin, non-lubricating liquid.

AMMONIUM HYDROXIDE
Other Names: Aqua ammonia; aqueous ammonia,
ammonia solution, ammonium hydrate
Formula: NH₄OH
Sp. Gr.: Slightly less than 1.0
Viscosity: Water-thin
Remarks: Colorless liquid, strong characteristic odor.
Ammonium hydroxide is made by dissolving ammonia gas
in water. Concentrations of solution range up to about 30%.
Used in making textiles, rayon, rubber, fertilizer, plastics,
ammonia soaps, lubricants, ink, explosives and in the
saponifying of fats and oils, as a detergent and household
cleanser. Ammonia window cleaners are weak solutions of
ammonium hydroxide.
Pump Notes: Cast iron construction, neoprene or buna n
elastomers are recommended. Pumps that have been used
for handling ammonium hydroxide will rust badly when they
are drained; fill with liquid or drained and fill with oil to
prevent rusting. Standard seals have a tendency to dry out
and harden if left exposed to air for any length of time.

AMYL ACETATE
Other Names: Amylacetic ester, banana oil
Formula: CH₃COOC₅H₁₁
Sp. Gr.: 0.88
Viscosity: Slightly greater than water
Remarks: Colorless liquid. Very slightly soluble in water;
miscible with alcohol and ether; vapor is heavier than air.
Flammable as a liquid. Solvent for lacquers and paints,
drained in dry cleaning preparations, as a flavoring agent and
in printing and finishing textile fabrics.
Pump Notes: Cast iron construction, Teflon® or Kalrez®
elastomers are recommended. Mechanical shaft seal is
recommended. Pump design must be suitable for handling
a thin liquid.
**Liquids List**

**AMYL ALCOHOL**
Other names: n-amyl alcohol, primary; n-butyl carbinol  
Formula: CH\(_3\)(CH\(_2\))\(_4\)OH  
Sp. Gr.: 0.81  
Viscosity: Water-thin  
Remarks: Amyl alcohol may exist with the same formula in several different molecular structures. Information given here pertains particularly to the alcohol identified as n-amyl alcohol, primary. A colorless liquid with a mild odor, slightly soluble in water, has a b.p. 138ºC / 280ºF, freezing point -79ºC / -110ºF, flash point (open cup) 48ºC / 118ºF. Used as a raw material for pharmaceutical preparations.  
Pump Notes: Cast iron construction, EPR elastomers are recommended. Mechanical shaft seal is recommended. Pump design should be capable of handling a thin liquid.

**BARIA SULFATE SLURRY**
Other Names: Barite  
Formula: BaSO\(_4\)  
Sp. Gr.: 4.4 (Powder)  
Viscosity: Varies with concentration and liquid used to make slurry  
Remarks: A fine, white, odorless powder. Practically insoluble in water and solvents; soluble in concentrated sulfuric acid. It is used as a pigment for paints, filler for plastics and inks and in the medical industry. Barium sulfate is abrasive.  
Pump Notes: Cast iron construction is satisfactory. An abrasion resistant mechanical seal should be used for shaft sealing. Due to the abrasive characteristics of the liquid, design features to combat abrasion must be used.

**BEER**  
Remarks: Beer, beer wort, spent beer and yeast q.v. can have a wide variety of properties depending on particular brewery or stage of process.  
Pump Notes: Positive displacement pumps usually do not handle beer in its drinkable form. Related products such as beer wort and spent yeast may be handled. Contact individual pump manufacturer for specific recommendations.

**BITUMEN**
Other Names: Asphaltum, bitumen, pitch, Trinidad pitch, mineral pitch, petroleum asphalt  
Viscosity: Varies widely with type and temperature, normally handled in the 150 to 205ºC / 300 to 400ºF range at which temperature viscosity is usually in the 100 cPs. to 5000 cPs. range.  
Remarks: A dark brown or black solid or semi-solid material made up primarily of bitumens, which occur in nature or are obtained as residuals in refining petroleum. Asphalt is used for paving roads, roofing, waterproofing, paints, softener in rubber blends, and fungicides.  
Pump Notes: Cast iron construction is recommended. Normally, packing is used for a shaft seal but mechanical seals have also been used with success. Pump jacketing is normally required to keep the product at temperature. Asphalt is a solid a room temperature which necessitates bringing the pump to temperature before operating.

**BITUMEN, CUT-BACK**  
Asphalt which has been diluted to a liquid or semi-solid with a petroleum thinner.  
Viscosity: Variable, depending on dilution and temperature, normally 22 to 220 cPs. / 100 to 1,000 SSU in the 21 to 93ºC / 70 to 200ºF range.  
Remarks: Cut-back asphalt is used for coating road surfaces.  
Pump Notes: Cast iron construction is satisfactory. Packing is the normal shaft seal.

**BITUMEN, EMULSIFIED**  
A suspension or emulsion of asphalt in water.  
Viscosity: Usually relatively thin; almost water-like  
Remarks: Can often be used without being heated. Asphalt emulsions can be applied in the same manner as asphalts; after the water has evaporated, the asphalt hardens into a continuous film. Used for coating roadways, cement waterproofing and roofing compounds.
BLACK LIQUOR SOAP
Other Names: Black liquor skimmings
Viscosity: Ranges from 22 cPs. to 5500 cPs.
Sp. Gr.: Ranges around 0.95
Remarks: Black liquor soap (skimmings) is the fatty and
rosin acid content of black liquor that floats to the surface
after partial evaporation of the water content. Black liquor
soap is a raw material for tall oil.
Pump Notes: Cast iron or stainless steel construction may
be appropriate depending on individual requirements.
Pump jacketing may be required if the product is handled at
elevated temperature.

BLACK STRAP MOLASSES - See Molasses

BLOOD
Other Names: Animal Blood
Sp. Gr.: 1.0
Viscosity: Slightly more than water
Remarks: Blood is somewhat corrosive. Blood from
packing houses is used for fertilizer, adhesives, and feed
for hogs and chickens.
Pump Notes: The pump recommendation above is not
intended for handling human blood. For packing house
service, the construction described should be considered
expendable. Consider steel fitted pumps if dirt or sand can
get mixed in with the blood. Pumps operate best if slowed
down to better handle the foreign materials.

BRIGHT STOCK
Viscosity: Highly viscous; check with individual
manufacturers for specific viscosity
Remarks: Bright stock is a lubricating oil of high viscosity,
obtained from residues of petroleum distillation. Used for
blending with neutral oils in preparing automotive engine
lubricating oils.
Pump Notes: Cast iron construction is satisfactory. Buna n
is usually suitable for elastomers. Packing must be used
due to viscosity.

BRINE
Other Names: There are many types of brine, such as
calcium chloride and sodium chloride. Look for the specific
type if known.
Remarks: Normally brines are water-thin and may be either
acid or alkaline in nature. Brine is used in some cooling
systems, for food preservation, and for cleaning some
products or systems.
Pump Notes: Iron pumps handling brine will corrode rapidly
when exposed to air. Check equipment construction in the
rest of the system for guidance on selecting pump
construction. To reduce possibility of electrolytic corrosion,
do not use dissimilar metals.

BUNKER "C" FUEL OIL - See Fuel Oil #6

BUTADIENE
Other Names: Vinylethylene
Formula: \( H_2C:CHHC:CH_2 \)
Sp. Gr.: 0.62
Viscosity: Water-thin
Remarks: Colorless gas with mild aromatic odor, easily
liquefied, 1.21 BAR / 17.6 PSI, extremely flammable,
soluble in alcohol, polymerizes easily, b. p. -5ºC / -23ºF,
vapor pressure 17.6 PSI @ 0ºC / 32ºF. Used in the
formulation of styrene-butadiene and nitrile-butadiene
rubbers; latex paints; rocket fuels.
Pump Notes: Cast iron construction is satisfactory. Viton®
elastomers are recommended. Use a mechanical seal or
sealless design because of the hazardous nature of this
product.

BUTANE
Formula: \( C_4H_{10} \)
Sp. Gr.: 0.58
Viscosity: 0.1 cPs. / 0.78 SSU
Remarks: Colorless gas; has no corrosive action on metals;
boils under atmospheric pressure at about -1ºC / 31ºF.
Used for making synthetic rubber, high-octane fuels, mixed
with propane for household and industrial fuels. Is one of
the liquids referred to as LP-Gas, although propane is more
frequently referred to as LP-Gas. Butane will form
explosive mixtures with air.
Pump Notes: Cast iron construction is satisfactory. Buna n
or Viton® elastomers are recommended. Use of a
mechanical shaft seal is recommended.

BUTYLANOL - See Butyl Alcohol

BUTYL ALCOHOL
Other Names: 1-butanol
Formula: \( CH_3(CH_2)_2CH_2OH \)
Sp. Gr.: 0.81
Viscosity: Water-thin
Remarks: Colorless liquid, b.p. 118ºC / 244ºF, used in
preparation of esters and butyl acetates; solvent for resins
and coatings; plasticizer; detergent formulations; some
urea and melamine resins. Avoid prolonged breathing of
vapor and contact with skin.
Pump Notes: Cast iron construction is satisfactory. Buna n
or Viton® elastomers are recommended. Use of a
mechanical shaft seal is recommended.

CALCIUM CHLORIDE BRINE
Formula: \( CaCl_2 \)
Sp. Gr.: 1.1 to 1.3
Viscosity: Water-thin
Remarks: Calcium chloride is a white, deliquescent crystal
that can combine with different amounts of water. In all
forms, it is soluble in water and alcohol. The water solution
is normally neutral or slightly on the alkaline or basic side.
Used for dust-proofing roads, thawing snow and ice,
freeze-proofing coal or sand, concrete conditioning; paper
and pulp industry; as refrigeration brine; as a ballast for
weighting implement tires and in pharmaceuticals.
Pump Notes: Rapid corrosion will take place when an iron
pump that has handled brine is exposed to air. Avoid the
use of dissimilar metals to reduce tendency for electrolytic
corrosion.
Liquids List

CALCIUM STEARATE
Formula: Ca(C18H35O2)2
Viscosity: Depends on concentration, but normally varies from 44 cPs. 200 to 200 cPs.
Remarks: A white powder, insoluble in water and slightly soluble in hot alcohol, m.p. 150ºC / 300ºF. Decomposed by many acids and alkalis. Used as a water repellent, flating agent in lacquers, in varnishes, paints, enamels, plastics; as a lubricant; in emulsions, cements, wax crayons; as a stabilizer for vinyl resins and as an anti-caking agent in foods. May be abrasive if handled as a slurry
Jacketed features may be helpful when handling molten calcium stearate.. Slurry form may require abrasion-resistant features. Check on the abrasive nature of liquid or possible corrosive attack on seal materials.

CANE SYRUP - See Sugar Syrup
CARBOLIC ACID - See Phenol

CARBON DISULFIDE
Other names: Carbon Bisulfide
Formula: CS2
Sp. Gr.: 1.3
Viscosity: Water-thin
Remarks: Clear, colorless, flammable liquid; strong disagreeable odor; b.p. 46ºC / 115ºF; soluble in alcohol, benzene and ether, slightly soluble in water. Used in making viscose rayon, cellophane, carbon tetrachloride and flotation agents; as a veterinary medicine; as a solvent for fats, resins, rubber, waxes and other chemical products; in varnishes, lacquers, paint and varnish removers; and in making rubber textiles, fumigants, matches, preservatives, and pesticides. Liquid is poisonous, extremely flammable, highly volatile, and has a harmful vapor.
Pump Notes: Cast iron construction is usually satisfactory. Other construction may be specified due to end use of the product. Viton® elastomers are recommended. Mechanical shaft seal is recommended.

CARBON TETRACHLORIDE
Other names: Tetrachloromethane, perchloromethane
Formula: CCl4
Sp. Gr.: 1.6
Viscosity: Water-thin
Remarks: Colorless liquid; vapor is heavier than air. Non-flammable, poisonous. b.p. 77ºC / 170ºF, f. p. -23ºC / -9ºF, vapor pressure 91 mm at 20ºC / 68ºF; no flash point. Miscible with alcohol, ether, chloroform, benzene, naphtha; slightly soluble in water. Used for refrigerants and propellants, metal degreasing, grain fumigants and insecticides, fire extinguishers, dry cleaning solvents, and general solvents. Vapor and liquid are hazardous. May be fatal if inhaled or swallowed.
Pump Notes: Cast iron construction is usually satisfactory. If contaminated with moisture, carbon tetrachloride can form hydrochloric acid which is corrosive to cast iron pumps. Be sure that system is clean and free of water to avoid corrosion problems indicated above. Liquid needs to be Adry- or anhydrous. Viton elastomers and a mechanical shaft seal are recommended.

CASTOR OIL
Other Names: Ricinus oil
Viscosity: 44 cPs. to 660 cPs. / 200 to 3,000 SSU
Sp. Gr.: 0.96
Remarks: Pale, yellowish color, transparent, mild odor, nauseating taste; solidifies at -10ºC / 14ºF; soluble in alcohol, ether, benzene, chloroform and carbon disulfide. Used in protective coatings, plastics, lubricants, fatty acids, textiles, rubber, hydraulic fluids, cosmetics, pharmaceuticals, flavoring, and insulating compounds.
Pump Notes: Cast iron construction is usually satisfactory but may vary depending on end use of product. Buna n elastomers are satisfactory. Mechanical shaft seal is recommended.

