American Polywater Corporation
Stillwater, MN 55082 USA

Technical Report

American Polywater Pump History

Background

Interest in automatically applying cable pulling lubricant increases whenever significant amounts of cable need to be pulled into conduit. Automatic lubrication can free up the manpower normally required for lubrication by hand, and also provide more consistent and optimal lubricant use. American Polywater has over 20 years experience applying lubricants through various kinds of pumps. Much of this development was not broadly commercialized, but the experience is valuable for anyone interested in automatic lubrication.

There are a number of design considerations for a pulling lubricant pumping system. First, pump systems must be able to handle the fluid flow properties of today's high performance, complex polymer-water lubricants. Polywater® Lubricants are proven compatible with cable and they produce extremely low friction (for low pulling tension). More than once, pulling lubricant pumping systems were designed that were limited to water-thin materials. These systems failed simply because they couldn't pump today's best friction reducers.

Pumping mechanisms must respect the shear sensitivity of the high molecular weight polymers in polymer/water lubricants. High shear pumps can break long-chain polymer molecules and degrade the properties of a lubricant.

Numerous manual grease pumps have been modified for hand pumping the thick gel lubricants. While piston-style grease pumps work for a while, unless they are coated steel, stainless, aluminum, or non-metallic, they eventually corrode from the water-base materials. Pumps should be designed to work with water-base materials. Suitable pumps are found in the chemical, food processing, agricultural, sewage, and medical industries.

The final consideration is pumping capacity. For a lot of pulling, the lubrication rates needed are only in the 1/10-gallon per minute range. To throttle down too large a pump to these low flow rates is hard on the pump, the lines, and the control systems.

This pump history is intended to aid our customers by showing pumping technologies and approaches that have been successfully used in the field. The experience, advantages and drawbacks of each approach are presented. If you have an interest in the details of any of these pumping systems, please contact American Polywater Technical Service at (651)-430-2270 or toll fee at (800)-328-9384.

Modified Industrial Pressure Pot

Extensive studies on pressure pot feeding of lubricants were done in a DeVilbiss Pot Type QMG (photo below). See www.polywater.com/ieeepump.asp for the technical details of these studies.

In this model, a full 5-gallon pail (pail and all as shown in picture) can be placed in the pot. Once the pail is pumped empty, it can be removed and a new full pail inserted. No lubricant pouring or vessel cleanup is necessary.

The length of the pot's dip tube is adjusted so that it just touches the bottom of the pail. The dip tube and fittings are modified to ¾ inch piping.

The pressure pot works best with a follower plate, especially when pumping gel lubricants. The plate cleans the sides of the pail as the lubricant pulls the plate down. A follower plate also prevents the formation of an air pocket around the dip tube. Such pockets tend to form in self-supporting gels. Air pockets let air blow through the lines before the pail is empty

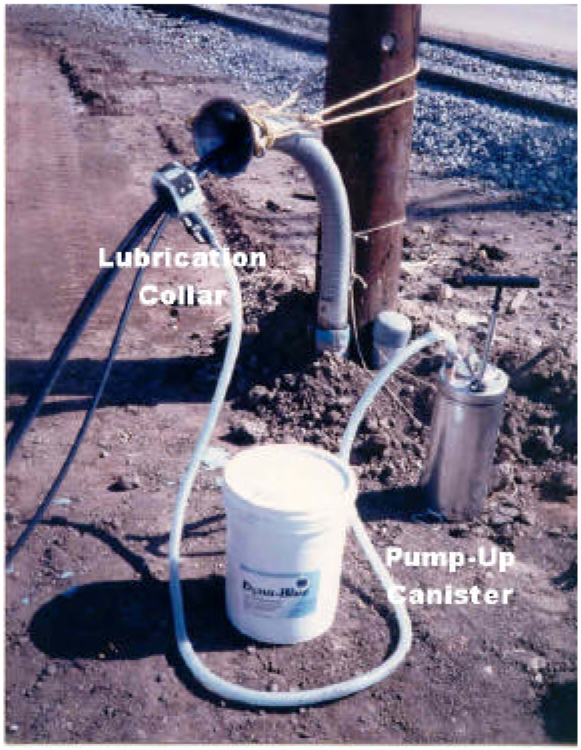
When used, the pot requires an air compressor hook-up to set the initial pressure head (20 to 80 psi depending on lubricant). A continuous, regulated, air hook up from a compressor is recommended to maintain a constant pressure head for predictable lubricant flow. Actual air use is very small.

