EXTERNAL GEAR PUMP PRINCIPLE OF OPERATION & ADVANTAGES

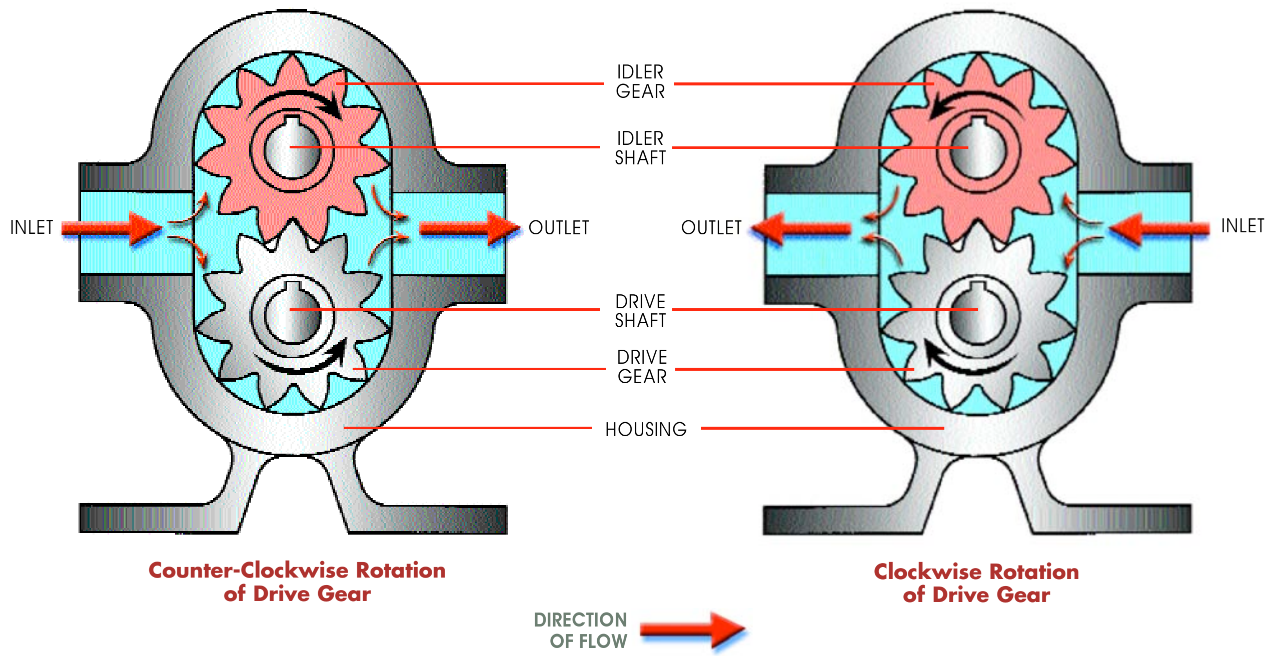

Figure 1: Cross-sectional views of external gear pump demonstrating operating principle.

The external gear pump is a positive displacement (PD) type of pump generally used for the transfer and metering of liquids. The pump is so named because it has two gears that are side-by-side or *external* to each other. (This nomenclature differentiates it from an *internal* gear pump, which has one gear positioned inside the other.) The gear pump is a precision machine with extremely tight fits and tolerances, and is capable of working against high differential pressures.

The working principle of the external gear pump is illustrated in **Figure 1**. A drive gear (that is driven by a motor) rotates an idler gear in the opposite direction. When the gears rotate, the liquid, which is trapped in the gear teeth spaces between the housing bore and the outside of the gears, is transferred from the inlet side of the pump to the outlet side. It is important to note that *the pumped liquid moves around the gears and not between the gears*. The rotating gears continue to deliver a fresh supply of liquid from the suction (inlet) side of the pump to the discharge (outlet) side of the pump, with *virtually no pulsations*. The meshing of the gears on the discharge side of the pump forces the liquid out of the pump and into the discharge piping.

Figure 1 also shows that the direction of rotation of the drive gear determines the direction of flow thru the pump, and which side of the pump is the inlet and which side is the outlet. If the direction of rotation of the motor (and therefore the drive gear) is reversed, the direction of flow thru the pump will also reverse. This *bi-directional flow characteristic* is one of the many advantages inherent to gear pumps.

Another important advantage of the gear pump is its *self-priming capability*. Gear pumps are capable of self-priming because the rotating gears evacuate air in the suction line. This produces a partial vacuum that allows the atmospheric pressure to force the liquid into the inlet side of the pump. This ability of the gear pump makes it an ideal choice when the application requires that the pump be located above the liquid level, and the liquid must be lifted to the pump. Because a gear pump cannot create a perfect vacuum, the total lift (including pipe friction losses) should not exceed about 7.5 PSI, or about one-half of the atmospheric pressure.

