White Paper
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The Role of Backpressure Regulators in Lease Automatic Custody Transfer Units

By Emerson Process Management

The oil and gas value chain that starts with discovery of oil fields and ends with providing products to end customers involves different stages: Exploration, Production, Storage and Shipping, Refining and Marketing. As the recovered oil journeys through the different stages of the value chain, its custody is transferred many times. At the point of custody transfer from the producer to the pipeline or other transportation carriers such as trucks or railcars, many invested parties are involved. These parties, which include producers, carriers, royalty owners, state regulatory bodies and tax authorities, are interested in an accurate measurement of the crude oil to ensure all are being properly compensated. Hence, reliable and accurate measurement from oilfield production to transportation method is a critical aspect of the value chain. The two common methods followed in the industry for this measurement are Tank Gauging and Lease Automatic Custody Transfer (LACT) units. Due to uncertainties with the tank gauging method such as changing shape of tank due to thermal expansion, difficulties in accurate temperature and level measurement and to operator safety, the industry is shifting to the use of LACT units for custody transfer measurement.

Lease Automatic Custody Transfer (LACT) Method

A LACT skid brings together devices and instrumentation to provide the required accuracy, sustainability and reliability of the custody transfer measurement. The inlet of the LACT unit is typically connected to a storage tank through a feedline and the outlet will generally supply a pipeline, truck tanker or railcar. For LACT units connected to pipelines, as the crude oil level within the storage tank rises, it trips the level controller and turns on the LACT unit, beginning the transaction. When the crude level drops sufficiently within the tank it will then turn the LACT unit off again, ending the transaction. At remote locations that are not accessible by existing pipelines, they are connected to trucks or rail cars, which may then transport the crude to a pipeline or refinery.

Functions of a LACT Unit

LACT units facilitate accurate measurement of the quality and quantity of crude oil as it is transferred from the custody of one legal entity to another. The factors affecting the quality and quantity of oil are temperature, API gravity, basic sediment and water (BS and W). The temperature of the crude oil affects its overall volume as the fluid expands or contracts in response to temperature change. API gravity determines how much the crude is worth because light crude will produce a higher yield of gasoline or diesel when it is refined. BS and W refers to the impurities such as sediment, water content and emulsion in the production stream. Since these are not part of the actual merchantable oil, they must be carefully measured and factored in order to calculate merchantable or net oil value. In addition, LACT units eliminate air or gas from the liquid, pull a representative sample for testing and automate the transfer process.

Components of a LACT Unit

The LACT skid is comprised of the following devices:

- **LACT Control Panel –** RTU or Flow Computer to control the entire system operation;
- **Flow Meter –** measures the quantity of fluid stream and total throughput;
- **Charge Pump –** provides the energy source for the fluid in the LACT unit;
- **Meter Prover Loop –** designed to prove meter accuracy and verify that no leakage is occurring within the LACT unit;
- **Strainer –** functions to remove any debris from the fluid before it flows to the pump;
- **Air Eliminator –** removes air and gas from the fluid stream before it reaches the flow meter;
- **BS and W Probe and Monitor –** measure the amount of BS and W present in the fluid stream;
- **Sampler System –** gathers samples from the fluid stream to determine the composite API Gravity and total percentage of BS and W;
- **Three Way Diverter Valve –** allows the flow of oil through the unit to the outlet or directs flow for further processing, based on the signal from the control panel;
- **Backpressure Regulator –** maintains a constant backpressure on the centrifugal charge pump, flow meter and renders constant flow rate through the unit;
- **Check Valve –** installed downstream of the backpressure regulator to prevent the backflow of metered fluid from the pipeline;
- **Isolation Valves –** stops the flow of the process, usually for maintenance and safety purposes.