The head pressure should be set based on the lubricant type and the highest flow rate needed. Metering valves can be used to reduce the flow rate. With limited line pressure, line damage is not of concern with valve restriction controlling flow. Because there are no moving parts, lubricant shear is not a problem with pressure vessel application.

Overall, industrial pressure pots are quite suitable for feeding lubricants in a field environment. Some years ago, a rectangular tank was built and pressurized to feed lubricants in the field. The tank was never taken above 10 psi because the side bulging raised a considerable safety concern. The forces inside a pressurized vessel are high, and American Polywater recommends that only vessels that have been designed and appropriately tested for internal air pressure be used.

Manual Pump-up, Pressure Pot

This pump, shown in the picture below, was also based on air pressure feed. The pump was a modified, hand-pump garden sprayer. The concept was to have a small, independent (no power sources needed) pump that would *not require continuous manual pumping* during the pull.



All internal and external piping was taken to ¾ inch in the sprayer. This pump could feed all American Polywater lubricants, including the thick gels, through a 10-foot feed hose at adequate volumes for typical electrical cable pulls.

The pump-up pump was limited to two gallons of lubricant if sufficient room was left for the pressure head. The lubricant was poured into the pump from a 1-gallon or a 5-gallon pail. Without care, this lubricant transfer could get messy.

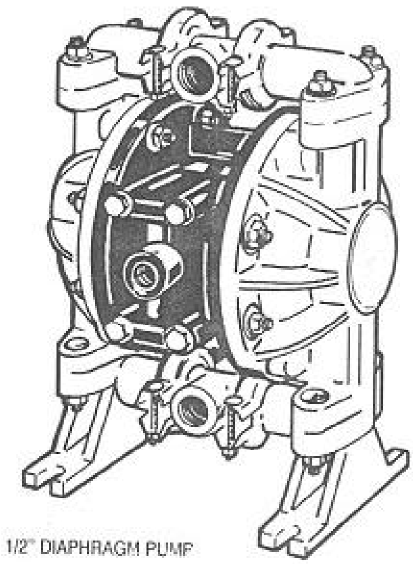
The pressure head was pumped up by hand (as shown in picture below). Since the pressure would decrease as the lubricant level dropped, the pump worked best if an adequate air head space (1/3 of canister volume) was available for pressurizing. Even then, there would be a slight decrease in flow rate over time due to decreasing internal pressure, and occasional pumping was necessary on long pulls.

This pump had a stainless steel canister, which made it fairly expensive. It was never commercialized beyond field testing. However, it did perform well in the field and showed the viability of manually pressurized pumps.

Also visible in the labeled picture is an experimental wrap-around lubrication collar. The cable(s) passed through the collar, which functioned as a “bristle contained” lubricant reservoir. This collar was only intended for thick gel lubricants where bristle containment was adequate to prevent leakage. It was difficult to get consistent lubricant films on the cable though the collar, especially with multiple cables, and to set a lubricant flow rate that was properly matched to cable feed rate to avoid overflow. It was best to stabilize the collar with a moving cable passing through it, but practical attachment areas were limited. In the picture above the feeder funnel has stopped the collar from advancing with the cable.

Air-Powered Diaphragm Pump

Air-powered diaphragm pumps (see illustration below) have been used to transfer lubricant from a tote container to a smaller vessel and to directly pump lubricant to a cable pull in the field. These pumps use air pressure to push an elastic diaphragm that moves the lubricant.