CAUSTIC - See Sodium Hydroxide
CAUSTIC POTASH - See Sodium Hydroxide
CAUSTIC SODA - See Sodium Hydroxide

CHLORDAN
Other Names: Chlordane
Formula: C10H8Cl8
Sp. Gr.: 1.6
Viscosity: 22 cPs. @ 38ºC / 100 SSU @ 100ºF
Remarks: Colorless, odorless, slightly viscous liquid, b.p. 175ºC / 347ºF; soluble in many organic solvents, insoluble in water; miscible in kerosene. Used as an insecticide in oil emulsions and dispersible liquids. Liquid is harmful if swallowed; can be absorbed through the skin. When used as an insecticide, Chlordan is reduced with water and becomes water-thin.
Pump Notes: Cast iron construction is satisfactory. Will cause rapid rusting of iron parts when pump is left exposed to air. Keep full of liquid or flush and fill with oil. Viton®, Teflon® or Kalrez® elastomers are recommended. Mechanical shaft seal is recommended.

CHLOROFORM
Other Names: Trichloromethane
Formula: CHCl3
Sp. Gr.: 1.5
Viscosity: Water-thin
Remarks: Colorless, heavy, volatile liquid; nonflammable; miscible with alcohol, ether, benzene, naphtha; slightly soluble in water, b.p. 61ºC / 142ºF, freezing point -63ºC / -81ºF; no flash point. Used in making fluorocarbon refrigerants and propellants, fluorocarbon plastics, dyes and drugs, anesthetics; also used as a general solvent, fumigant, and insecticide. Vapor is harmful. Liquid may be fatal if swallowed.
Pump Notes: Cast iron construction is satisfactory. Keep pump full of liquid at all times to prevent rapid oxidation or rusting. If pump is drained, fill with oil; any dilution or impurity can make this liquid corrosive. Viton® elastomers are recommended. Mechanical shaft seal is recommended.

CHLOROTHENE - See Trichloroethane
Liquids List

CHOCOLATE
Other Names: Bitter chocolate, sweet chocolate, milk chocolate, chocolate liquor, chocolate coating.
Viscosity: Varies widely from 2,000 cPs. to several thousand cPs. depending on type and process; also varies over normal temperature range of 38°C to 93°C / 100°F to 200°F. Chocolate viscosity is often expressed in degrees MacMichael. This is a standard viscosity unit of measure in the chocolate industry.
Remarks: Chocolate is made from cacao beans. The beans are roasted, ground up, and mixed with oils to get a semi-liquid which is the beginning point in the making of chocolate. Chocolate in the early stages of processing is known as bitter chocolate. Bitter chocolate to which sugar has been added is known as sweet chocolate (the sugar in sweet chocolate can carbonize to form abrasives in close running pump parts). Sweet chocolate to which milk has been added is known as milk chocolate. Chocolate that has been thinned down for spraying foods is known as chocolate liquor. Chocolate can be diluted with vegetable fats such as palm nut or coconut oils.
Pump Notes: Cast iron pumps are normally satisfactory but stainless steel may also be used. The handling of chocolate with positive displacement pumps can involve a number of challenges. Provide complete application details to individual manufacturers for recommendations.

CHOLINE CHLORIDE
Formula: (CH3)3N(C1)CH2OH
Viscosity: Water-thin
Remarks: White crystals with a salty, bitter taste and fishy odor. Soluble in water and alcohol; insoluble in ether, benzene and carbon disulfide; extremely hygroscopic. Used in medicine, nutrition, and as an animal feed supplement.
Pump Notes: Cast iron construction is satisfactory for concentrations up to 75%. Buna n elastomers are recommended. Mechanical shaft seal is recommended.

CLAY COATINGS - See Paper Coatings

COAL TAR
Viscosity: Highly viscous or semi-solid at ambient temperatures. Normal pumping temperature ranges from 66°C to 260°C / 150°F to 500°F with viscosities ranging from 40 cPs. to several thousand cPs.
Remarks: A black, semi-solid material, heavier than water, obtained in the destructive distillation of coal. Sp. Gr. 1.2. Soluble in ether, benzene, carbon disulfide; slightly soluble in water. A major raw material for a variety of dyes, drugs and other organic chemicals. Coal tar or its fractions can also be used for waterproofing, paints, pipe coating, roofing, insulation, pesticides and in medicine.
Pump Notes: Cast iron construction is satisfactory. Pump jacketing features are recommended to keep the product liquid especially at start up.

COAL-TAR PITCH
Viscosity: Solid at ambient temperatures; viscosity depends on the grade and handling temperature.
Remarks: A dark brown residue left after coal tar is redistilled. Coal tar pitch normally constitutes 50-65% of the usual grades of coal tar. Used as a binder for carbon electrodes, as a base for paints and as a plasticizer for elastomers and polymers, extenders, saturants and impregnants. Also used in impregnation of fiber pipe for electrical conduits and drainage, foundry core compounds, briquetting coal, paving and roofing.
Pump Notes: Cast iron construction is satisfactory. Pump jacketing features are recommended to keep the product liquid especially at start up. The product may contain abrasives that would require use of abrasion resistant parts in the pump.

COCOA BUTTER
Other Names: Cacao butter, theobroma oil
Sp. Gr.: 0.86
Viscosity: Variable, depending on how it was put in solution and at what temperature it is being handled. Can range from a few hundred cPs. to several thousand cPs.
Remarks: Yellowish-white, brittle solid with chocolate-like taste and odor m.p. 35°C / 95°F.; insoluble in water; slightly soluble in alcohol; soluble in boiling alcohol. Used in making candies, pharmaceuticals, and soaps.
Pump Notes: Cast iron construction is usually satisfactory but stainless steel may be required. Pump jacketing may be required to keep the product liquid.

COCONUT OIL
Other Names: Coconut palm oil, cocoanut oil; coconut butter
Sp. Gr.: 0.92
Viscosity: In the range of 22-110 cPs., depending on temperature.
Remarks: White, semi-solid lard-like fat; characteristic odor. Soluble in alcohol, ether and carbon disulfide, m.p. from 20-28°C / 68°F-82°F. Used in soaps; in foodstuffs; cosmetics; candles; emulsions; alkyd resins; lubricating greases; synthetic detergents; as a butter substitute and as a source of glycerin and fatty acids.
Pump Notes: Cast iron construction is usually satisfactory but stainless steel may be specified as well. Buna n elastomers are recommended.

COD-LIVER OIL
Other Names: Morrhua oil
Sp. Gr.: 0.92
Viscosity: Approximately 110 cPs.
Remarks: Pale yellow, liquid, non-drying oil; slightly fishy odor and taste. Soluble in ether, ethyl acetate and carbon disulfide. Used in medicine for its vitamin A and D content and in leather dressing.
Pump Notes: Cast iron construction is satisfactory but user needs may dictate stainless steel. Buna n elastomers are recommended.

COLD FAT - See Fats
CONTACT CEMENT
Other Names: Rubber cement
Viscosity: Varies depending on the particular type of contact cement but is normally considered to be quite viscous.
Remarks: Contact cement covers a wide range of materials; some may be emulsions sensitive to shearing; others may be flammable because of their vehicles; still others may be water solutions. Used for wide variety of adhesive-type applications.
Pump Notes: Cast iron or steel construction is satisfactory. Choice of elastomer depends on the particular grade of solvent used.

COOKING OILS, HOT
Oils used for deep fat frying of foods.
Viscosity: Water-thin at normal operating temperatures of 150°C-204°C / 300°F-400°F
Remarks: Hot cooking oils are used primarily for deep fat frying of vegetables and meats. Some cooking oils or fats will become solid at room temperatures; some provision may be necessary to assure melted fat or oil in the pump.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are recommended due to temperature. Some buildup on pump parts from residues in the oil may occur when continuously recirculating oils being used to fry certain kinds of meat.

CORN OIL - See Vegetable Oil
CORN STARCH - See Starch
CORN SYRUP
Other Names: Glucose, starch syrup
Sp. Gr.: Varies, depending on amount of vapor removed, but normally 1.3 to 1.4
Viscosity: Varies, depending on amount of water vapor removed and temperature, but normally from 5,000 cPs. to 22,000 cPs.
Remarks: A thick, syrupy mixture of dextrose, maltose and dextrins with some water. Normally colorless; soluble in water and glycerin. Used in making candy, jelly, and other food products, alcoholic fermentations, pharmaceuticals, and in treating tobacco.
Pump Notes: Cast iron construction is usually satisfactory although stainless steel may also be specified. Buna n elastomers are satisfactory. Corn syrup may be handled at elevated temperature to reduce viscosity; pump jacketing features should be considered if this is the case. Mechanical seals may be used depending on liquid viscosity.

COTTONSEED OIL
Viscosity: 44 to 110 cPs.
Sp. Gr.: 0.92
Remarks: Pale yellowish-brown to black-red, semi-drying oil. Odorless with a bland taste. Soluble in ether, benzene and carbon disulfide; solidifies around 32°C / 90°F. Used in medicine, soap stock, lubricants, glycerol, cosmetic creams; in food as an oleo or butter substitute, and in salad and cooking oils.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are satisfactory.

CREOSOTE
Other Names: Creosote wood-tar; creosote coal-tar, often referred to as creosote. Creosote wood-tar and creosote coal-tar have similar pump application properties and will be combined herein.
Viscosity: Varies, depending on the source, but normally 22 cPs.-66 cPs.
Remarks: Oily liquid with distinctive odor; coal-tar creosote is poisonous. Sp. Gr. of the wood-tar creosote is 1.1. Creosote is used for wood preservatives and as a disinfectant.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are satisfactory. Mechanical seals may be used depending on the grade of creosote.

CRESOL
Other Names: Methyl phenol, hydroxymethylbenzene, also similar to cresylic acid. Commercial cresol is normally a mixture of the ortho, meta and /or para cresols.
Formula: C₆H₅CH₂OH
Sp. Gr.: 1.04
Viscosity: 8 cPs. - 22 cPs.
Remarks: Meta is a yellowish liquid; others are crystals; all are soluble in alcohol and ether; all are hazardous, rapidly absorbed through the skin, and cause severe burns.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are satisfactory; use Teflon® for meta.

CRESYLIC ACID - See Cresol

CRUDE OIL
Viscosity: Varies, depending on oil field source. Can range from 8 cPs. to several thousand cPs.; some crudes have to be heated before they can be easily handled.
Remarks: All crude oils are complex mixtures of paraffin, naphthene and aromatic hydrocarbons with small amounts of aromatic hydrocarbons with small amounts of sulfur. The terms paraffin base crude, asphalt base crude and aromatic base crudes are used to indicate the most prevalent constituents of crudes from various fields. Crude oil is a flammable liquid varying in color from yellow to dark reddish-brown, has a peculiar heavy odor; specific gravity ranges from 0.78 to 0.97; crude is refined to give natural gas, gasoline, naphtha, kerosene, fuel oil, lubricating oil, paraffin wax, road oil, asphalt and coke. Crude oil and some of its fractions are major raw materials for many chemicals.
Pump Notes: Cast iron construction is satisfactory although some crude oils may require use of some stainless steel parts. Elastomer recommendation depends on the particular grade of crude and may range from buna n to Teflon®.
DENATURED ALCOHOL
Ethyl alcohol to which another substance has been added to make it unfit for human consumption, and also to prevent recovery of the alcohol from the mixture. The denaturants do not prevent use of the alcohol in the industry and the arts. Many chemicals have been used as denaturants including acetone, camphor, chloroform, ethyl acetate, gasoline, iodine, kerosene, phenol, pine oil, soaps, and wood alcohol.

Pump Notes: Cast iron construction is usually satisfactory although other construction may be requested by the end user. Teflon® or Kalrez® elastomers are recommended.

DIETHYLENE GLYCOL
Other Names: DEG, dihydroxydiethyl ether
Formula: CH₂OHCH₂OCH₂CH₂OH
Sp. Gr.: 1.1
Viscosity: Thin
Remarks: Clear, colorless, practically odorless, syrupy liquid; non-corrosive; hygroscopic. Miscible with water, ethyl alcohol, acetone, ethylene glycol, with a b.p. of 245°C / 443°F and a f.p. of -8°C / 18°F. It is used as a textile lubricant, a conditioner and softener for casin, gelatin, vulcanizing fibers, book-binding pastes, synthetic resins as a solvent for nitrocellulose, gums, resins, oils, organic compounds, for moistening and softening agent for cork compositions, glues, parchments, paper, tobacco, etc. It also can be used in cosmetics and as an anti-freeze to lower the freezing point of water.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended.

DIISOCYANATE - See Toluene Diisocyanate

DIMETHYL FORMAMIDE
Other Names: DMF
Formula: HCON(CH₃)₂
Sp. Gr.: 0.95
Viscosity: Thin
Remarks: A water-white liquid, non-corrosive with a b.p. of 153°C / 307°F and a m.p. of -61°C / -78°F; flash point (open cup) 67°C / 153°F. Miscible with water and most organic solvents. Used as a solvent for vinyl resins an dacetylene, solvent for butadiene and some petroleum components, used in dyestuffs and pharmaceuticals.

Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers and standard mechanical shaft seals are recommended.

DIMETHYLKETONE - See Acetone

DIOCTYL PHTHALATE
Other Names: Di(2-ethylhexyl) Phthalate, DOP
Formula: C₈H₁₄[COOC₆H₄CH(C₂H₅)C₄H₈]₂
Sp. Gr.: 0.99
Viscosity: 66-88 cPs.
Remarks: Light colored, odorless liquid; pour point -46°C / -50°F; flash point 220°C / 425°F; vapor pressure nil; insoluble in water; miscible with mineral oil. Used as a plasticizer for many resins and synthetic rubbers, used as a barrier fluid in handling TDI and other foam liquids.

