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## FLUID FUNDAMENTALS

Fluids include liquids, gases, and mixtures of liquids, solids, and gases.

In this bulletin, the terms fluid and liquid are used interchangeably to mean pure liquids, or liquids mixed with gases or solids which act essentially as a liquid in a pumping application.

### **Density or Specific Weight of a Fluid:**

This is weight per unit volume, often expressed in units of pounds per cubic foot, or grams per cubic centimeter.

The density of a fluid changes with temperature.

Example: If weight is 80#; density is 80#/cu. ft.

### **Specific Gravity of a Fluid:**

This is the ratio of its density to the density of water.

As a ratio, it has no units associated with it.

Example: Specific gravity is 80#/62.4# or SG = 1.282

### **Temperature :**

This is a measure of the internal energy level in a fluid.

It is usually measured in units of degrees Fahrenheit (°F) or degrees centigrade (°C).

The temperature of a fluid at the pump inlet is usually the greatest concern.

### **Vapor Pressure of a Liquid:**

This is the absolute pressure (at a given temperature) at which a liquid will change to a vapor.

Vapor pressure is best expressed in units of psi absolute (psia).

Each liquid has its own vapor pressure temperature relationship.

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### **Viscosity:**

The viscosity of a fluid is a measure of its tendency to resist a shearing force.

High viscosity fluids require a greater force to shear at a given rate than low viscosity fluids.

**The CENTIPOISE (cps):**

This is the most convenient unit of absolute viscosity measurement. Other units of viscosity measurement such as the centistoke (cks) or Saybolt Second Universal (SSU) are measures of Kinematic viscosity where the specific gravity of the fluid influences the viscosity measured. Kinematic viscometers usually use the force of gravity to cause the fluid to flow down a calibrated tube, while timing its flow.

**The Absolute Viscosity:**

Absolute viscosity is measured in units of centipoise (1/100 of a poise) and is a convenient and consistent unit for calculation.

Example: Other units of viscosity can easily be converted to centipoise.

Kinematic viscosity	X	Specific Gravity	Absolute Viscosity
Centistokes	X	S.G.	Centipoise
SSU X.216	X	S.G.	Centipoise

**Viscosity:**

Is not a constant, fixed property of a fluid, but is a property which varies with the conditions of the fluid and the system. In a pumping system, the most important factors are the normal decrease in viscosity with temperature increase. The viscous behavior properties of the fluid in which the viscosity can change as shear rate or flow velocity changes.

**Effective Viscosity:**

This term describes the real effect of the viscosity of the ACTUAL fluid, at the SHEAR RATES which exist in the pump and pumping system at the design conditions.

It is important to note that Centrifugal pumps are generally not suitable for pumping viscous liquids. The reason is pumping more viscous liquids instead of water, the capacity and head of the pump will be reduced and the horsepower required will be increased.

**pH Value for a Fluid:**

Defines whether the aqueous solution is an acid or base (with values of pH usually between 0 and 14):

1. Acids or acidic solutions have a pH value less than 7
2. Neutral solutions have pH value of 7 at 25°C (example: pH of pure water = 7)
3. Bases or alkaline solutions have a pH value greater than 7