The tight clearances of the working parts inside a gear pump are what enable it to effectively pump liquids against high pressure. Low viscosity fluids such as alcohols and other solvents have more of a tendency to "slip" thru these tight spaces from the higher-pressure discharge side of the pump back to the lower-pressure suction side of the pump. The phenomenon of *slip* causes a reduction in flow rate and pump efficiency. Slip depends on the magnitude of the differential pressure (i.e., the difference between the discharge and suction pressures), the viscosity of the liquid pumped and the working clearances inside the particular pump that is used. Slip increases with decreasing viscosity, increasing differential pressure and increasing gear-housing clearances, and is usually measured as a percent decrease from ideal flow (i.e., flow with zero slip). For fluid viscosities greater than about 50-100 cP (depending on the particular pump), the slip is minor, but it still depends on the differential pressure. This behavior is shown in **Figure 2**, which compares a typical gear pump's performance curve for a thin fluid (such as water with a viscosity of about 1 cP at room temperature) with that of a moderately viscous fluid (such as a particular oil with a viscosity of 100 cP).

EXTERNAL GEAR PUMP PRINCIPLE OF OPERATION & ADVANTAGES *(continued)*

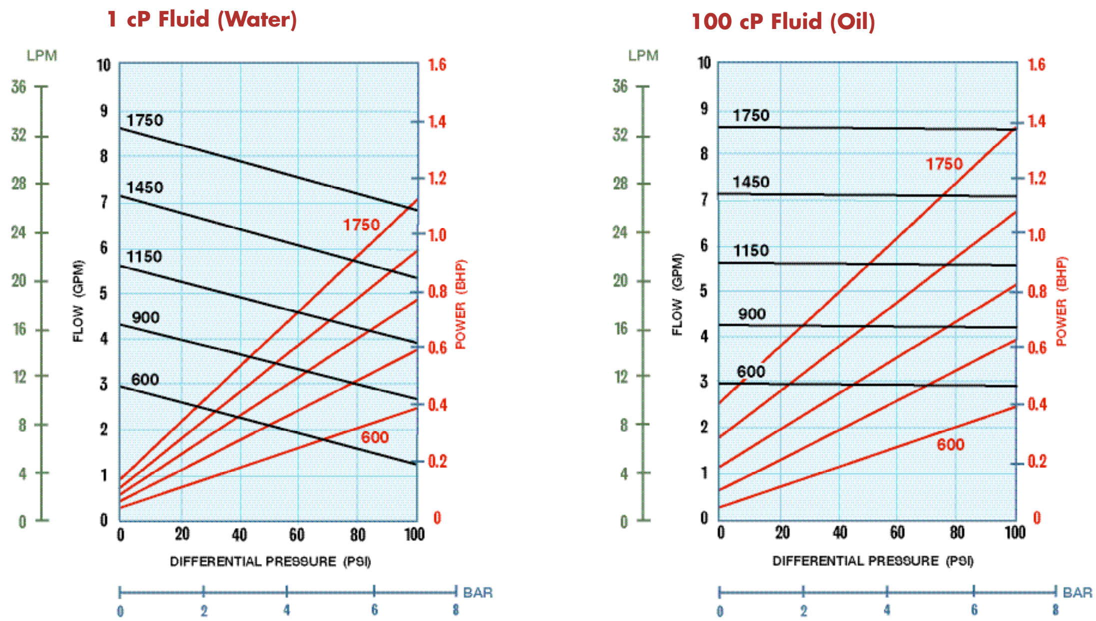

Figure 2: Performance curves for a typical external gear pump showing slip as a function of viscosity and differential pressure.

The Flow vs. Pressure curves for the thin fluid have high slopes, which indicate significant reductions in flow rate with increasing differential pressure (i.e., high slip). The curves for the 100 cP fluid are almost level, which indicate nearly constant flow rates with increasing differential pressure (i.e., almost zero slip).

The close tolerances and tight spaces inside the gear pump also limit liquids containing abrasives from being pumped. This is because the abrasive particles can work their way into these tight spaces and cause accelerated wear, and this can rapidly reduce pump performance. The resulting wear rate from pumping abrasives is dependent upon the hardness, size, and concentration of the particles, and the operating speed of the pump. The wear rate of a pump can also be adversely affected by pumping thin fluids because they have poor lubricating properties. For this reason, more care must be taken when making material selections for the internal components of the gear pump. Special materials are available to increase lubrication (such as carbon graphite) and resist wear when pumping extremely thin liquids or liquids containing abrasives. Please contact the factory to assist you with the material selection process.

Gear pumps – properly designed and engineered – can offer many advantages. These include compactness, simplicity of design, easy serviceability, bi-directional flow capability, ability to self-prime, pulseless flow, low NPSHR (net positive suction head required), high MTBM (mean time between maintenance), high-pressure and high-temperature capability, precise and accurate metering, and availability in multiple seal configurations or sealless mag-drives. **Liquiflo has over 35 years experience in designing and manufacturing quality high-alloy gear pumps for the chemical processing industry, and extensive experience in pumping acids, caustics, solvents, polymers and other types of chemicals.** Liquiflo's experienced engineers are available to assist you with your special chemical pumping applications.