Pump Notes: Cast iron construction is satisfactory. Teflon® and Kalrez® are the best elastomers to use although Viton® is fair. Mechanical shaft seal is recommended.
DIVINYLBENZENE
Other Names: Alkane, detergent alkylate
Formula: C_6H_4(CH:CH_2)_2
Sp. Gr.: 0.93
Viscosity: Thin
Remarks: Water-white liquid easily polymerized; b.p. 200°C / 390°F; used in drying oils, casting resins and polyesters. Liquids is highly reactive; once reaction started, may proceed with violence.
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers and mechanical shaft seals are recommended.

DODECYLBENZENE
Other Names: Alkane, detergent alkylate
Formula: C_{12}H_{25}C_6H_5
Sp. Gr.: 0.86
Viscosity: 11 cPs. / 50 SSU
Remarks: Used in making synthetic detergents.
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers and mechanical shaft seals are recommended.

DOP - See Diocetyl Phthalate

DOWTHERM - See Heat Transfer Liquids

EDIBLE OILS
This group of oils may consist of vegetable, peanut, canola, corn, safflower, etc.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers and mechanical shaft seals are usually used.

EMULSIFIER - See Emulsion

EMULSION
A substantially permanent mixture of two or more liquids which do not normally dissolve in each other, but which are held in suspension, one in the other. The suspension is usually stabilized by small amounts of additional substances known as emulsifiers. Typical emulsions are milk, Mayonnaise, liquid petroleum emulsions, asphalt emulsions, etc. Typical emulsifiers are egg yolk, casin, certain proteins, soap, bentonite.
Pump Notes: Construction varies based on the particular emulsion.

ENAMEL
A type of oil-base paint containing binders that form a film on exposure to air. Enamel has an outstanding ability to level off brush marks and to form an especially smooth film. It is usually intended for use as top coats and contains relatively less pigment than paint formulations for priming or surfacing.
Viscosity: Ranges from 22 cPs. to 5,500 cPs., depending on make-up of the enamel.
Pump Notes: Cast iron construction is satisfactory. Elastomers may be Viton® or Teflon® depending on solvents used. Pump construction capable of handling mild abrasives should be considered.

EPOXY RESINS
Epoxy resins are those materials resulting from the reaction of bisphenol-A and epichlorohydrin. They may be either viscous liquids or a clear, brittle solid. To the basic resin many different curing agents, diluents and modifiers can be added, as a result there is a wide range of properties.
Viscosity: Ranges from 1,200 to 22,000 cPs., depending on make-up of the resin and the temperature it is being handled. Normal temperature range for handling epoxies is ambient to 90°C / 200°F.
Remarks: Epoxy resins are used for surface coatings, as adheresives and for laminating to make tanks, pipe and some structural parts, some are cast to make plastic metal-forming tools and dyes; other grades are used for potting and encapsulation of electrical parts. Pumps should be slowed down in keeping with viscosity being handled.
Pump Notes: Cast iron construction is usually satisfactory. EPR or Neoprene elastomers are recommended. A sealless pump design may be used. Mechanical shaft seals and packing have also been used with success.

ETHANOL - See Ethyl Alcohol

ETHANOLAMINE
Other Names: MEA, monoethanolamine, colamine
Formula: HOCH_2CH_2NH_2
Viscosity: 100-200 cPs.
Sp. Gr.: 1.02
Remarks: Colorless, moderately viscous liquid. Ammonia-like odor. Strong base. Chemically active. Miscible with water; soluble in carbon tetrachloride and alcohol. b.p. 170°C / 340°F, freezing point 10°C / 50°F, vapor pressure 0.48 mm @ 20°C / 68°F, flash point (open cup) 93°C / 200°F. Used as a non-ionic detergent in dry cleaning, emulsion paints, polishes and agricultural sprays, used as a chemical intermediate, in pharmaceuticals and as a corrosion inhibitor.
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended as are mechanical shaft seals.

ETHYL ACETATE
Other Names: Acetic ether, acetic ester
Formula: CH_3COOC_2H_5
Sp. Gr.: 0.89
Viscosity: Water-thin
Remarks: Colorless, fragrant, flammable liquid. Soluble in chloroform and alcohol, slightly soluble in water. b.p. 77°C / 170°F, vapor pressure 73 mm @ 20°C / 68°F, freezing point -84°C / -120°F, flash point 4°C / 40°F. Used as a lacquer and plastic solvent, as a general solvent, in flavoring and making perfumes, in pharmaceuticals. Ethyl acetate is flammable.
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended as are mechanical shaft seals.
Liquids List

ETHYL ACRYLATE
Formula: CH₂: CHCOOC₂H₅
Sp. Gr.: 0.92
Viscosity: Thin
Remarks: Colorless liquid, b.p. 99°C / 210°F, m.p. -72°C / -97°F, flash point 10°C / 50°F. Readily polymerized. Used in making polymers, acrylic paints, as a chemical intermediate. Liquid is flammable and the vapor is harmful; may irritate skin and eyes.
Pump Notes: Cast iron construction is satisfactory. Viton® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

ETHYL ALCOHOL
Other Names: Alcohol, grain alcohol, ethanol
Formula: C₂H₅OH
Viscosity: Water thin
Sp. Gr.: 0.82
Remarks: Colorless, volatile liquid. b.p. 78°C / 172°F, freezing point -117°C / -178°F. Soluble in water, methyl alcohol and ether. Vapor pressure 43 mm @ 20°C / 68°F, flash point 14°C / 57°F. Used as a solvent and in the manufacture of dyes, synthetic drugs, synthetic rubber, detergents, cleaning solutions, cosmetics, pharmaceuticals and explosives. Used as an anti-freeze, as a beverage and a rocket fuel. Flammable liquid.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as are mechanical shaft seals.

ETHYL CHLORIDE
Other Names: Chloroethane
Formula: C₂H₃C1
Viscosity: Thin
Sp. Gr.: 1.25
Remarks: Colorless, oily liquid. Will not corrode metals. miscible with most solvents, slightly soluble in water. b.p. 83°C / 180°F, freezing point 35°C / 95°F, flash point 21°C / 70°F. Used in making vinyl chloride; as a solvent for fats, oils, waxes, rubber, various resins, gums; used as a fumigant, in dry-cleaning solvents, in lacquers, paints, varnish and finish removers, as a metal degreaser, in soaps and in wetting or penetrating agents. Ethylene dichloride is flammable.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are recommended as is a mechanical shaft seal.

ETHYLENE GLYCOL
Other Names: Ethylene alcohol, glycol
Formula: CH₂OHCH₂OH
Sp. Gr.: 1.1
Viscosity: 7 to 15 cPs. range; 50-50 mix by weight with water has viscosity of 8 cPs. at 24°C / 75°F
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

ETHYLENE OXIDE
Formula: CH₂ CH₂O
Sp. Gr.: 0.87
Viscosity: Water-thin
Remarks: Colorless liquid; soluble in most organic solvents and miscible with water in all proportions. Explosive limits of vapor in air 3 to 80%, b.p. 11°C / 52°F, flash point (open cup) below -20°C / -4°F. Basic material used in manufacturing several of the glycols, in making acrylonitrile, ethanolamines; used in making detergents; petroleum emulsifiers; also used as a rocket propellant. Ethylene oxide is extremely flammable; vapor is harmful and may cause burns. Spontaneous combustion may take place at or near ambient temperatures.
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended. Due to the explosive nature of this product, double mechanical seals or a sealless design pump should be used.

FATS
Other Names: Animal fat, cold fat, liquid fat, hot fat, lard, hashed fat and ground fat
Viscosity: For liquid fat, hot fat or melted lard, viscosity is water-thin. For hashed fat or ground fat, viscosity is very indefinite, but on the order of 22,000 cPs.
Remarks: Handling fats, both liquid and ground, is most often encountered in packing or food processing plants. Ground pork fat normally presents no problems, but beef fat is much more difficult to handle because of its "dry" nature.
Pump Notes: Cast iron construction is satisfactory. Buna n is satisfactory for ambient temperature applications; Viton® may be required for high temperature applications. Use of a mechanical shaft seal depends on the product pumped. Cold fat applications generally required us of a packed pump.
FATTY ACID
Other Names: Oleic acid, palmitic acid, stearic acid
Viscosity: Several hundred cPs., depending on the specific acid and temperature. Normal temperature range is from ambient to 93°C / 200°F.
Remarks: Fatty acids are used in the making of soaps and synthetic detergents, lubricants, rubber products, cosmetics, waterproofing and as a nutrient. Sp. Gr. 0.84 (typical).
Pump Notes: Cast iron construction is generally acceptable although stainless steel may be required if slight corrosion on cast iron cannot be tolerated. Viton®, Teflon® or Kalrez® elastomers are recommended. Mechanical shaft seal is recommended.

FILTER AID - See Diatomaceous Earth

FISH OIL
Viscosity: 20-70 cPs.
Sp. Gr.: 0.93
Remarks: Fish oils are a by-product of the cannery industry. Are used as nutrients, source of vitamins, in soaps and for leather dressing. Have a characteristic odor.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

FISH SOLUBLES
"Fish Solubles" is residue from canning plants, consisting of fish scales, skin, small bones, other non-useable parts of the fish, non-cannable fish, along with sand or other materials the fish might have had in his stomach at the time of the catch. "Fish Solubles" is shipped as liquid sludge and then stored in closed tanks at the point of use for several years to allow fermentation to take place. The fermentation process increases the nutritive value of the solubles so they are more effective when added to animal feed. As they ferment they become increasingly acidic, making them more difficult to handle corrosive-wise as they age.
Viscosity: Varies from thin to thick, depending on the stage the juices have been concentrated.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are normally acceptable. This product may be abrasive; choice of sealing options and abrasion resistant pump options should be considered based on the product handled.

FLUOROCARBONS - See Freons

FOAM - See Polyurethane Foams

FOOTS
Foots has several definitions, depending upon the industry under consideration. In the bean and seed processing (soy, cottonseed, etc.) it is the fibrous residue material after the beans have been processed and all of the oil completely removed; may include dirt and sand from the harvest fields. In the soap-making industry it is a mixture of soap, oil and impurities that precipitate out when natural fatty oils are refined by treatment with caustic soda. The make-up of "Foots" varies so widely in both industries that a pump recommendation is difficult to make. Some of the bean or seed Foots can build up within a pump, requiring that clean out or flush out features be considered. Foots, basically, are what is left after processing has been done in either industry and as a result, the pump recommendation should be based on each particular installation.

FORMALDEHYDE
Other Names: Oxyethylene, formic aldehyde, methanal, formalin
Formula: HCHO
Sp. Gr.: 1.1 for 37% solution
Viscosity: 37% solution - water-thin
Remarks: Colorless gas; soluble in water, alcohol and ether; polymerizes easily. Is usually handled as an aqueous solution with or without methanol which acts as an inhibitor of the polymerization. Properties of 37% solution (also called formaldehyde or formalin): clear, colorless liquid; pH 3.0. Used in urea and melamine resins, in making phenolic resins, ethylene glycol, fertilizer, dyes and medicine. Also used in emulsifying fluids and as a preservative. Formaldehyde causes irritation of the skin, eyes, nose and throat. Proceed with caution when selecting a pump for handling formaldehyde.
Pump Notes: Cast iron construction may be used on an expendable basis. Percent concentration and end use of product may require other construction. Teflon® and Kalrez® are recommended elastomers with Viton® rated fair. A mechanical shaft seal is recommended.

FORMALIN - See Formaldehyde

FREONS
Other Names: Fluorinated hydrocarbons, fluorocarbons
Formula: Depends on particular Freon
Sp. Gr.: 1.19-1.56
Viscosity: 0.2 to 0.4 cPs.
Remarks: Current use of Freons is limited mostly to refrigeration applications due to concerns of ozone depletion with Freons used as propellants or cleaning agents.
Pump Notes: Cast iron construction is satisfactory. Choice of elastomers depends on the particular Freon used. Mechanical shaft seals or sealless pump designs are recommended.

FRUIT JUICES
Processing fruit juices presents some special problems because the acids contained in fruits are corrosive to many metals. There also can be corrosive action from some of the preservatives used.
Viscosity: Varies from thin to thick, depending on the stage in the process
Remarks: Processing of fruit juices may involve sanitary requirements, possible flushing cycles and handling of many additives and preservatives, as well as the fruit juices. Some viscosity may be involved, depending on the extent to which the juices have been concentrated.
Pump Notes: Pumps designed for sanitary service and constructed of stainless steel are normally required for this application.
Benzene, m.p. -36°C / -32°F, b.p. 162°C / 260°F, flash point (open cup) 65°C / 150°F.

VISCOSITY: Thin

Lubricating oils, solvent for nitrocellulose, cellulose acetate, gums, pharmaceuticals, perfumery, cosmetics, foodstuffs, as a solvent, in printer's ink rolls, as an emulsifying agent, as a solvent, for floor-sweeping compounds, cosmetics, paper work, foods, rubber substitutes, adhesives, cements, photographic film, sizing, plastic compounds, textile and cleaner. Type A gelatin is obtained from acid treated raw materials and type B from alkali treated raw materials. Viscosity: Varies widely, depending on temperature and liquid in which they are in solution. Normally handled in 49° to 71°C / 120° to 160°F range.