1/2" DIAPHRAGM PUMP

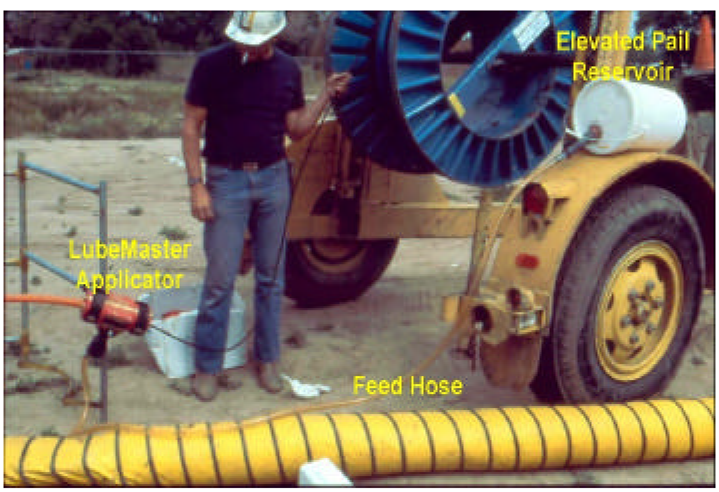
Diaphragm pumps require a relatively low volume of air (at 60-psi line pressure uses roughly I cubic foot of air for each gallon of lubricant pumped). These air pressure powered pumps have many of the advantages of the pressure pot, including low line pressure and the ability to safely control flow with a restriction valve.

Diaphragm pumps are suitable for both gel and liquid Polywater® Lubricants.

There is some inherent pulsing in a diaphragm pump, and the pump should be sized to allow sufficient cycling for a reasonably smooth feed at the flow rates desired. As a mechanical pump, some maintenance is necessary, and diaphragms will wear out and must be replaced.

Gravity Feed Lubrication

The most successful example of gravity feed lubrication was American Polywater's LubeMaster™ Applicator with the LM100-5 Lubricant Feed Hose. This system is shown in the adjacent photo. The LubeMaster™ Applicator is used extensively in outside plant, fiber optic cable pulling. Such pulls are long (3000 plus feet); they are underground; they involve a single cable of restricted size; and they offer a stable attachment point (the polyethylene innerduct coming out of the ground).



The concept behind the LubeMaster™ Applicator is simple. The cable is run through a reservoir of Polywater® F lubricant contained by split sponges (under different compressions). Note that Polywater® F is a liquid lubricant. The lubricant is fed through a hose directly attached to the pour spout of an *elevated* 5-gallon pail. The pail needs to be air-relieved to allow consistent lubricant flow. The sponge containment is tight enough that the lubricant does not leak when the cable is not moving.

One creative field modification of the LubeMaster™ Application System was to only use the pail and feed hose. The pail was again elevated (above the application point), and the valves on the feed hose were set to produce a lubricant trickle. The lubricant trickle was generally dropped directly on the cable through a boat cut in the innerduct. While the flow had to be adjusted and turned on or off manually, this simple gravity feed approach was still a very effective hands-free way to lubricate fiber optic cable passing through a vault

Gravity feed lubrication may be practical for broader use. The keys are to have a liquid lubricant that will flow adequately; to elevate the pail (hopper) sufficiently to produce the desired fluid head; and to have a valving system to control and set the flow rate.

Electric Powered LP-7 Pump

The LP-7 Pump (see figure below) was the first of two electrically powered pumps tested at large electrical construction jobs with extensive cable pulling.

The LP-7 was a simple device with a 15-gallon hopper for lubricant storage and pump feed. A follower plate covered the lubricant in the hopper and prevented the formation of an air pocket over the reservoir outlet.

