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Sliding Vane Positive Displacement Pumps Offer Lower Life Cycle Costs and Higher Efficiency For Dual Hose Autogas Dispensing Applications Over Other LPG Pump Technologies

For dual hose Autogas dispenser applications, sliding vane positive displacement pumps are quickly becoming the pump technology of choice worldwide because they offer performance, reliability and financial benefits over other high differential LPG pump technologies. Sliding vane pumps are capable of overcoming many of the challenges that plague other Autogas-type pumps, such as inconsistencies in mixed LPG composition, line pressure changes, entrained vapors, vapor lock and temperature changes. In addition, sliding vane pumps offer a lower upfront cost, are safe and easy to install and maintain, and provide high efficiency and reliability even for the most active Autogas fueling operations.

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Executive Summary

In the world of Autogas dispensing, pump requirements will vary widely depending on local regulations, conditions, and quality of LPG mixtures. When selecting a pump for Autogas applications, special consideration must be given to the specification standards (in India this would be Indian Standard Specification For Petroleum Gas - IS 4576 -1978) and the circumstances surrounding a particular site. These considerations must include the type of tank being used (underground or above ground tanks), which may be based on population density, aesthetics, space, and safety concerns; the volume of vehicle activity in a given period of time; continuous duty (durability) requirements; and geographic climates relative to mixtures of propane/butane that can affect differential pressures, all of which can impact flow and pressure capability of various pump types. Relative to LPG Autogas applications, there are four (4) pump technologies most commonly specified today. These include:

1) **Submersible Pumps** – typically used at large, multi-dispenser sites, these centralized pump units are generally electric motor-driven multi-stage centrifugal-type pumps installed in a manifold and submerged into the underground storage tank. In order for the submersible pump to work properly, it must maintain a minimum differential pressure above 4 bar (58 psi), and because it is a centrifugal-type pump it can only build differential pressure when the first stage of the pump is completely submerged in liquid. The NPSH (Net Positive Suction Head) is generally 100 mm (3.9 in.) above the pump inlet, so tank levels must be closely monitored to avoid the difficult task of priming the pump if the liquid levels drop too low. Submersible pumps are quiet and are not subject to vapor lock, but they are expensive and extremely difficult to remove and repair. Pump performance can be adversely affected by unsaturated and inconsistent LPG composition that have been known to cause frequent breakdowns in submersible pumps. In the event of a breakdown, the site would need to be shut down, and, due to the danger of removing a submersible pump from a pressure vessel, trained technicians would need to be hired to remove the pump and either replace or repair it. These submersible pumps are not only expensive and difficult to remove and repair, but initial installation carries relatively high costs (expensive pump and special tank head).

2) **Multi-Stage Side Channel Pumps** – another type of centralized pump system generally used for large multi-dispenser sites, multi-stage side channel pumps are pumps designed for low flow, high head applications (typically possessing a NPSH range of 0.4-3.5 m (1.3-12 ft.). Side channel pumps can transfer liquid-gas mixtures with up to 50% vapor to eliminate air and vapor lock. Multi-stage side channel pumps are quiet but inefficient when compared to other pump types. Due to their complex design, they are difficult and expensive to repair, and, like submersible pumps, require a trained technician for removal, disassembly, repair and maintenance.

3) **Regenerative Turbine Pumps** – a variation of a centrifugal pump, these pumps are typically used at smaller fueling sites where a single or dual hose dispenser is used. Typically, regenerative turbine pumps have a flow range between 45 - 220 L/min (12 to 58 gpm) and maximum differential pressure of 250 psid (17.2 bar). Regenerative turbine pumps are quiet and simple with better priming capability than centrifugal pumps, but do not possess the priming capabilities of sliding vane pumps. Regenerative turbine pumps offer the least favorable performance levels of the four types of Autogas pumps due to the fact that high differential pressure has a considerable impact on the pump's capacity (steep curve); low vapor pressure products (low temperature or high butane percentage mixture) have an adverse impact on capacity and maximum differential pressure. The pump is better than a centrifugal pump at handling vapors, but is not nearly as effective as sliding vane pumps.