Remarks: Gelatin is a colorless, transparent, odorless, tasteless material available in sheets, flakes or powder. It swells up and absorbs five to ten times its weight of water; soluble in hot water, glycerol and acetic acid; insoluble in alcohol and other organic solvents. It is used in making photographic film, sizing, plastic compounds, textile and cleaner. Type A gelatin is obtained from acid treated raw materials, type B from alkali treated raw materials. Gelatin may set up in pump during down times; provision for heating should be considered along with consideration of oversize ports. Pump Notes: Cast iron construction is satisfactory but Viton® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

GLUCOSE - See Corn Syrup

GLUCOSE
Other Names: Glycerol, glycy alcohol

Formula: C₃H₅(OH)₃
Viscosity: Varies from 44 to 1,000 cPs. depending on temperature and concentration

Remarks: Clear, colorless, odorless, syrupy liquid; hygroscopic. m.p. 18°C / 64°F, b.p. 290°C / 554°F; soluble in water and alcohol; insoluble in ether; flash point 177°C / 350°F. Used in alkyd resins, cellophane, explosives, ester gums, pharmaceuticals, perfumery, cosmetics, foodstuffs, as a solvent, in printer's ink rolls, as an emulsifying agent.
in anti-freeze, for paper coatings and finishes, for special soaps, lubricants and softeners and as a hydraulic fluid. Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

GLYCEROL - See Glycerin

GLYCOL - See Ethylene Glycol

GRAPE JUICE - See Fruit Juices

GREASE
Other Names: Lubricating grease, automotive grease, bearing grease, etc. For hot cooking grease see Cooking Oils, Hot.
Viscosity: From 2,100 cPs. to several hundred thousand cPs. There are several different grades of greases running from an NLGI grade of 000 up through grade #6. NLGI is the National Lubricating Grease Institute. The smaller the grade number, the less viscous the grease. The viscosity of grease is often indicated by penetration number as determined by the distance a plumb bob of a known weight will sink into the surface of the grease during a given time period; thus, the higher the penetration number, the softer the grease, e.g., a number 1 grade grease has a penetration range from 310 to 340, while a number 4 grease has a penetration range of 175-205.
Remarks: Lubricating greases are generally mixtures of a mineral oil with one or more metallic soaps; the most common soaps are those of sodium, calcium, barium, aluminum, lead, lithium, potassium and zinc. The texture of grease may be smooth, buttery, ropy, fibrous, spongy or rubbery. Texture does not necessarily indicate the viscosity.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. Shaft packing is normally used although a mechanical shaft seal may be used if viscosity permits. Grease is normally shear thinning so special attention must be paid to pump port sizing and motor sizing for correct horsepower.

HEAT TRANSFER LIQUIDS
Heat transfer liquids are generally made from one of the following: mineral oil, diphenyls, modified terphenyls or polyalkalene glycols. Heat transfer liquid is also known by a variety of trade names such as Dowtherm, Mobiltherm, Therminol, Ucon, etc.
Other Names: Heat transfer oil, HTO
Sp. Gr.: Approximately 1.0 @ pumping temperature; varies with liquid and temperature
Viscosity: Less than 1 cPs. at pumping temperatures
Remarks: Heat transfer liquids are used instead of steam for transferring heat from a source to a point of use such as dies, presses, cooking vessels, processing equipment, etc. Many of them can operate at temperatures up to 315°C / 600°F.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are normally recommended due to heat but Teftlon® or Kalrez® may also be needed. Mechanical shaft seals are recommended. Because of the low viscosity, pump capacity is sometimes less than nominal. To extend the service life, it is recommended that the pumps be run at rated speed or less and that the operating pressure in the system be kept as low as possible. Heat transfer liquid pumps are often critical to the success of an extensive operation, standby pumps should be considered.

HEPTANE
Other Names: Dipropylmethane
Formula: C₆H₁₄
Sp. Gr.: 0.66
Viscosity: 0.4 cPs.
Remarks: Colorless, volatile liquid; highly flammable; b.p. 68°C / 154°F, flash point -22°C / -9°F; soluble in alcohol, acetone and ether; insoluble in water. Used as a solvent, especially as an extraction solvent for vegetable oils, also as a paint diluent and as an alcohol denaturant. Hexane is highly flammable.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as are mechanical shaft seals.

HONEY
Other Names: Bees honey
Viscosity: 1,000-11,000 cPs. depending on how much moisture has been removed and on pumping temperature
Sp. Gr.: Approximately 1.2
Pump Notes: Pump construction depends on requirements of the end user. A pump suited for sanitary service may be specified.

HOT MELT
Hot melt adhesives are those adhesives that do not contain solvents. They bond by being applied as a hot liquid and solidifying as they cool. Hot melts can produce a rapid bond because they bond as soon the heat is removed. Hot melts normally are handled in the temperature range from 149 to 260°C / 300 to 5000F. See discussion on similar materials under Adhesive.
Pump Notes: Pump construction varies from cast iron to stainless steel depending on the corrosive nature of individual adhesives. Elastomers also vary depending on individual adhesives and pumping temperature. Shaft sealing may be packing or special lip seals. Generally, adhesives are very viscous and the pump design must be capable of handling those viscosities. Adhesives may also contain abrasives and the pump design must be capable of handling particulate.

HUMBLETHERM 500 - See Heat Transfer Liquids
HYDRAULIC FLUIDS
Other Names: Fire resistant hydraulic fluids. Among the more common fire resistant hydraulic fluids are those made up of water and glycol with some thickeners and additives, phosphate esters and water in oil emulsions with additives.
Viscosity: Viscosities of the above liquids range from 22 to 110 cPs. at ambient temperatures
Pump Notes: Cast iron construction is satisfactory.
Elastomers vary depending on the particular grade of hydraulic fluid. Hydraulic fluids are normally used at high differential pressures and a pump design capable of those pressures must be used.

HYDRAULIC OILS - Also See Hydraulic Fluids
Viscosity: Normally in the 22 to 66 cPs. range at ambient temperatures
Remarks: There are many brands of hydraulic oils. They are all basically petroleum oils with various additives to enhance specific properties.
Pump Notes: Cast iron construction is satisfactory.
Elastomers vary depending on the particular grade of hydraulic fluid. Hydraulic fluids are normally used at high differential pressures and a pump design capable of those pressures must be used.

HYDROCARBONS
Hydrocarbons are compounds of carbon and hydrogen. Under ordinary conditions some of the hydrocarbons are gases, others are liquids, and still others are solids. Propane, gasoline, kerosene, lubricating oils, Vaseline and paraffin are all hydrocarbons. Other hydrocarbons serve as the raw material for dyes, medicines and other end products.
Paraffin Hydrocarbons - A mixture of some of the solid compounds of this series. Paraffin hydrocarbons satisfy the general formula CnH2n+2. The low carbon compounds of this series, such as methane, ethane, propane and butane, are gases under ordinary conditions. Compounds with 5 to 16 carbon atoms are liquids, and those materials that contain more than 16 carbon atoms are solid at ordinary conditions. Paraffin hydrocarbons are also known as saturated hydrocarbons.
Aromatic Hydrocarbons - Hydrocarbons characterized by a molecular structure with 6 carbon atom rings. The solvents benzene, toluene, xylene, naphthalene, etc., are all typical aromatic hydrocarbons. The compounds of this series are liquids under ordinary conditions.
Olefin Hydrocarbons - Stable organic liquids defined by a molecular structure containing at least one pair of double bonded carbon atoms. Ethylene and propylene are typical examples of olefin hydrocarbons.
Normal Hydrocarbons - These are compounds in which all of the carbon atoms of the molecule are in a single unbranched chain. Typical of this group is normal-hexane.
Branched Chain Hydrocarbons - A compound in which not all of the carbon atoms of the molecule are in a single chain. The simplest is isobutane.

INK - See Printing Ink

INSECTICIDES
A broad term used almost synonymously with fumigants to mean those liquids, sprays or gases used to control harmful insects. These liquids can be highly corrosive, depending on concentration and liquid in the solution. Oftentimes they are highly toxic to plant and animal life.
Pump Notes: Specific recommendations are not possible as there is such a diversity in chemical make up of individual insecticides.

IRON OXIDE SLURRY
Other Names: Ferrous oxide slurry
Viscosity: 22 to 1,648 cPs. depending on concentration, vehicle and additives
Remarks: Iron oxides are used in heavy-duty paint pigments such as used in railway finishes, marine paints and metal primers. They are also used for magnetic tape, polishing compounds, as pigment in rubber products and in grease paints.
Pump Notes: Cast iron construction is satisfactory.
Elastomers depend on the solvents used in the slurry. Iron oxide is very abrasive which necessitates use of a pump suitable for abrasive liquid service.

ISOBUTANE
Other Names: 2-methylpropane, trimethylmethane
Formula: (CH3)2CHCH3
Sp. Gr.: 0.56
Viscosity: 0.1 cPs.
Remarks: A colorless, stable gas that does not react with water and has no corrosive action on metals. It has a b.p. of -12ºC / -10ºF and a flash point -47ºC / -117ºF. It is used in organic synthesis, as a refrigerant, as a fuel and as an aerosol propellant.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

ISOBUTYL ALCOHOL
Other Names: Isopropylcarbinol, isobutanol, 2-methyl-1-propanol
Formula: (CH3)2CHCH2OH
Sp. Gr.: 0.81
Viscosity: Thin
Sp. Gr.: 0.81.
Remarks: There are many brands of hydraulic oils. They are all basically petroleum oils with various additives to enhance specific properties.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

ISOCYANATE - See Toluene Diisocyanate

ISOPROPANOL - See Isopropyl Alcohol

ISOPROPYL ACETATE
Formula: CH3COOCH(CH3)2
Sp. Gr.: 0.87
Viscosity: 0.5 cPs.
Remarks: Colorless, aromatic liquid. Stable, with a b.p. of 89ºC / 192ºF, and miscible with most of the common organic solvents. It is used as a solvent for nitrocellulose, fats, oils, waxes, gums, natural and synthetic resins, as well as in making artificial leather, dopes, films, lacquers, plastics and synthetic perfumes.
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.
**Liquids List**

**ISOPROPYL ALCOHOL**
Other Names: IPA, dimethylcarbinol, isopropanol
Formula: \((\text{CH}_3\text{)}_2\text{CHOH}\)
Sp. Gr.: 0.80
Viscosity: Thin
Remarks: Colorless, clear, mobile liquid; flammable, b.p. 82°C / 180°F, vapor pressure 33 mm Hg at 20°C / 68°F, flash point 22°C / 72°F; soluble in water and ether. Used for making acetone; used as a solvent for oils, gums, resins; used as a deicing agent for liquid fuels; used in pharmaceuticals, perfumes, lacquers, as a preservative, antifreeze and rocket fuel. Isopropyl alcohol is flammable.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

**ISOTRON**
Trade name for a line of fluorinated hydrocarbons made by Pennsalt Chemical Corporation. They have numbers and properties similar to Freons, q.v.

**JET FUELS**
Jet fuels are petroleum products similar to kerosene used in jet engines. The most common jet fuels now in use are:
- **JP-4** - Widely used fuel made up of approximately 65% gasoline and 35% light petroleum distillate.
- **JP-5** - A highly refined kerosene having a flash point of 60°C / 140°F. And a freezing point of -40°C / -40°F. Used by carrier based aircraft.
- **JP-6** - A higher kerosene cut than JP-4 with less impurities; used in advanced engines. Commercial jets use ASTM type A, A-1, or B. A and A-1 are kerosene types. Type B is a gasoline-kerosene type similar to JP-4.
  - Viscosity: 1.5 to 6 cPs.
  - Pump Notes: Cast iron construction is satisfactory. Buna n or Viton® are recommended depending on the particular grade.

**KETONE -** See specific Ketone such as Methyl Ethyl Ketone (MEK)

**LACQUER**
A type of solvent-base paint that forms a film by evaporation of the solvent or by congealing from a molten state. The film-forming constituents consist of cellulose esters or ethers especially nitro-cellulose, often in combination with alkyl resins. Typical solvents used are ethyl alcohol, methyl isobutyl ketone, butyl acetate, toluene or xylene. Lacquer is used for coating metals and wood, especially furniture.
  - Viscosity: From 22 to 21,978 cPs. depending on make-up
  - Sp. Gr.: 0.9 to 1.0
  - Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are required. A mechanical seal or sealless design pump may be used depending on viscosity and characteristic of the lacquer.

**LACTIC ACID**
Other Names: Milk acid
Formula: \(\text{CH}_3\text{CHOHCOOH}\)
Sp. Gr.: 1.2
Viscosity: 40 to 100 cPs.
Remarks: Colorless, odorless, hygroscopic, syrupy liquid. b.p. 122°C / 251°F, m.p. 18°C / 64°F; miscible with water, alcohol and glycerin. Used in foods and beverages, as a flavoring and preservative; also used in plastics and textiles.
Pump Notes: Stainless steel is required. Teflon® or Kalrez® elastomers are recommended.

**LANOLIN**
Other Names: Wool fat, hydrous
Viscosity: Widely variable, depending on amount of water
Remarks: A yellowish-white, ointment-like mass incorporating not less than 25% and not more than 30% water. Soluble in ether; insoluble in water; derived from the wool of sheep. Used as an ointment base, in cosmetics; leather dressing as a finishing and softening agent and in rosin soaps. May be mixed with other oils or fatty acids.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. Shaft sealing depends on the viscosity of the product.

**LARD**
Lard melts at from 38º to 43ºC / 100º to 110ºF. It has a very sharp demarcation between solid and liquid. For handling both solid and melted lard, see pump construction recommendations under Fats.
Other Names: Hog fat, fat

**LATEX**
LATEX - A milk-like fluid in which small globules or particles of natural or synthetic rubber or plastic are suspended in water.
Viscosity: Varies; generally in the range from 20 cPs. to 5,500 cPs.
Remarks: Latex is used in paints, in producing special papers, in adhesives, as a bonding age in fibers and to make foam and sponge rubber.
Pump Notes: Construction varies and may range from cast iron to stainless steel. Elastomer recommendation varies as well. Latex is very shear sensitive; pump and shaft sealing selection are critical.