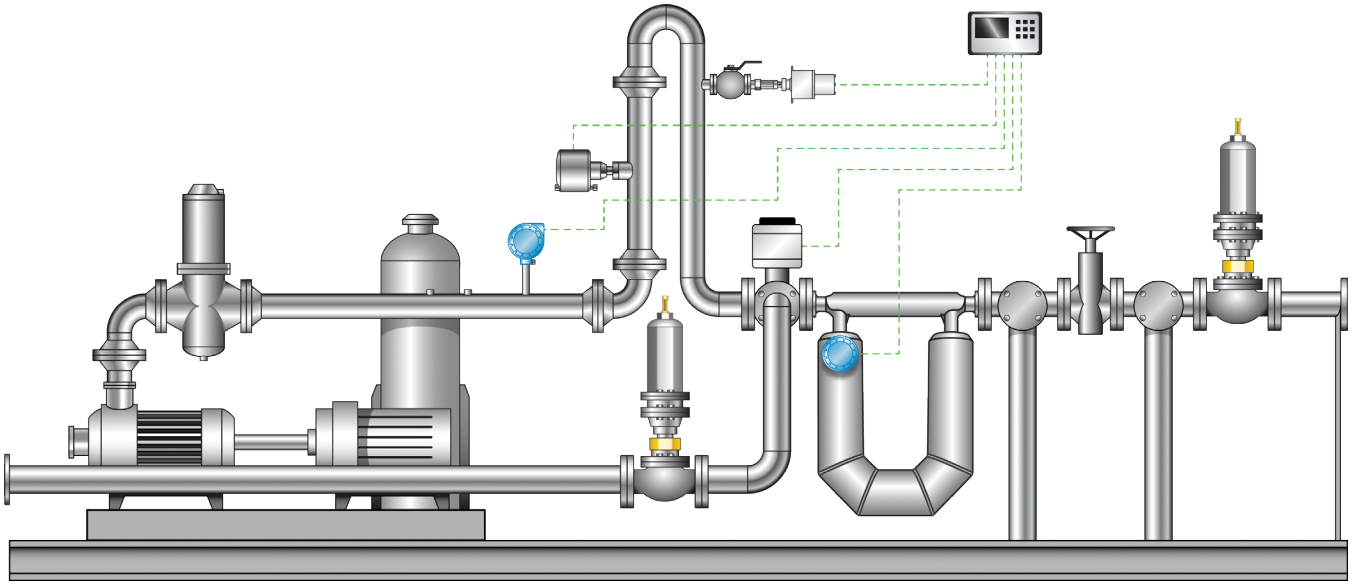

Figure 1. **Typical LACT Unit**

What is a Backpressure Regulator and How Many are Used in a LACT Unit?

A regulator is a self-contained mechanical control valve that senses and responds to changes in process pressure. A backpressure regulator is frequently installed at the end of a piping system to provide an obstruction to flow and thereby maintain a desired upstream (back) pressure. In a flow line that uses a pump, the valve ensures proper backpressure on the pump, so that it will operate properly. It provides the additional benefit of relieving pressure if the line should become blocked, thus preventing the pump from deadheading. It is often used to control pressure in recirculating loops, relieve excess pressure buildup or control a vacuum.

In a LACT unit, there may be one or two backpressure regulators. The primary back pressure regulator is always installed downstream of the prover manifold to hold a minimum pressure against the entire unit.

The pressure sensing port of the primary backpressure regulator may be piped to a tap on the line between the meter and the prover connections or into the body of the regulator. For maximum meter accuracy the control line should be connected near the meter outlet instead of into the body. It is often recommended that a second backpressure regulator be installed on the discharge side of the diverter valve. The function of this backpressure regulator is to prevent the charge pump from operating at a very high flow rate due to a lack of backpressure.

Why is the backpressure regulator important?

The backpressure regulator holds a minimum pressure against the LACT unit to ensure that the meter always operates against a pressure above the vapor pressure of the fluid being metered. This eliminates the formation of cavitation which would occur if the pressure drops below the vapor pressure of the fluid at the pump discharge. Cavitation could impact

the accuracy of the meter and negatively affect the life and performance of the pump. In addition, the backpressure regulator regulates the flow from the pump, keeping a constant flow rate to the flow meter, which aids in accurate measurement of the quantity of fluid.

Challenges in Selecting the Correct Backpressure Regulator

Careful attention must be paid in selecting and sizing the backpressure regulator for the skid. Most LACT skids are designed to ASME CL150 pressure and temperature ratings. Sometimes a skid manufacturer must take exception to the rating for the backpressure regulator because many manufacturer's products do not meet this standard. Also, capacity must be taken into account when selecting a backpressure regulator. Restricted capacity back pressure regulation would impede the flow of fluid through the skid, which would increase pipe/truck filling time and reduce daily throughput by limiting the amount of fluid being transported by the carrier. This would result in revenue loss for all the vested parties. The solution to this problem is to select a backpressure regulator that requires a lower internal buildup pressure. The buildup pressure is defined as the pressure above the spring set point required to fully open the valve. Selecting a backpressure regulator with lower internal buildup characteristics results in reduced pressure required to fully open the valve and thereby allowing more flow while maintaining constant pressure. In addition, lower internal buildup would result in savings on operating costs by reducing the pump's horsepower while increasing the product throughput. If proper backpressure regulators are sized and selected,

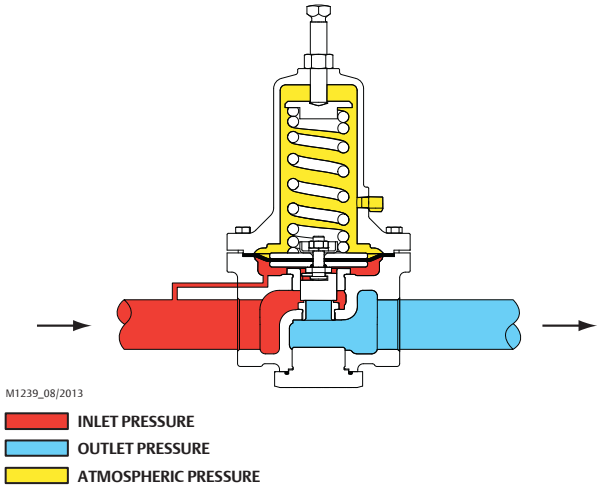

Figure 2. **Backpressure Regulator Operational Schematic**

they will help increase total throughput, decrease capital and operational cost and decrease time spent performing maintenance.

Conclusion

LACT units form an integral part of the oil and gas value chain. These units accurately measure not only the quantity but also the quality of the crude oil as it is transferred from the custody of one legal entity to another. There are several components within the skid, an important one being the backpressure regulator. A properly sized backpressure regulator is critical to the overall performance of the LACT unit. To the end user, the value of an appropriately sized back pressure regulator is increased truck filling rate, achieving daily throughput that helps meet production targets, accurate metering leading to correct royalty payments and reduced capital expenses by avoiding the purchase of additional LACT skids.

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