4) **Positive Displacement Sliding Vane Pumps** – used primarily in single and dual hose dispenser applications, sliding vane, positive displacement pumps, such as the Blackmer LGL158 (Figure 1), are designed for high differential pressure liquefied gas applications (13.8 bar/200 psi). In Autogas applications they are used to pump from underground storage tanks and to feed LPG vaporizer/mixer stand-by units (Figure 2). Positive displacement pumps provide a nearly constant flow rate over a wide range of differential pressures and are capable of handling entrained vapors. At 150 psid (10.3 bar) differential pressure, the LGL 158 is rated for 32.3 gpm at 1,750 rpm (60Hz) or 24 gpm at 1,450 rpm (50Hz) (Figure 3) with static suction lift capability up to 4 meters (approx. 13 ft). Typical applications include:

- Single and dual hose fuel dispensers
- Underground and above ground storage tanks
- Aerosol filling
- Vaporizer feed

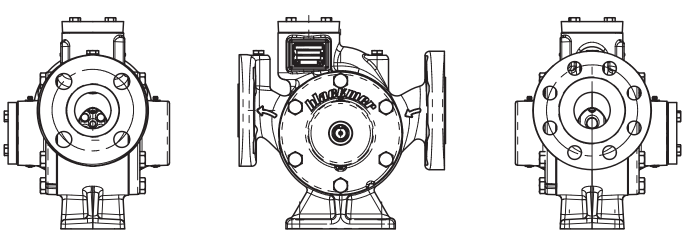

Figure 1

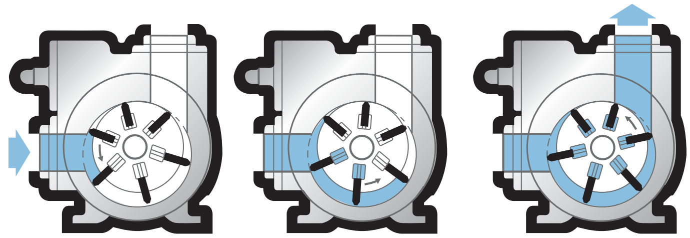

Figure 2

Positive displacement sliding vane pumps offer the lowest upfront equipment cost and the easiest installation and maintenance of all four Autogas pump technologies. The pump can be repaired in place without disconnecting piping, and no special tools are required. They can be maintained by on-site personnel in most cases. The pump handles the widest range of LPG mixtures of any of the four Autogas pump types without adverse effect and can run dry for short periods of time.

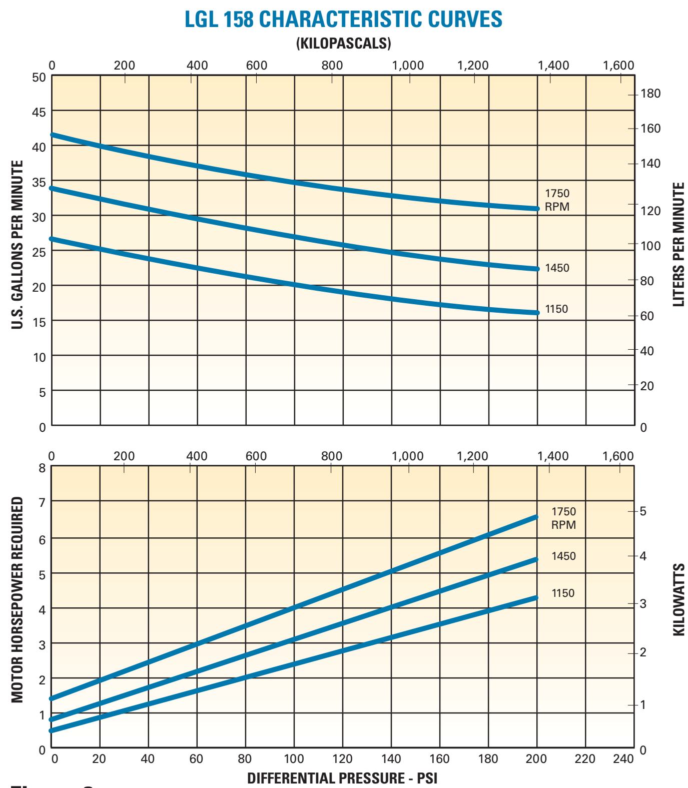

Figure 3

Due to the pump's low upfront cost, long service life, easy installation, low maintenance, ease of repair and energy efficiency, the Blackmer LGL158 positive displacement sliding vane pump offers the lowest life cycle cost and the best warranty guarantee (3 Years) of the four Autogas pumps types.