**LEAD**
Chemical Symbol: Pb
Sp. Gr.: 11.3
Viscosity: Unknown, but relatively thin
Remarks: Lead melts at about 329ºC / 625ºF. It must be handled at this or somewhat higher temperatures. Molten lead is used in molding many of the end products made from lead, such as storage battery plates, bearings, pipes, etc. Remember to take into account the specific gravity of the lead when making pressure calculations.
Pump Notes: Cast iron construction is satisfactory. Pumps are usually submerged in molten lead to avoid sealing problems.

**LECITHIN**
Viscosity: Varies widely over the range from 1,100 cPs. to 11,000 cPs. depending on make-up and temperature
Sp. Gr.: 1.0 to 1.2
Remarks: Lecithin is a mixture of acetone-insoluble phosphatides and triglycerides, fatty acids and carbohydrates. It is derived usually from soybean oil, but may be obtained from corn, other vegetable seeds and egg
yolks. In the commercial form it is a light brown, viscous semi-liquid with a characteristic odor, is insoluble in acetone, partly soluble in water and soluble in chloroform and benzene. It is used as emulsifying, dispersing, wetting and penetrating agent; also in margarine, chocolate and candies, animal feeds, paints, printing ink, soaps and cosmetics, blending agent in oils and resins.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal can be used depending on liquid viscosity.

LEMON JUICE - See Fruit Juices

LINSEED OIL
Other Names: Flaxseed oil
Viscosity: Ranges from 200 to 1600 cPs, in its raw or refined state. Blown or boiled linseed oil may have viscosities of 11,000 cPs. or higher.
Sp. Gr.: 0.95
Remarks: Linseed oil is a golden-yellow or brown oil with bland taste; thickens and hardens on exposure to air; it is a typical drying oil used on paints. Soluble in ether, chloroform, carbon disulfide and turpentine. Used in making paints, varnishes, linoleum and oil cloth, printing inks, synthetic resins, caulking, soap and pharmaceuticals.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal may be used depending on liquid viscosity.

LINSEED OIL, BLOWN
Linseed oil which is bodied, i.e., its viscosity is increased by having air bubbled through it while heated to 125ºC / 257ºF. The resulting product dries to a harder film and is used largely in interior paints and enamels. Pump construction recommendations are the same as for linseed oil for the high viscosities.

LINSEED OIL, BOILED
This term is a misnomer since the oil is not boiled. Small amounts of manganese, lead or cobalt are added to hot linseed oil. They serve to accelerate the drying of the oil. Pump construction recommendations are the same as for linseed oil for the high viscosities.

LIQUID FEED
Other Names: Cattle feed solution, liquid cattle feed, liquid supplement; also known by such trade names as Morea, Beef Shake, Mol-Mix, CLS, etc.
Viscosity: Varies from 20 cPs. to several thousand at ambient temperatures. May go to 11,000 cPs. or more at sub-zero temperatures, depending on make-up of particular liquid feed.
Sp. Gr.: 1.1 to 1.3
Remarks: Liquid feed is normally made up of molasses, urea and a variety of additives such as trace minerals, vitamins, phosphorus, etc.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are generally acceptable. A mechanical shaft seal may be used depending on liquid viscosity.

LIQUID STICK
Liquid stick is the product left after the water vapor is removed from the juices of cooked meats. It is primarily protein and is a highly viscous, sticky semi-liquid, difficult to pump. It is normally handled in a temperature range of 82°C / 180°F. Liquid stick is a by-product of packing plants.

LIQUEFIED PETROLEUM GAS - See LP-Gas

LP-GAS
Other Names: Liquefied hydrocarbon gas, liquefied petroleum gas; propane is the best known LP-Gas
Formula Propane: C3H8
Sp. Gr. Propane: 0.51
Viscosity:.1 cPs.
Remarks: LP-Gas is a compressed or liquefied gas obtained as a by-product in petroleum refining or natural gasoline manufacture. Propane is a colorless gas, has no corrosive action on metals, boils at -42ºC / -44ºF. It is used primarily for a domestic fuel, an industrial fuel, motor fuel and in chemical synthesis.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal is required due to the hazardous nature of this liquid.

LUBRICATING GREASE - See Grease

LUBRICATING OIL
Other Names: Lube oil
Viscosity: Ranges widely, depending on the grade or number of oil
Sp. Gr.: 0.90
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal is normally used.

LYE - See Sodium Hydroxide

MAPP GAS
Other Names: Methylacetylene Propadiene, stabilized
Sp. Gr.: 0.58 @ 16ºC / 60ºF
Vapor Pressure: 94 PSIG @ 21ºC / 70ºF
Viscosity: 0.1 to 0.2 cPs.
Remarks: MAPP Gas is an industrial fuel gas produced by Dow and distributed by Air Reduction Company. It is used as a replacement for acetylene, natural gas and propane in the metal cutting industry.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are recommended. A mechanical shaft seal is required due to the hazardous nature of this liquid.

MAYONNAISE
Other Names: Salad dressing
Viscosity: Appears very viscous but is shear thinning.
Remarks: Mayonnaise is a thick sauce of egg yolk beaten up with additions of edible vegetable oil, vinegar, salt and water. At some stages in production mayonnaise may change state if sheared excessively.
Pump Notes: Stainless steel construction is satisfactory. Buna n elastomers are recommended. A designed for shear sensitive liquids must be used.
MEAT EMULSION
Finely ground meat used for wieners, bologna, sausage, etc. Viscosity is very thick and extremely difficult to measure.
Pump Notes: Stainless steel construction is recommended due to sanitary requirements. Buna n elastomers are recommended. Meat emulsion is difficult to handle. Use a pump designed for this service.

MELAMINE RESINS
Viscosity: 200 to 1000 cPs.
Melamine resins are made from melamine and formaldehyde. They are widely used as molding compounds with cellulose, wood-flour or mineral powders as fillers; they may incorporate coloring materials. Also used for laminating, boil proof adhesives, for increasing wet strength of paper, and for textile treatment to achieve crease and wrinkle resistance. By varying percentages of the main constituents, and by the use of additives, resins with many different properties can be made. Butylated melamine resins and melamine-acrylic resins are examples of these variations. Melamine resins have high retention of color and luster at high temperatures and have fast curing rates at relatively low temperatures.
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended. Consider use of a mechanical shaft seal or sealless design pump.

MERCAPTANS
Viscosity: Thin
A group of organic compounds similar to alcohol but having some of the oxygen replaced by sulfur. There are several kinds of mercaptans such as ethyl, lauryl, etc. They have a strong, disagreeable odor; are frequently used for the "stench" in LP-Gas or natural gas.
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

METHANOL
Other Names: Methyl alcohol, wood alcohol
Formula: CH3OH
Sp. Gr.: 0.97
Viscosity: Thin
Remarks: Colorless, non-corrosive, liquefiable gas, non-irritant but poisonous; b.p. -24ºC / -11ºF, m.p. -98ºC / -144ºF, flash point below 0ºC / 32ºF. Soluble in alcohol, benzene and carbontetrachloride. Used in making silicones, as a refrigerant, in medicine, as a fluid in thermometers, as a low temperature solvent, as a propellant in high pressure aerosols and as a pesticide. Flammable liquid. Vapor harmful. Corrosive in presence of water.
Pump Notes: Do not use a pump with any aluminum parts. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

METHYLENE CHLORIDE
Other Names: Chloromethane
Formula: CH2C12
Sp. Gr.: 1.3
Viscosity: .4 cPs.
Remarks: Colorless, volatile liquid. Poisonous when inhaled. Soluble in alcohol and ether, m.p. -97ºC / -142ºF, b.p. 40ºC / 104ºF. Used as a component of paint removers, as a fumigant, solvent for alkoids, crude rubbers, oils, resins, waxes, in textile and leather coatings, refrigeration, local anesthetic, for the extraction of oils, fats, perfumes, flavors and drugs, as a propellant for aerosol and a blowing agent in foam. Avoid prolonged or repeated contact with skin or breathing of vapor. Corrosive in presence of water.
Pump Notes: Do not use a pump with any aluminum parts. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

METHYL ETHYL KETONE
Other Names: Ethyl methyl ketone, 2-butanone, MEK
Formula: CH3COC2H5
Sp. Gr.: 0.82
Vapor Pressure: Approximately 90mm Hg. absolute at 21ºC / 70ºF
Viscosity: 0.4 cPs. / 2.22 SSU
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

METHYL ALCOHOL - See Methanol
METHYLBENZENE - See Toluene
METHYL CHLORIDE - See Chloromethane

MINERAL OIL - Also see Lubricating Oils
Any liquid product of petroleum within the viscosity range of liquids commonly called oils. Mineral oil is also the official title for a grade of petrolatum, q.v.
Viscosity: From 20 to 1000 cPs.
Sp. Gr.: 0.8 to 0.9
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.
Liquids List

MINERAL SPIRITS - See Naphtha, Painter's

MOBILTERM - See Heat Transfer Liquids

MOLASSES
Other Names: Beet molasses, cane molasses
Viscosity: From a few hundred cPs. 22,000 cPs.
Remarks: In the raw cane sugar industry in the United States, molasses is defined as the syrupy mother liquor which is left after the sucrose has been removed from the cane juice by concentration. If only one crop of crystals had been removed, the mother liquor is called FIRST MOLASSES. If the second crop has been removed after concentration, the product is termed SECOND MOLASSES and so on. The final mother liquor from which no more cane sugar can be extracted is called Final Molasses.
Black Strap Molasses. Molasses is used as an animal feed, in food for human consumption, as a raw material for Butanol and acetone; it is also mixed with urea to make an animal feed called "liquid feed." Viscosity of liquid feed is generally quite low with respect to most grades of molasses.

Pump Notes: Cast iron construction is satisfactory but stainless steel may also be specified because of sanitary reasons. Buna n elastomers are usually recommended. Pumps are normally furnished with shaft packing.

MONOETHANOLAMINE - See Ethanolamine

MONOMER
A compound usually containing carbon and of simple structure which is capable of conversion to polymers, synthetic resins or elastomers by combination with itself or similar molecules or compounds. Styrene is the monomer from which polystyrene resins are produced; vinyl chloride and vinyl acetate are the monomers from which "Vinylite" resins are obtained. Styrene and butadiene are the monomers from which SBR synthetic rubber is obtained.

Pump Notes: Since monomer is a general term, there is no construction that generally applies.

MORPHOLINE
Formula: C₄H₈ONH
Sp. Gr.: 1.0
Viscosity: 4 cPs.
Remarks: Colorless, mobile, hygroscopic liquid. A mild base. Miscible with water. Soluble in alcohol and ether, b.p. 129°C / 264°F, m.p. -5°C / 23°F, vapor pressure 6.6 mm @ 20°C / 68°F, flash point (open cup) 38°C / 100°F. Used as a solvent for dyes, resins and waxes, as an emulsifying agent, to make water resistant adhesives and polishes and as a corrosion inhibitor.

Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended as a mechanical shaft seal.

MUSTARD
Viscosity: Depends on the mix. Estimated 5,500 cPs.
Remarks: Mustard is the yellow powder of the mustard seed mixed with a liquid for use as a condiment.

Pump Notes: Stainless steel construction is satisfactory. Buna n elastomers are recommended.

NAPHTHA
The term is usually applied to a narrow-boiling-range fraction of petroleum with volatility somewhere between that of gasoline and kerosene. There are many different types, some of which are listed below.

PETROLEUM NAPHTHA
A general term applied to refined or partially refined petroleum products and liquid products of natural gas which are distilled off in the temperature range of 177-238°C / 350-460°F.

PAINTER'S NAPHTHA
Also called naphtha, V.M. & P. - varnish makers' & painters', varnish makers' naphtha, petroleum spirits, petroleum thinner, mineral spirits, turpentine substitute, mineral thinner, mineral turpentine. Any of a number of narrow-boiling-range fractions of petroleum with boiling points of about 93-204°C / 200-400°F according to the specific use.

SOLVENT NAPHTHA
A term applied to aromatic solvents derived from coal tar. Information below applies to all naphthas listed.

Viscosity: Water thin
Remarks: Naphthas are used primarily as solvents for a variety of applications such as thinning paints and varnishes, as a source for certain petro chemicals.

Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are recommended as is a mechanical shaft seal.

NAPHTHALENE
Other Names: Tar camphor
Formula: C₁₀H₈
Sp. Gr.: 1.14
Viscosity: 0.8 cPs.
Remarks: White crystalline, volatile flakes; strong coal-tar odor; soluble in benzene; m.p. 80°C, b.p. 218°C, flash point 176°F. Used as a moth repellent, fungicide, cutting fluid, lubricant in synthetic resins, as a preservative, solvent and for textile chemicals. May be some tendency for crystals to form.

Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are recommended. A mechanical shaft seal may be used but should include proper circulation for any crystals formed.

OIL - See specific oil, such as Lubricating Oil, Fuel Oil, etc.

