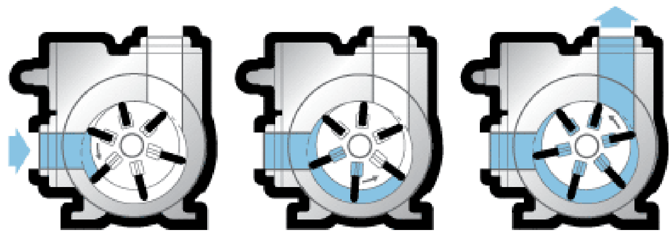
PRODUCT PUMP & DRIVE SYSTEMS ON BOBTAILS

System Components and Operation

Positive Displacement Sliding Vane Pump

A sliding vane product pump is used to efficiently transfer LP gas from the cargo tank into the receiving tank. The pump vanes rotate to "scoop and push" product downstream through the piping system.



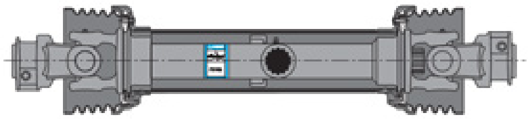


Power Take-Off (PTO)

A PTO bolted to a provision on the truck's transmission is typically the source for auxiliary power to drive the sliding vane pump.

PTO Shaft

The traditional method of transferring power from the PTO to the pump is using a shaft. The system consists of splined shafts with front yoke, rear stub, hanger bearing and bracket, universal joints, set screws, keyways, protective shield assembly, etc.



Advantages

- Cost effective to manufacture
- Replacement parts are common readily available

Disadvantages

- Accessibility/maintenance
- Failures or breakage can be costly to repair
- Safety issues
- Oscillation effects and transfer of harmonic resonance to powertrain

Hydraulic Pump Drive

One method gaining popularity in the propane industry is utilizing a hydraulic pump drive instead of a PTO shaft. The basic components of the system include pump, motor, motor adapter, hoses, cooler/reservoir.

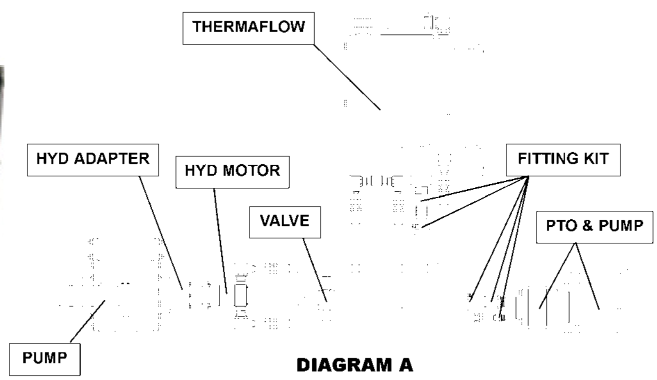


DIAGRAM A
Hydraulic plumbing diagram for THERMAFLOW MODEL **500P**

Advantages

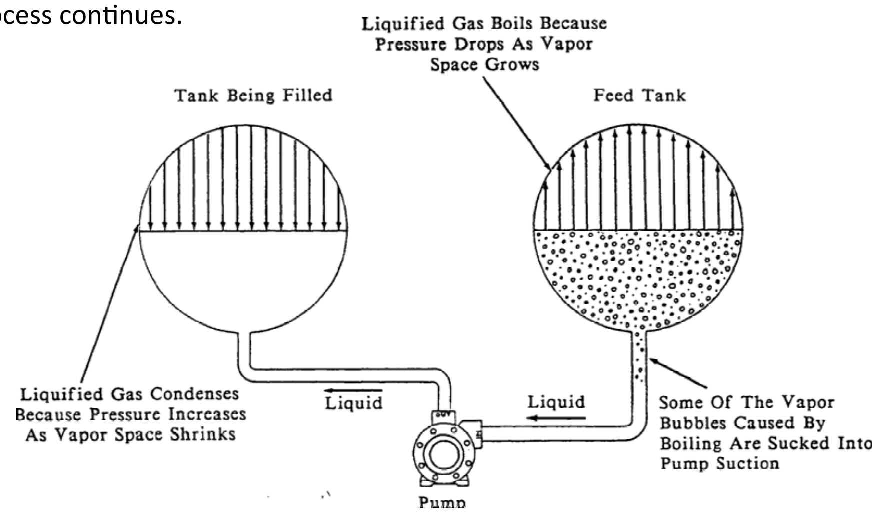
- Reduced maintenance
- Improved safety
- Consistent speed – oscillation effects greatly reduced
- Extended pump life, greater flowrate
- Tank stabilization