Blackmer - The World's Foremost Authority and Inventor of Sliding Vane Technology Offers a Continuous Duty, High Differential Pressure LPG Pump for Autogas Applications – the Blackmer LGL158.

Figure 4

The Blackmer LGL158 sliding vane pump (Figure 4) is the premier LPG pump on the market today for single and dual hose Autogas applications. Introduced in January 2005, the pump has been field tested in the United States, Turkey, Serbia, Canada and Chile where it received high marks for durable, flawless performance. Most recently, the pump has been placed into service in Kazakhastan.

In Turkey and Serbia, the LGL158 has endured rigorous field-testing in Autogas applications in difficult situations. It is being used to handle underground Autogas (Figures 5 and 6) in unfavorable conditions and is performing exceptionally well.

Figure 5

The LGL158 is capable of developing a differential pressure of 200 psi (13.8 bar), with working pressures of 425 psig (29.3 bar) and is UL Listed for use on propane, butane and butane/propane mixes. The uniquely designed liner and vanes of the pump allow it to effectively handle these high differential pressures as well as perform continuous duty operation. Utilizing self-adjusting vanes, the pump performance is maintained and highly efficient. The vanes and seals can be quickly changed at proper intervals without removing the pump from service or using expensive technicians.

The LGL158 is an impressive high-pressure LPG pump. It features high-load roller bearings. The inlet/outlet connections are 2" and 1.5" 300# compatible ANSI raised face flanges respectively (180 degrees). By utilizing proper piping layouts, the LGL158 is designed to handle all issues relative to pressure changes and vaporization common in tropical environments.

One of the most notable features of the new pump is Blackmer's patented Noise Suppression Liner. Available only on Blackmer pumps, this innovative design feature offers the benefits of quieter operation (down to 12 dBA), less vibration and longer pump life.

The LGL 158 is capable of handling the various propane/butane mixtures as found in Indian LPG which may contain traces of propylene and butylene; C_2 and C_5 fractions; normal butane, iso-butane and lighter hydrocarbons like ethane and ethylene; and heavier hydrocarbons like pentane, all without experiencing any of the adverse effects that have been suspected of causing damage to submersible pumps.

The Blackmer LGL158 is designed for any type of single and dual hose dispensing application, providing operators a high value, low life cycle cost solution for LPG fueling.

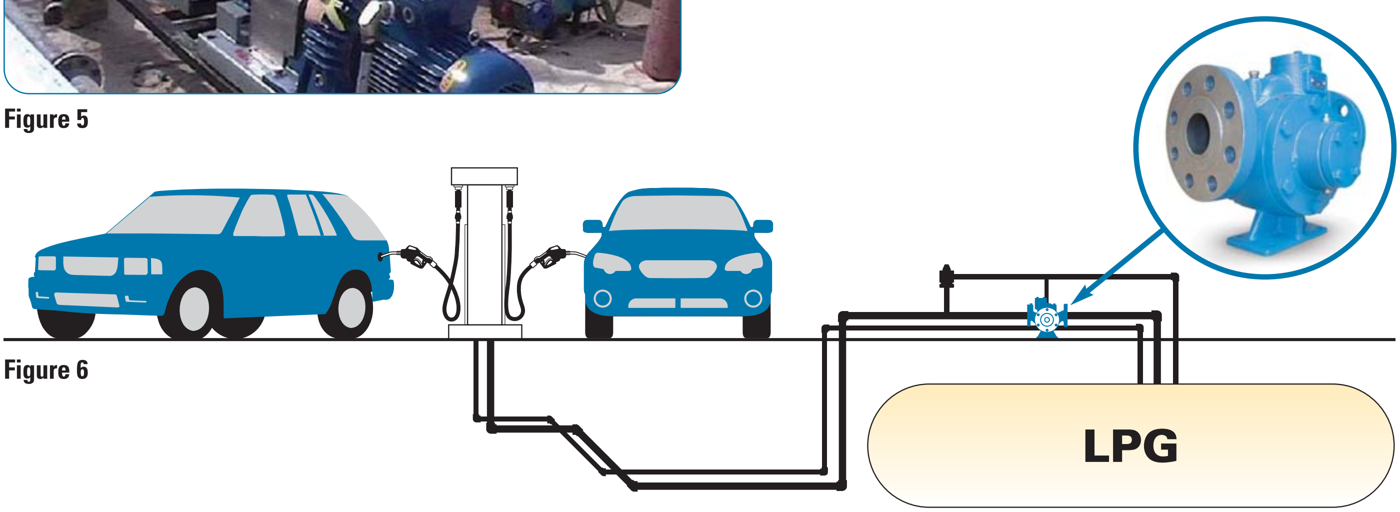

Figure 6

Blackmer's Expertise is Also Available for LPG Transfer and Vapor Recovery Applications with its Complete Line of Reciprocating Compressors.