OLEIC ACID - See Fatty Acid

OLIVE OIL - See Vegetable Oil

ORANGE JUICE - See Fruit Juice

ORGANIC SOLVENTS - See Solvents

ORTHOPHOSPHORIC ACID - See Phosphoric Acid
Liquids List

PAINT
Other Names: Many names are used to describe various types of paints or liquids used in various stages of the making of paints, e.g., primer, abrasive paint, hot bituminous paint, latex paint, water soluble, non-abrasive, Flocoat, paint paste, paint base, alkyd base, epoxy paint, acrylic paint, etc., etc.
Paint is a liquid mixture which can be applied to surfaces to form a dry, thin, protective or decorative film. Paint is composed of a solid (pigment) and a liquid vehicle. The vehicle consists of a binder which forms a film and usually a volatile solvent to improve the ease of application. Paints may be either water-base or oil-base. Oil-base paints have as the thinner organic liquids such as turpentine, naphtha, benzene, acetone or an alcohol.
Some paint binders form film by oxidation or polymerization. Examples of these are drying oils and phenolic or melamine resins. Other binders form films by evaporation of the thinner. Still other binders form a film when particles coagulate from a latex or dispersion of synthetic rubbers.
Paints also contain small amounts of plasticizers, driers, extenders, emulsifiers, stabilizers, etc.
Viscosity: Varies from 20 cPs. to 5,500 cPs. normally, with some of the paste-like materials going much higher
Remarks: Paints are used, in addition to the normally accepted applications of protective and decorative coatings, for such things as imparting resistance to corrosion, fire or mildew and fungus growth, providing electrical insulation, reduction of frictional resistance, etc.
Pumps are used for handling paints and their constituents at all stages of production. Pumps are used in feeding liquid to and taking it from sand grinders in preparation of the pigments, in the mixing and blending of the various paints when they are being compounded, for circulating, transferring and delivering directly to the point of application, such as a spray head or a striper.
Some paints are shear sensitive; the latex and emulsion type should be handled cautiously, particularly if they are recirculated. Many pumping systems are flushed when colors are changed or at the end of a run, so provision should be made for handling a thin solvent as well as for the paint itself.
Pump Notes: Cast iron construction is usually satisfactory but stainless steel may be required depending on the paint handled. Elastomer recommendations depend on the solvent used. Many paints or paint constituents are abrasive and must be handled with a pump designed to handle abrasives.

PALMITIC ACID - See Fatty Acid

PAPER COATING
Paper coating is basically a starch slurry with a high percentage (up to 70%) of finely ground clay mixed in. Some paper coatings may also include small amounts of other materials such as titanium dioxide (extremely abrasive), methyl ethyl ketone, latex, toluene and alcohol.
Viscosity: In the 20,000 cPs. range as measured on normal viscosity testing equipment. Liquid is shear thinning. The estimated viscosity as it passes through the pump is in the range of 2,000 cPs. Use of 2,000 cPs. for determining capacity and horsepower gives reasonable results.
Sp. Gr.: Varies from 1.3 to 1.7
Remarks: Paper coating provides the "slick" surface to paper stock used for magazines. Coating is normally applied by blade coaters.
Pump Notes: Stainless steel construction is frequently used to maintain product color and purity. Buna n elastomers are recommended. Paper coating is abrasive and a mechanical shaft seal and pump design must be selected that are suitable for handling abrasives

PARAFFIN
Other Names: Paraffin wax, paraffin hydrocarbon
Viscosity: Solid at ambient temperatures, almost water-thin when melted (melts above 1200F)
Remarks: White, translucent, waxy, tasteless, odorless solid. Soluble in benzene, warm alcohol, chloroform and olive oil. Insoluble in water and acids. m.p. in the range of 49°C to 65°C / 120°F to 150°F. Used in the manufacture of candles, wax paper, waterproofing wood, impregnating matches, as a lubricant, for preserving eggs, in making crayons, in ointments, preservative coating for food products, phonograph records, floor polishes, cosmetics and in packing tobacco products.
Pump Notes: Cast iron construction is satisfactory. Buna n or Viton® elastomers are recommended depending on temperature. A mechanical shaft seal may be used.

PASTE - See Adhesive

PEANUT BUTTER
Viscosity: Ranges from 2,000 to 22,000 cPs., varying as make-up and temperature. Normal pumping temperature is from 32°C to 82°C / 90°F to 180°F.
Sp. Gr.: 1.1 to 1.2
Remarks: Peanut butter is made by mixing ground up peanuts with various additives and fillers. From the mixer peanut butter is pumped through a deaerator and/or a heat exchanger to remove entrained air and to drop the temperature prior to being pumped to the jar filling machines.
Pump Notes: Cast iron construction is satisfactory but stainless steel may be used because of sanitary requirements. Buna n elastomers are recommended.

PEANUT OIL - See Vegetable Oil

PENTACHLOROPHENOL
Other Names: PCP
Formula: C₇C₅Cl₅OH
Sp. Gr.: 2.0
Viscosity: Thin. Depends on the liquid in which it is in solution.
Remarks: White powder or crystals; soluble in alcohol, acetone, pine oil, benzene. Used as a fungicide, bactericide, herbicide and as a wood preservative. Dust is harmful. Solutions can cause skin irritation.
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.
Liquids List

PENTANE
Other Names: n-Pentane, amyl hydride
Formula: CH₃(CH₂)₃
Sp. Gr.: 0.63
Viscosity: Thin.
Remarks: A colorless, mobile, flammable liquid; freezing point -130°C / -202°F, b.p. 36°C / 97°F. Soluble in hydrocarbons, oils and ether; flash point -49°C / -57°F. It is one of the fractions of petroleum; is used as an anesthetic, for low temperature thermometers, as a solvent in extraction processes, as a general solvent, as a blowing agent in plastics and as a pesticide. Pentane is flammable. Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

PERCHLOROETHYLENE
Other Names: "per", tetrachloroethylene, perk
Formula: C₂Cl₄
Sp. Gr.: 1.6
Viscosity: Thin
Remarks: Colorless liquid, nonflammable, nonexplosive, extremely stable. b.p. 121°C / 250°F, flash point none, miscible with alcohol, ether and oils in all proportions. Used as a dry cleaning solvent, vapor degreasing solvent, drying agent for metals and certain other solids, solvent for rubber, waxes, tar, paraffins, gum. May be corrosive in presence of water.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are recommended as is a mechanical shaft seal.

PERCHLOROMETHANE - See Carbon Tetrachloride

PETROLATUM
Other Names: White mineral oil, paraffin oil-white, Vaseline
Sp. Gr.: 0.85
Viscosity: Grease-like at room temperatures, turns to liquid at 38°C / 100°F; has a viscosity of 22 cPs. at its melting point
Remarks: Soluble in ether, carbon disulfide, benzene.
Derived by distillation of one of the high boiling point petroleum fractions. Used in medicine, cosmetics, dispersants, diluents, plastics manufacture, as a binder in foods, as a defoaming agent, lubricant, as a release agent and as a protective coating.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

PHENOL
Other Names: Carbolic acid, phenyllic acid, benzophenol, hydrobenzene
Formula: C₆H₅OH
Sp. Gr.: 1.07
Viscosity: Phenol melts at 43°C / 110°F. It is thin in the molten state.
Remarks: White, crystalline mass; absorbs water from the air and liquefies, distinctive odor. Poisonous. m.p. 43°C / 110°F, b.p. 182°C / 360°F, flash point 83°C / 182°F. Soluble in alcohol, water, ether, chloroform, glycerol, carbon disulfide, petrolatum. Used in making phenolic resins, epoxy resins (bisphenol-A), in weed killers, as a solvent for lubricating oils, for making a number of acids and pharmaceuticals. Hazardous liquid; rapidly absorbed through the skin, causing severe burns.
Pump Notes: Cast iron construction is generally satisfactory but stainless steel may also be requested. Viton® elastomers are recommended as is a mechanical shaft seal.

PHENOL-FORMALDEHYDE RESINS - See Resins

PHOSPHORIC ACID
Other Names: Ortho phosphoric acid, phosphoric anhydride. Phosphorus pentoxide, formula P2O5, absorbs moisture to form phosphoric acid H3PO4.
Viscosity: At ambient temperatures, viscosity varies from thin at the 50 and 75% strengths to a syrupy liquid at the 85% strength, to crystals at 100% phosphoric acid.
Sp. Gr.: Solid - 1.8
Remarks: Phosphoric acid is a clear, colorless, odorless, sparkling liquid, or a transparent, crystalline solid, depending on the concentration and the temperature. The percent concentration of acid is frequently given as a percentage of P2O5, e.g., 75% phosphoric acid contains 54% P2O5, 58% phosphoric acid contains 42% P2O5. Phosphoric acid is used in making fertilizers, soaps and detergents, in pickling and rust-proofing of metals, in pharmaceuticals, sugar refining, water treatment, animal feeds, waxes and polishes and in foods. CAUTION! Phosphoric acid causes skin irritation. Some phosphoric acids contain impurities which can affect corrosive and abrasive nature of the acid.
Pump Notes: Stainless steel construction is satisfactory. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

PHTHALIC ANHYDRIDE
Formula: C₆H₄(CO)₂O
Sp. Gr.: 1.5
Viscosity: Thin
Remarks: White, crystalline needles; soluble in alcohol; melts at 127°C / 260°F. Used in making alkyd resins, plasticizers, hardener for resins, used in making chlorinated products, insecticides and diethyl and dimethyl phthalate. Phthalic anhydride sets up to a brittle solid when it comes in contact with moisture.
Pump Notes: Cast iron construction is usually satisfactory but other construction may be requested. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

PITCH
Other Names: Coal-tar pitch, hot pitch, tar pitch, roof pitch.
Pitch is a thick, dark-colored bituminous substance obtained either as the result of industrial destructive distillation, or as deposits in the earth. Pitch is usually insoluble in water, miscible with carbon disulfide and benzene; has a "tarry" odor. Pitch can be divided into several groups:
(1) Natural deposits - such as asphalt.
(2) Residues from the distillation of mineral oils.
(3) Residues from the distillation of tars. Typical of this group are coal tar pitch, wood tar pitch, pine tar pitch.
(4) Residues from the distillation of fusible organic substances. Fatty acid pitch is typical of this group.
Liquids List

POLYPROPYLENE GLYCOL
- Similar to Polyethylene Glycol, q.v.

POLYURETHANE FOAM
To make polyurethane foam, a polyether such as polypropylene glycol is treated with a diisocyanate in the presence of water and a catalyst (amines, tin soaps, organic tin compounds), as well as fillers, dispersing and emulsifying agents, etc. Simultaneously with the polymer-forming reactions the water reacts with the isocyanate group to cause cross linking and curing, and also produces carbon dioxide which causes foaming. In some foams, a volatile material such as Freon is incorporated to serve as a blowing agent. Foam is normally made by one of two basic methods, the prepolymer system or the one-shot system. The prepolymer system brings two streams together at the foaming head. Component A is a mixture of a polyol, catalyst, surfactant and blowing agent, while component B is a polyol isocyanate mixture. Both components are quite viscous. The one-shot system brings all components together at the spray head through independent lines from separate supplies. This system requires more equipment and
Precise metering, but once controls are established the uniformity of the foam is much better than with the prepolymer system.

Viscosity: Varies widely from thin for the blowing agents, catalyst and amines to the order of 5,000 for the polyols or resins. Remarks: Flexible foams, made with resins having triols as a basic material, have high strength, good heat insulating properties, and resistance to water, oil, solvents and abrasion. The rigid foams made from polyether containing compounds such as sorbitol, or sucrose, add strength and rigidity to metal framework at little increase in weight.

Foams are used in insulating tresses and upholstery, interlining for clothing and sleeping bags, for soundproofing walls, as an insulation against heat loss, in life preservers, fish net floats, foam rubber applications, packaging and many other areas of use.

Pump Notes: Cast iron construction is normally satisfactory. Elastomer selection varies based on the particular grade of material. A sealless design pump is the pump of choice due to crystallization tendencies of the products pumped.

**POLYVINYL ACETATE**

Other Names: PVAc

Viscosity: Ranges from 1,100 to 11,000 cPs.

Sp. Gr.: 1.2

Remarks: Colorless, odorless, tasteless, non-toxic, transparent, thermoplastic solid. Insoluble in water, oils and fats. Soluble in alcohols, esters, benzene and ketones. Used in latex water paints, in hot melt and other types of adhesives, for coating and finishing fabrics, as a component of lacquers, inks and in caulking compounds and chewing gum.

Pump Notes: Cast iron construction may be satisfactory but stainless steel may also be required. EPR elastomers are generally acceptable. Attention needs to be given to speed and sealing methods with this liquid.

**POLYVINYL ALCOHOL (PVA)**

A water soluble synthetic resin made by hydrolysis of polyvinyl acetate.

Viscosity: Variable, depending on the degree of hydrolysis; ranges from 400 to 40,000 cPs.

Sp. Gr.: 1.2 to 1.3

Remarks: A base material for water-resistant laminating adhesives. Used in adhesives, in binders for leather, cloth and paper, in grease proof paper, as a paper size, as an emulsifying agent, as an emulsion stabilizer and thickener, for temporary protective coatings.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are generally acceptable. A mechanical shaft seal may be used depending on viscosity.

**POTASSIUM HYDROXIDE**

- See Sodium Hydroxide

**PRINTING INK**

A mixture of finely divided pigment such as carbon black suspended in a drying oil such as linseed oil. Synthetic resins are frequently used plus cobalt, manganese and lead soaps are often added to achieve rapid drying by oxidation and polymerization. Mineral oils are also used in certain inks. Some types of ink dry by evaporation of a volatile solvent rather than by oxidation of a drying oil. For colored inks, pigments such as chrome yellows or lithol reds are used.

Viscosity: Varies from a few hundred cPs to 40,000 cPs., depending on the type of ink and temperature

Remarks: Some inks such as carbon paper inks contain wax; these inks and certain other types are often handled at temperatures in the range of 82 to 93°C / 180 to 200°F. Steam jacketed features may be required for handling these inks. Certain inks, depending on the solvent, may be considered flammable.

Pump Notes: Cast iron construction is generally acceptable. Elastomers depend on the solvent used. A mechanical seal suitable for thick and or abrasive type liquids should be used.