Disadvantages

- Preliminary cost
- Some component specific items

LP Gas Pumping

Pumping propane at higher flowrates is especially challenging by virtue of its nature and especially in colder temperatures. During the delivery process as liquid level in the cargo tank drops, vapor space above expands causing a reduction in product temperature, pressure and mass. The resulting effect is boiling of the liquid which creates vapor bubbles. As the pumping process continues, the vapor bubbles enter the pump where along the way they expand causing more boiling and more bubbles to form. The effect "snowballs" as the pumping process continues.



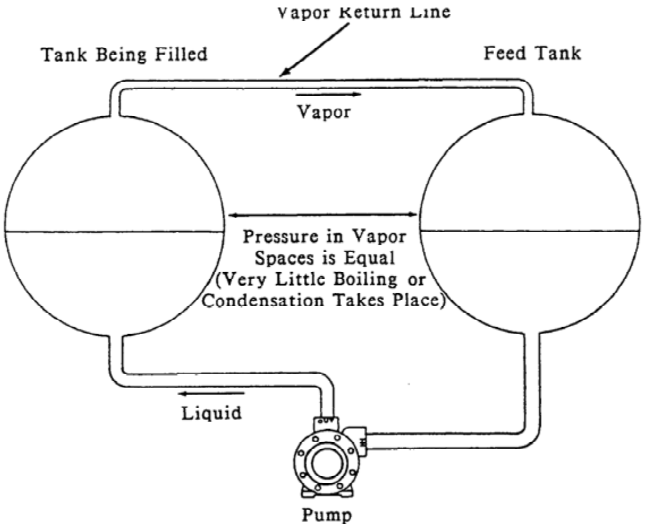
The vapor bubbles have an adverse reaction on pumping performance and pump life. Excessive vapors entering the pump may cause the following problems:

- Reduced pump capacity (reduced flow rate)
- Large pressure spikes
- Vane actuation (bounce off liner) – increased noise
- Premature mechanical seal failure – lack of liquid to cool seal face

Believe it or not, this is a natural phenomenon that occurs in healthy pumping systems. However, it is much less likely to be detected in systems that operate in warmer environments (+40°F and above). The higher vapor pressures associated with warmer temperatures assist in keeping liquid in the cargo tank stable during pumping.

Stabilizing LP Gas

Connecting a vapor equalizing hose between the cargo and receiving tank is the simplest way to stabilize. Unfortunately, the added step in the delivery process to connect a vapor equalizing hose can be inconvenient, inefficient, and has been declared illegal in many states.



Another way to achieve stabilization is through using a heat exchanger to generate vapor and replace head pressure during the pumping process. There are 2 types of heat exchangers that have been effective and improve pump performance.

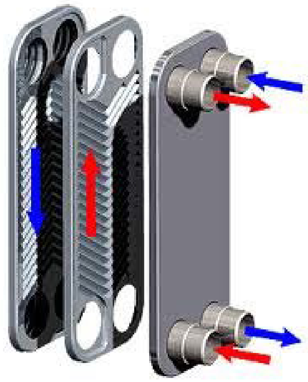
- Hot water heat exchanger
- Hydraulic reservoir heat exchanger

Hydraulic Reservoir Heat Exchanger

The hydraulic reservoir heat exchanger is really quite brilliant. Here's how it works:

The hydraulic fluid reservoir and heat exchanger is a self contained unit that holds approx 2.0 gallons. When the hydraulic pump is active, pressure creates heat within the fluid. After the fluid has completed the loop at the hydraulic motor it returns to the reservoir. Before entering the reservoir, the fluid's heat is transferred between solid walls within a flat plate exchanger to another media.