When transferring LPG from rail cars to storage tanks, Blackmer compressors (Figure 7) are specialized among the many types of compressors on the market. They are positive displacement, vertical, reciprocating, oil-free designs and can be used on applications with pressure ranges of 3-750 psia (0.2-51.7 bar) and 2-50 bhp (1.5-37 KW). They are capable of liquid transfer rates of approximately 40-675 gpm (9-153 m^3/hr). A pump cannot completely empty an LPG vessel. A small amount of liquid (liquid heel) will always remain in the vessel. Even if all the liquid was removed, the vessel would still be full of vapor at vapor pressure. This remaining vapor can equal approximately 3% of the tank's total capacity and can only be recovered/unloaded by using a compressor. This method of unloading can significantly improve product yields. The Blackmer Reciprocating Series compressors have long been the industry standard for LPG transfer applications.

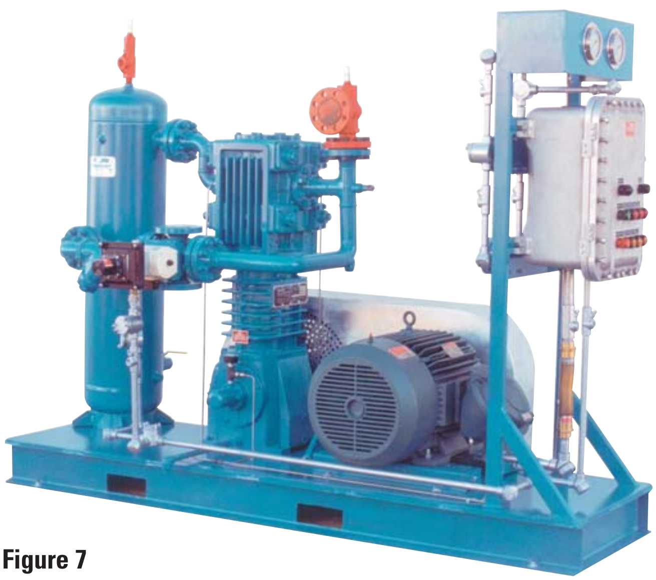

Figure 7

Liquid Gas Transfer

Blackmer compressors withdraw vapor from the vessel being filled, pressurize it, then discharge into the top of the vessel being emptied, raising its pressure. This pressure then pushes the liquid LPG to another vessel (Figure 8). The most common application is unloading LPG railcars into stationary tanks. After the liquid has been pushed out of the vessel, a boil-off and vapor recovery operation is often performed.

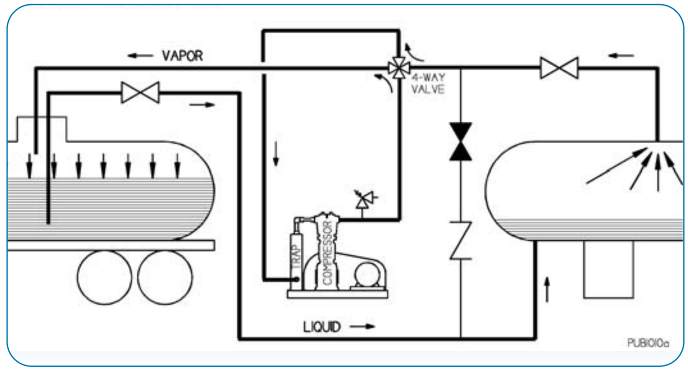

Figure 8

Boil-Off and Vapor Recovery

When a liquid heel is present in the vessel, the first part of the vapor recovery process will boil-off the remaining liquid until only gas remains. Gases that were previously left in the vessel or vented to the atmosphere can then be recovered after the liquid has been removed. Some typical examples would include liquefied gas vapors left in a vessel after the liquid has been evacuated, emptying of vessels prior to maintenance or refurbishing operations, and evacuation of cylinders, hoses and lines.