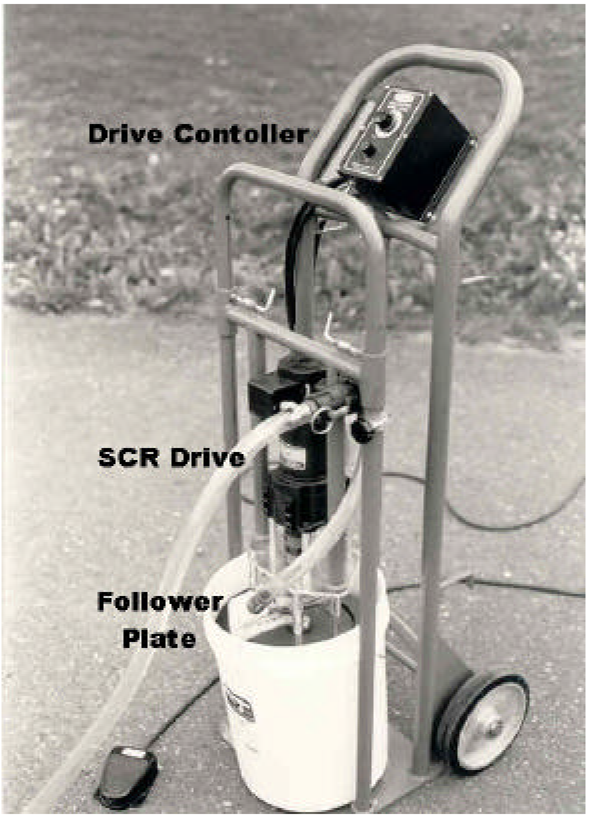
The pump was a directly driven, single speed Moyno (progressive cavity) pump. While the shear in a progressive cavity pump is not high, continuous pumping against a closed line can break down the lubricant. To avoid this, flow was controlled on the unit with a remote on/off switch.

The hopper on the LP-7 had to be partially filled to provide enough head pressure to prime the Moyno. Once primed, this pump could pump all of American Polywater's lubricants.

Overall, the LP-7 was bulky and not field durable.

Electric Powered WP-7 Pump

The WP-7 pump (see picture below) was a much more sophisticated approach to pumping based on experience gained with the LP-7.The pumping mechanism was a peristaltic (tubing) type pump. This pump functions by pushing lubricant through a rubber tube with a rotating roller.



Flow volume was adjusted on the WP-7 by controlling motor RPM with an SCR drive. Restricting flow with a valve in a tubing pump can burst the rubber tube.

As the picture shows, lubricant was fed directly from a 5-gallon pail with the pump and motor mounted on the follower plate. The weight of the pump and drive provided any priming pressure that was needed.

The pail, pump, motor and controls were mounted on a two-wheel cart for convenient movement. The WP-7 also had a remote and a local on/off switch.

The WP-7 could pump all of American Polywater's gel and liquid lubricants. It was used on a number of large jobs and pumped hundreds of pails of lubricant.