**PROPANE**

- See LP-Gas

**PROPYLENE GLYCOL**

Other Names: Methylene glycol, methyl glycol

Formula: CH₃CHOHCH₂OH

Sp. Gr.: 1.04

Viscosity: From 10 to 100 cPs.

Remarks: Colorless, viscous, stable, hygroscopic liquid. Miscible with water, alcohols and many organic solvents. b.p. 187°C / 369°F, vapor pressure 0.07 mm @ 20°C / 68°F, flash point (open cup) 107°C / 225°F. Used in making polyester resins, anti-freeze solutions; used as a solvent for fats, oils, waxes, resins, perfumes. Serves as a hygroscopic agent; lubricant in refrigeration machines, plasticizer, cosmetics, solvent in foods, as a wetting agent, an emulsifier and as an animal feed additive.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

**PVA**

- See Polyvinyl Alcohol

**PVAc**

- See Polyvinyl Acetate

**REFRIGERANTS**

- See Anhydrous Ammonia and Freons

**RESINS**

Resin is an organic, semi-solid or solid material produced by union (through polymerization or condensation) of a large number of molecules of one or two relatively simple compounds. Properties vary widely with the raw materials, their proportions and the conditions of formulation of the resin. Resins are broadly classified as thermoplastic or thermosetting according as they soften or harden with the application of heat.

Listed below are some of the synthetic resins classed by their derivation:

1. Modification of natural polymers, e.g., chlorinated rubber, cellulose acetate, casein and ester gums.
2. Resins formed by polymerization (union of small molecules without formation of water or some other simple molecule as a by-product), e.g., acrylate resins, polystyrene, vinylidene resins, etc.
3. Resins derived by condensation (union of small molecules with the formation of water or some other simple molecule as a by-product), e.g. alkyd resins, q.v., epoxy resins, q.v., phenolic resins, polyurethane resins, urea-formaldehyde resins, q.v., etc.
Liquids List

Shellac is a resin secreted by an insect from the far east. After processing the resin becomes shellac as we know it. Other Names: Lac, garnet lac, gum lac or stick lac
Viscosity: 22 cPs. to several thousand, depending on how much it has been reduced
Remarks: Insoluble in water, soluble in alcohol. Used in paints, stains, varnishes, as a general binder and for making sealing wax.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are usually acceptable.

SILICATE OF SODA - See Sodium Silicate

SILICONE FLUIDS
Viscosity: Commericially available in a range of viscosities from 1 cPs. to several thousand cPs.
Remarks: Silicone fluids are characterized by heat stability, water repellency, good dielectric properties and incompatibility with many organic polymers which makes them effective release agents. Some silicones tend to have low surface tension which means they have little lubricating ability.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are recommended. A mechanical shaft seal or sealless design pump may be used.

SOAP
Other Names: Kettle soap, soap stock, soap skimmings, liquid soap; soap as discussed here is from natural oils and fatty oils as differing from black liquor soap that is a by-product of the paper pulp processing.
Ordinary soap is a mixture of sodium salts of various fatty acids of natural oils and fats. It is made by heating the oils with caustic soda, salting out the soluble soap formed and drawing off the dilute glycerol produced. Common soap is largely a mixture of the sodium salts of palmitic, stearic and oleic acids. Rosin soaps as used for laundry purposes are made by adding a soap made from rosin or rosin itself to an ordinary soap. Castile soaps are made from olive oil.
Transiscent soaps are made from decolorized fats with the addition of glycerol or sugar. Liquid soap is usually a potash soap dissolved in water.
Viscosity: Varies from 40cps to 40,000 cPs. SSU and up depending on type of soap and stage in process. Soap is normally handled anywhere between ambient temperatures and 93°C / 200°F.
Sp. Gr.: 0.9 to 1.0
Pump Notes: Cast iron or stainless steel construction is usually satisfactory depending on the particular soap and stage in process. Teflon® or Kalrez® elastomers are recommended. Mechanical seals may be used but Teflon® packing is also frequently used.

SOAP SKIMMINGS - See Black Liquor Soap

ROOFING TAR - See Tar

ROUSION
Other Names: Gum rosin, colophony, pine resin, wood rosion
Viscosity: Varies from a few hundred cPs. to 20,000 cPs. depending on temperature and/or solvent. Rosins without solvents are often handled in the 204 to 260°C / 400 to 500°F. temperature range.
Sp. Gr.: 1.1
Remarks: Rosin occurs as angular, translucent, amber-colored fragments. M.p. in the 93 to 149°C / 200 to 300°F range; insoluble in water; soluble in alcohol, benzene, ether and oils. It is obtained from pine trees by distillation process. Rosin is used in making linoleum, in making soldering compounds, core oils, insulating compounds, molding compounds, sealing waxes, medicines, in paper sizing, printing inks and varnishes. Rosin is combustible; gives off flammable vapors when heated.
Pump Notes: Cast iron construction is usually satisfactory although stainless steel may also be requested. Elastomer and shaft sealing recommendation depends on the particular rosion and temperature.

RUBBER CEMENT
Viscosity: Varies widely, depending on particular cement.
Can range from 150 to 22,000 cPs. and higher.
Sp. Gr.: 0.6 to 0.9
Remarks: Rubber cement is normally a solution of rubber and a hydrocarbon solvent. Used as a binder to hold materials in position until sewing or clamping is accomplished, as permanent bonds, as vulcanizing seals, in shoe manufacture, as a sound deadener, as an adhesive for paper and for repairing.
Pump Notes: Cast iron construction is usually satisfactory. Elastomer recommendation depends on the solvent used in the cement. Mechanical shaft seals have been used successfully on this product.

SALAD DRESSING - See Mayonnaise

SAUSAGE STUFFING - See Meat Emulsion

SILICATE - See Sodium Silicate

SHORTENING - Similar to Vegetable Oil, q.v.

SHELLAC
Liquids List

SODIUM CHLORIDE BRINES
Other Names: Table salt, sea salt, common salt, rock salt.
Brine is made when the salt is put into solution in water.
Formula: NaCl
Sp. Gr.: 1.1 to 1.2
Viscosity: Brines being solutions in water are normally almost as thin as water.
Remarks: Sodium chloride brine is used for refrigeration purposes in food preservation.
Pump Notes: Cast iron construction is usually acceptable. Avoid use of dissimilar metals in pump construction due to electrolytic action of the salt. Buna n elastomers are recommended as is a mechanical seal.

SODIUM HYDROXIDE
Other Names: Caustic, caustic soda, lye, sodium hydroxide, aqueous
Formula: NaOH
Sp. Gr.: 1.1 for 10% concentration, 1.4 for 50% concentration
Viscosity: From water-thin to 40 cPs. depending on concentration and temperature
Remarks: Sodium hydroxide is a white, crystalline hygroscopic solid. It is soluble in water, alcohol and glycerol. It is used in the manufacture of other chemicals, rayon and film, petroleum refining, pulp and paper, making of aluminum, refining vegetable oil, in detergents, soaps, textile processing, in reclaiming rubber and as an alkali in foods. Causes severe burns to skin and eyes.
Pump Notes: Concentrations up to 50% can usually be handled with cast iron construction. Elastomer recommendation depends on concentration and ranges from buna n to Teflon® or Kalrez®.

SODIUM METASILICATE - Similar to Sodium Silicate.

SODIUM SILICATE
Other Names: Soluble glass, silicate of soda, liquid glass, water glass; similar to Sodium metasilicate
Formula: Na₂O·3·75 SiO₂ to 2Na₂O·SiO₂ with various proportions of water
Viscosity: Varies widely over a range. Normal range is from 100 cPs. to 5,500 cPs. Normally handled at room temperature.
Sp. Gr.: 1.4 to 1.5
Remarks: White powder or clear liquid with widely varying viscosity. Freezing point is slightly lower than that of water. Made by melting sand and soda ash. Used as a catalyst. Also used in making soaps and detergents, adhesives, pigments, water treatment, bleaching and sizing of textiles and paper pulp, as a binder for foundry cores and molds and in waterproofing mortars and cements. Sodium silicate is irritating to the eyes and skin.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal may be used if suitable for the viscosity and potential abrasion but packing is also frequently used.

SOLDER - See construction recommendations under Lead

SOLVENTS
A solvent normally means the liquid used to dissolve a solid or put it into solution. The term is used widely in the paint industry, metal cleaning, degreasing, plastics, etc. Alcohol, naphtha, toluene, ketones are all typical solvents. Many solvents are listed by name in this Liquid List.
Viscosity: Almost all solvents are water-thin

SOYBEAN OIL
Other Names: Soya bean oil, Chinese bean oil, soy oil
Viscosity: From 10 cPs. to several hundred cPs. depending on stage of process and temperature
Remarks: Pale, yellow oil; soluble in alcohol, ether, chloroform and carbon disulfide; m.p. approximately 25°C / 77°F. The oil is obtained from soybeans that are crushed, heated with steam and pressed, or by solvent extraction. Soybean oil is used in making soaps, as a food, in making inks, as a substitute for linseed oil in paints and varnishes, as a cattle feed, a butter substitute, in salad dressings, in resins, linoleum and in the manufacture of glue.
Soybean feet are sometimes encountered in soybean oil processing. See Foots.
Soybean gums are also sometimes handled as a by-product of soybean oil processing. These gums can have viscosities upwards of 20,000 cPs.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

STARCH
Other Names: Hot starch, cooked starch, raw starch, starch slurry. For recommendations on clay and starch mixtures in the paper industry see Paper Coatings.
Formula: (C₆H₁₀O₅)ₓ
Sp. Gr.: 1.5
Viscosity: Varies from a few cPs. to at least 20,000 cPs., depending on type of starch, amount of liquid in the slurry, temperature, etc.
Remarks: Starch is a white, tasteless powder; insoluble in cold water, forms a jelly with hot water. It is derived from corn, arrowroot or potatoes. It is used for making adhesives, for the sizing and finishing of textiles, in foods, in sizing paper, in making explosives, in medicines, face powders, cosmetics, bookbinding, making glucose, malt sugar, caramel and in cattle feeds.
Pump Notes: Construction varies from cast iron to stainless steel. Buna n elastomers are normally acceptable. Starches are generally shear sensitive liquids; the pump design must be capable of handling that type of liquid.

STEARIC ACID - Melts at 71°C / 160°F, viscosity 30 cPs. at 82°C / 180°F. See Fatty Acid for additional information.

STICK - See Liquid Stick

STODDARD SOLVENT - See Solvents

STYRENE
Other Names: Styrene monomer, vinyl benzene, phenylethylene
Formula: C₆H₅CH:CH₂
Sp. Gr.: 0.90
Viscosity: Styrene monomer - thin. If polymerization has taken place, or if the styrene has been mixed with other liquids, viscosity may range up to 100,000 cPs.
Remarks: Styrene is a colorless, oily-like liquid, aromatic odor; freezing point -31°C / -24°F, -b.p. 145°C / 293°F, flash point (open cup) 38°C / 100°F. Insoluble in water,
SULFURIC ACID, CONCENTRATED
Other Names: Hydrogen sulfate, oil of vitriol, battery acid, 660 Baume sulfuric acid (93.2%), 98% sulfuric acid
Formula: H₂SO₄
Sp. Gr.: 1.84
Viscosity: Less than 160 cPs.
Remarks: Sulfuric acid is one of the most important of the heavy chemicals. It is strongly corrosive, dense, oily, colorless to dark brown depending on purity. It is miscible with water in all proportions, but great caution is necessary in mixing due to evolution of much heat that may cause explosive spattering. It is very reactive, dissolves most metals; concentrated acid oxidizes, dehydrates, or sulfonates most organic compounds, often causing charring. Used in making fertilizers, as a source of many chemicals, in petroleum refining, in making paints and pigments, in production of iron and steel, in the manufacture of rayon and cellulose film, in making industrial explosives. Some of the high concentrations are prone to "salt out," which can cause the pump to bind up in the bushing areas. Applicants for handling sludge or spent sulfuric acid should be reviewed with user.
Pump Notes: Because of the corrosive characteristics of this liquid consult the pump manufacturer for specific recommendations.

SUGAR SYRUP
Other Names: Liquid sugar, sugar, beet sugar, cane sugar, sucrose
Formula: C₁₂H₂₂O₁₁
Viscosity: Varies widely depending on specific gravity and temperature, e.g., 21°C / 70°F., 68 Brix syrup has a viscosity of approximately 240 cPs. while 21°C / 70°F. 76 Brix sugar has a viscosity of 1,300.
Remarks: The term sugar syrup or syrup is a very broad one and is applied very generally to a number of sweet tasting carbohydrates. Sugar syrups are used in food, for sweetening, in candy, preserves and jams, in making soap, pharmaceuticals, caramel, as a chemical intermediate for detergents, as an emulsifying agent in such things as plasticizers, resins, explosives, glues and insecticides.
Pump Notes: Construction varies from cast iron to stainless steel depending on user needs. Buna n elastomers are recommended. Mechanical shaft seals are frequently used.

SULFUR
Other Names: Brimstone, flours of sulfur, molten sulfur
Formula: 1 S
Sp. Gr.: 1.8
Viscosity: In the suggested handling range of 121°C / 250°F to 154°C / 310°F, viscosity varies from 9 cPs. to 6 cPs. Above 154°C / 310°F, the viscosity increases rapidly as the temperature increases until at 188°C / 370°F it is almost solid.
Remarks: Sulfur is mined as the pure element in areas of Texas, Louisiana and Sicily. It is also found combined in many ores, petroleum and natural gas. It is used in making sulfuric acid, in the pulp and paper industry, in making carbon disulfide and other chemicals and dyes, for vulcanizing rubber and in medicines. Some sulfur contains abrasive impurities; sulfur should be considered a non-lubricating liquid.