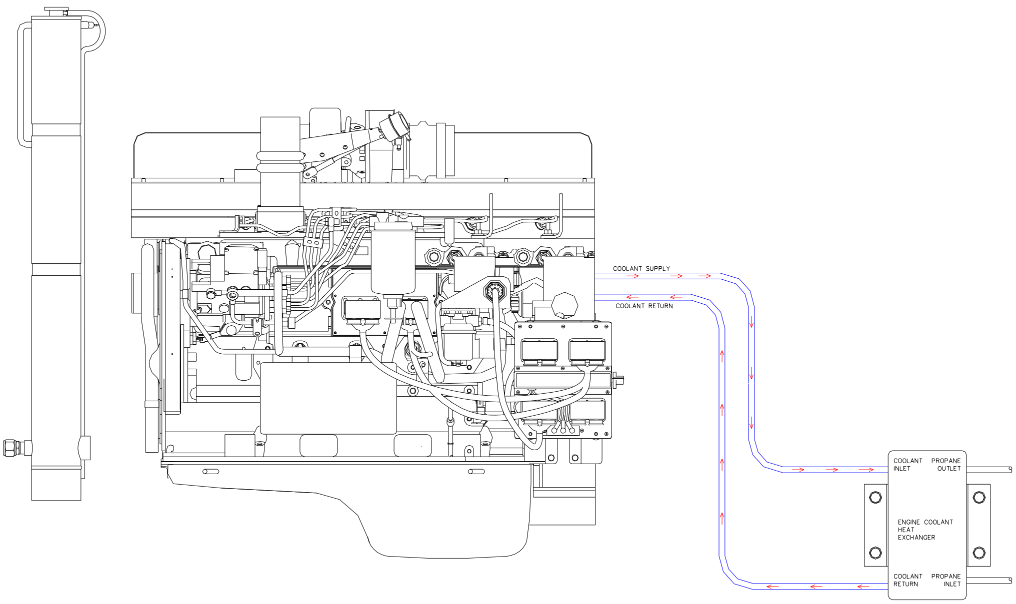
The other media…..drum roll please……Yup – you guessed it……..PROPANE!



Here's why propane works so well with the system. Propane flows through the heat exchanger whenever the product pump is operating. The product pump spins whenever the hydraulic system is active. Therefore, both products (hydraulic fluid and LP gas) flow through the heat exchanger at the same time. The propane source comes from a tap off a pressure port on the product pump. After the transfer of heat occurs within the exchanger, warm propane returns through a carburetion fitting in the cargo tank. The warm propane replaces the vapors leaving the tank which naturally occur in the pumping process thereby stabilizing the vapor in the cargo tank.

Hot Water – Propane Heat Exchanger

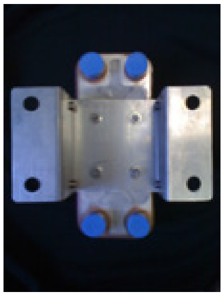
Method of operation for a hot water propane heat exchanger is somewhat similar to the system described above except, the heat source is provided by chassis engine coolant (antifreeze) instead of hydraulic fluid. The heat exchanger is supplied by means of a splice into the coolant system after it exits the engine and heater core. The engine's water pump circulates coolant through the heat exchanger whenever the vehicle is running.

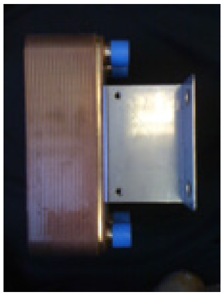


Similar to the hydraulic system, propane is supplied from the gauge port of the product pump. Therefore, propane flow and effective heat transfer occurs only when the pump is engaged.

Flow of coolant through the heat exchanger is regulated to maintain adequate engine combustion chamber temperatures. This is currently accomplished by monitoring engine temperatures and adjusting coolant flow manually using a ball valve. Adjustment are not required very often and performed mostly when drastic (+/- 30°F) temperature changes occur. Automatic protection using an inline thermostat is currently under development.

Pump tests in 20°F and below outside ambient air temperatures have shown tank stabilization is very effective in improving pumping performance. Several tests completed on different bobtails using 2900+ gallon non-stop pumping deliveries resulted in maintaining flow rates within 3-5 GPM and differential pressures within 3-5 PSI from start to finish.





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