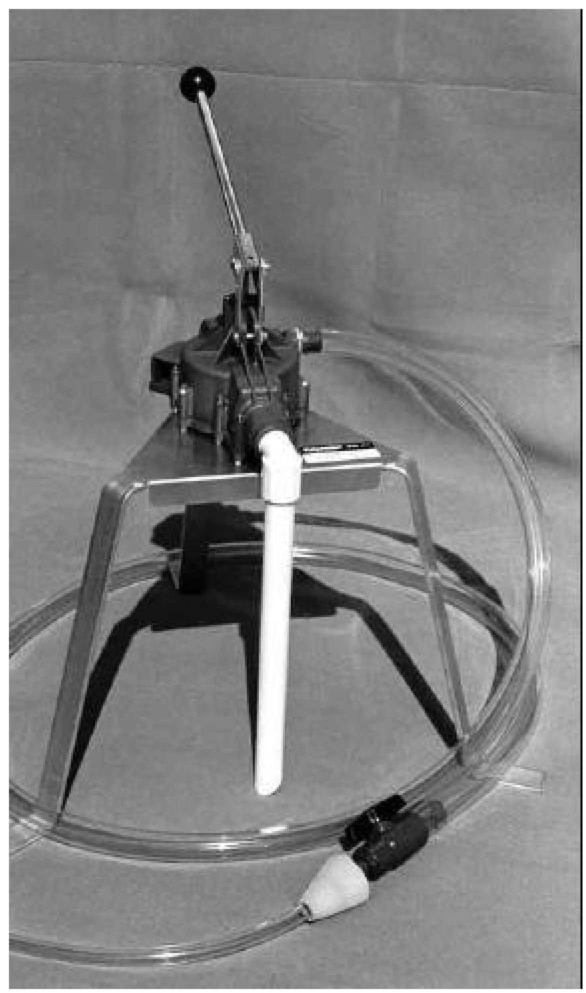
The only field problem with the WP-7 was a limitation of tubing pumps. Occasionally field crews would blow rubber tubes by crimping the feed hose to control lubricant flow, rather than adjusting the SCR control. While the tube was easy to replace, losing the pump in the middle of a cable pull was a significant inconvenience.

LP-3 and LP-5 Manual Piston Pumps

Over the years, American Polywater has evaluated a number of hand operated, piston-style grease pumps for pumping pulling lubricants. Besides the rusting problems mentioned earlier, some of these pumps took more than 60 cycles to move a gallon of lubricant.   This is too much repetitive work for a typical cable pull.

The LP-3 (for a 5-gallon pail) and the LP-5 (for a 55-gallon drum) pumps commercialized by American Polywater are corrosion-resistant, large volume, piston pumps suitable for pumping most Polywater® Lubricants. These pumps have evolved over the last 10 years as shown here.

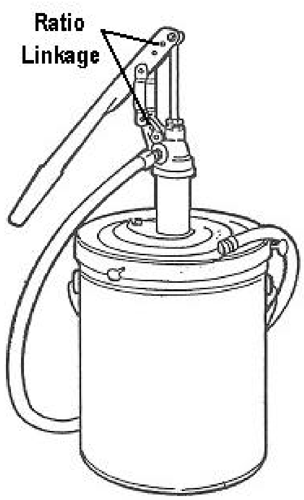
The first version of the LP-3 (see photo on the left) was mounted on the top of a 5-gallon pail. The pump had a dual acting piston that pumped on both the up and the down stroke, and thus required force in both directions. The length of the lever arm tended to tilt the pail on the upstroke as it emptied. Note the foot in the photo being used to stabilize the pail.



The second version of the LP-3 was put on a tripod as shown in the photo on the right. The tripod stabilized the pump to avoid the pail-tipping problem. A hole was cut in the 5-gallon pail lid and the dip tube inserted through the hole into the pail.

This version of the LP-3 was widely distributed and is still being used worldwide to apply Polywater® Lubricants. This pump could pump all American Polywater® lubricants. However, with the thick gel lubricants, the forces on the lever arm and the valve springs were high. Aggressive pumping of the thick gels could damage the pump.

Today's version of the LP-3 Pump is shown In the drawing on the left. The pump is a single acting piston located directly over the pail center. The pump is mounted on the pail with a thumbscrew lid.



Today's LP-3 is adjustable with a linkage that changes the ratio of the pump. The 2:1 ratio is recommended for Polywater's pourable lubricants (F, PJ, PR, etc.) and the 4:1 for the thicker gel lubricants (J, WJ, NN, etc.) The LP-3 pumps a gallon in approximately 16 strokes at the 2:1 ratio and in approximately 32 strokes at the 4:1 ratio.

The LP-3 and LP-5 pumps are available on a special order basis from American Polywater.

See www.polywater.com/pumping.asp for additional sales and technical information on pumps and automatic lubrication.