SULFONIC ACID
Sulfonic acid is a very general term which often is applied to a liquid which has been sulfonated, i.e., a liquid which has been joined together with the SO₂OH group. This process is called sulfonation. An example of this is the conversion of benzene (C₆H₆) into benzene sulfonic acid (C₆H₅HSO₃). Common sulfonating agents are concentrated sulfuric acid, fuming sulfuric acid, sulfur trioxide and other sulfur-containing liquids. Generally sulfonic acid will be rather active corrosion-wise.
Pump Notes: Construction varies from cast iron to stainless steel depending on the liquid. Teflon® or Kalrez® are elastomers are normally used.

TALL OIL
Other Names: Tallol, liquid rosin
Viscosity: Varies widely, depending on source of tall oil and stage in process. Can vary from 220 to 560 cPs. Generally handled in the temperature range from ambient to 93°C / 200°F.
Remarks: Tall oil is the oily mixture of rosin acids, fatty acids and other materials obtained by acid treatment of the alkaline liquors from the digesting of pine wood. The spent black liquor from the pulping process is concentrated until the sodium salts of the various acids separate out and are skimmed off. These soaps are acidified by sulfuric acid to obtain the crude tall oil. Used in drying oils, alkyd resins, linoleum, soaps, cutting oils, emulsifiers, flotation agents, lubricants and greases, and in making rubber. Suggest checking with user or supplier of material to make sure materials of construction recommended for the pump are in keeping with materials in the rest of the system.
Pump Notes: Cast iron construction is satisfactory. Elastomer recommendation varies with specific product.
Liquids List

TAR
Tar is a dark-colored bituminous substance, liquid or semi-liquid at ambient temperatures, obtained by the destructive distillation of coal, wood, peat, or other carbonaceous or vegetable materials. On further distillation, it forms a pitch. The composition and origin of tar varies widely.
Other Names: Roofing tar; often called, although perhaps incorrectly, asphalt, or pitch
Viscosity: Solid or semi-solid at room temperatures; 100 cPs. to 500 cPs. at normal pumping temperature range of 204°C / 400°F to 315°C / 600°F
Remarks: Tar is often a residue remaining after the processing of basic materials; as a result, it frequently contains a variety of materials and liquids which makes one single pump construction recommendation impractical. Tar is used oftentimes for such things as coating roofs, coating cast iron pipe or gas transmission lines, etc.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are normally recommended due to temperature. A mechanical shaft seal can be used but packing or submerging the pump in the liquid is more common sealing solutions.

TDI - See Toluene Diisocyanate

TETRACHLOROETHYLENE - See Perchloroethylene

TETRAHYDROFURAN
Other Names: THF
Formula: C₄H₈O
Sp. Gr.: 0.89
Viscosity: Thin
Pump Notes: Cast iron construction is satisfactory. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

THERMINOL - See Heat Transfer Liquids

TITANIUM DIOXIDE
Handled as a slurry. It is extremely abrasive.
Formula: TiO₂
Sp. Gr.: 3.8
Viscosity: Varies, depending on the type of slurry being handled from 22 to 2,200 cPs.
Remarks: Titanium dioxide is used as a paint pigment, in paper coating, making floor coverings; also in printing inks.
Pump Notes: Cast iron construction is satisfactory. Elastomer recommendation depends on the solvent used. The pump design needs to be capable of handling abrasives.

TOLUENE
Other Names: Toluol, methylbenzene, phenylmethane
Formula: C₇H₈
Sp. Gr.: 0.87
Vapor Pressure: Approximately 30mm Hg. absolute at 70°F
Viscosity: Thin, 1 cPs.
Remarks: Colorless, flammable liquid. B.p. 111°C / 232°F, flash point 4°C / 40°F. Soluble in alcohol, benzene and ether; insoluble in water. Used in blending aviation gasoline, as a raw material for benzene phenol, as a solvent for paints, coatings, gums, resins and rubber cement. Used for making chemicals, in medicines, dyes, perfumes and as a source of toluene diisocyanates used in polyurethane resins. Flammable; vapor is harmful.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are usually acceptable. A mechanical shaft seal or sealless pump design may be used.

TOLUENE DIISOCYANATE
Other Names: TDI, toluene-2,4-isocyanate; commercial grades are often mixtures of the 2,4- isomer and the 2,6-isomer
Formula: CH₃C₆H₄ (NCO)₂
Sp. Gr.: 1.2
Viscosity: Variable depending on mixture of isomers but normally in the range of 7 to 165 cPs.
Remarks: Water-white to pale yellow liquid with a sharp, pungent odor; b.p. 250°C / 418°F, flash point 132°C / 270°F, m.p. (pure) 20°C / 68°F, vapor pressure 0.01 mm @ 20°C / 68°F; soluble in ether, acetone and other organic solvents. Used in making polyurethane foams q.v., elastomers and resins. Irritating to eyes and nose; causes burns.
Pump Notes: Cast iron construction is usually acceptable. Viton®, Teflon® or Kalrez® elastomers are recommended. TDI is normally handled with a sealless design pump.

TOLUOL - See Toluene

TRANSFORMER OIL
Any refined petroleum oil suitable for use in surrounding the coils of transformers to provide electrical insulating and to conduct heat.
Viscosity: 10 to 22 cPs.
Remarks: Transformer oil is highly refined to keep oxidation, moisture, acid, soap, salts and suspended matter to a minimum. Some applications may involve a high vacuum if equipment is being used to remove vapor from the transformer oil.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

TRICHLOROETHANE
Other Names: 1.1, 1-trichloroethane; methyl chloroform
Formula: CH₃CCl₃
Viscosity: Thin
Remarks: Colorless liquid. b.p. 75°C / 167°F; insoluble in water, soluble in alcohol and ether. Used in medicine; as a pesticide; as a general solvent for fats, oils, waxes, resins, and cutting oil compounds; as a coolant and lubricant.
Pump Notes: Cast iron construction is satisfactory. Teflon®, Kalrez® or Viton® elastomers provide acceptable results.
TRIETHYLENE GLYCOL
Other Names: TEG
Formula: HO(C₂H₄O)₃H
Sp. Gr.: 1.12
Viscosity: 25 to 65 cPs.
Remarks: Colorless, hygroscopic, odorless liquid. Soluble in water. Used as a solvent for nitrocellulose, for various gums and resins, in making lacquers and as a textile conditioner.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

TRICHLORETHYLENE
Formula: CHCl·CCl₂
Other Names: VC, chloroethene, chloroethylene
Sp. Gr.: 0.91
Viscosity: Thin
Remarks: Colorless liquid, stabilized with inhibitors. B.p. 73°C / 163°F, flash point (open cup) -1°C / 30°F. Soluble in most organic solvents. Insoluble in water. Used in making polivinyl acetate, polyvinyl alcohol and polyvinyl chloride-acetate resins. These materials are used particularly in latex paints, adhesives and textile finishing. Vinyl acetate is extremely flammable.
Pump Notes: Cast iron construction is satisfactory although other construction may be requested by the end user. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

VARNISH
An unpigmented, oil-base paint composed of a solvent and one of two types of binders. One type of binder is made up of drying oils alone or in combination with resins which form a film by oxidation or polymerization. The second type of binder is that which forms a film by evaporation of the solvent; typical of this type is shellac or alkyd and phenolic resin varnishes.
Viscosity: Varies from several cPs. to several thousand cPs. depending on type, proportions and temperature.
Remarks: Varnish is used primarily for a protective coating, particularly of such items as furniture, woodwork and the like.
Pump Notes: Cast iron construction is satisfactory. Elastomer recommendation depends on the solvent used. A mechanical shaft seal or sealless design pump may be used.

VEGETABLE OIL
Other Names: Shortening edible oil; also may be identified by specific name such as corn oil, or cottonseed oil, etc.
Viscosity: Varies from 11 cPs. to 110 cPs., depending on specific oil and temperature
Sp. Gr.: 0.9 to 1.0
Remarks: Vegetable oils are an important class of oils obtained from plants and used industrially as drying oils, for lubricants, in cutting oils, for dressing leather and many other purposes. The edible oils are used in such things as salad oils, shortenings, margarine, etc.
Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

VINYL ACETATE
Other Names: Polyvinyl acetate, polyvinyl alcohol and polyvinyl chloride-acetate resins. These materials are used particularly in latex paints, adhesives and textile finishing. Vinyl acetate is extremely flammable.
Pump Notes: Cast iron construction is satisfactory although other construction may be requested by the end user. Teflon® or Kalrez® elastomers are recommended as is a mechanical shaft seal.

VEINYL CHLORIDE
Other Names: VC, chloroethene, chloroethylene
Formula: CH₂·CHCl
Sp. Gr.: 0.93
Viscosity: Thin
Remarks: The most important of the vinyl monomers. It is an easily liquefied gas. B.p. -14°C / 7°F, vapor pressure 3.45 BAR / 50 PSI at 20°C / 68°F; flash point -78C / -108°F; slightly soluble in water, soluble in alcohol and ether. Used mainly for making polyvinyl chloride and copolymers. Extremely flammable liquid.
Pump Notes: EPA/OSHA regulations call for special construction. Consult with individual pump manufacturer.
Liquids List

VISCOSE
Other Names: Sometimes referred to as rayon viscose by converting cellulose to the soluble xanthate, which can be spun into fibers and then reconverted to cellulose by treatment with acid. Wood pulp is steeped in caustic soda and then shredded and aged. It is then treated with carbon disulfide of cellulose xanthate. After filtration and deaeration, the remaining solution is known as viscose.
Viscosity: Ranges from 5,500 cPs. to 55,000 cPs. with the most normal range being 5,500 cPs. to 11,000 cPs.
Remarks: Much of the viscose ends up as cellophane or rayon fibers.
Pump Notes: Cast iron construction is satisfactory. Pumps are normally supplied with shaft packing.

WATER GLASS - See Sodium Silicate

WATER
Also further identified by such terms as deionized, demineralized, soft, tap, hard, salt, mine, sea, distilled, hot, bilge, fresh, etc.
Formula: H$_2$O
Sp. Gr.: 1.0
Viscosity: 1 cPs.
Remarks: Water is the most readily available liquid and one of the most difficult to handle, primarily because of its lack of lubrication, corrosive and erosive nature. Adding a small amount of soluble oil or glycol to water changes its properties very materially and makes it much more suitable for handling in a positive displacement pump.
Pump Notes: Construction varies from cast iron to stainless steel. Elastomer recommendation depends on the particular service. Not all pump manufacturers recommends pumps for handling water; check with individual suppliers.

WAX
Waxes are unctuous, fusible, variably viscous to solid substances having a characteristic waxy luster. They are insoluble in water but soluble in most organic solvents. Waxes have a relatively sharp melting point. They have several different origins such as animal wax, e.g., beeswax; vegetable wax, e.g., carnauba, bayberry, etc.; mineral wax, e.g., paraffin and petroleum waxes, etc.; synthetic waxes, e.g., polyethylene glycols, etc.
Other Names: Liquid wax, molten wax, beeswax, paraffin
Viscosity: From water-thin to several thousand cPs. depending on origin and temperature. Many waxes are handled in the temperature range of 93°C / 200°F to 121°C / 250°F.
Sp. Gr.: From 0.80 to 1.0 range
Remarks: Waxes are used as protective coatings for furniture, floors, automobiles and machine tools, in the food preserving process, making paper and the packaging industry, printing inks, cosmetics, candles, waterproofing and in lubricant manufacture.
Pump Notes: Cast iron construction is usually acceptable. Shaft packing is normally supplied. Abrasion resistant materials may be required due to fillers.

WHEY
Other Names: Milk serum
Viscosity: Thin
Remarks: Whey is the liquid remaining after the fat and the casein have been removed from milk. It is essentially a 5% water solution of lactose.
Pump Notes: Stainless steel construction is normally required. Buna n elastomers are recommended as is a mechanical shaft seal. This liquid is normally handled with a pump designed for sanitary service.

WOOD ALCOHOL - See Methanol

XYLENE
Other Names: Xylol, dimethylbenzene
Formula: C$_6$H$_4$(CH$_3$)
Vapor Pressure: Nil at 21°C / 70°F
Viscosity: Thin
Remarks: Clear, toxic, flammable, soluble in alcohol and ether and insoluble in water. Flash point 23°C / 73°F. Used in aviation gasoline, in protective coatings, as a solvent for alkyd resins, lacquers, enamels and rubber cements.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are recommended as is a mechanical shaft seal.

YEAST
Other Names: Barm. Information given below also applies to terms such as spent yeast and yeast slurry.
Viscosity: Viscosity varies from slightly more than the viscosity of water to that of heavy cream, depending on the type of yeast and its use.
Remarks: Yeast is a yellowish-white liquid. It is used for the fermentation of sugars, molasses and cereal grains for alcohol brewing, medicine and making bread. Yeast is an important source of Vitamin B complex.
Pump Notes: Stainless steel construction is normally required. Buna n elastomers are recommended as is a mechanical shaft seal. This liquid is usually handled with a pump designed for sanitary service.

ZINC OXIDE
Other Names: Zinc oxide coating, zinc oxide slurry
Viscosity: 44 to 220 cPs.
Remarks: Used as a filler and accelerator-activator in rubber and plastics, as a pigment in paints, in medicines and cosmetics. Zinc oxide is abrasive.
Pump Notes: Cast iron construction is satisfactory. Viton® elastomers are usually acceptable. A pump designed for abrasive service must be used.

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