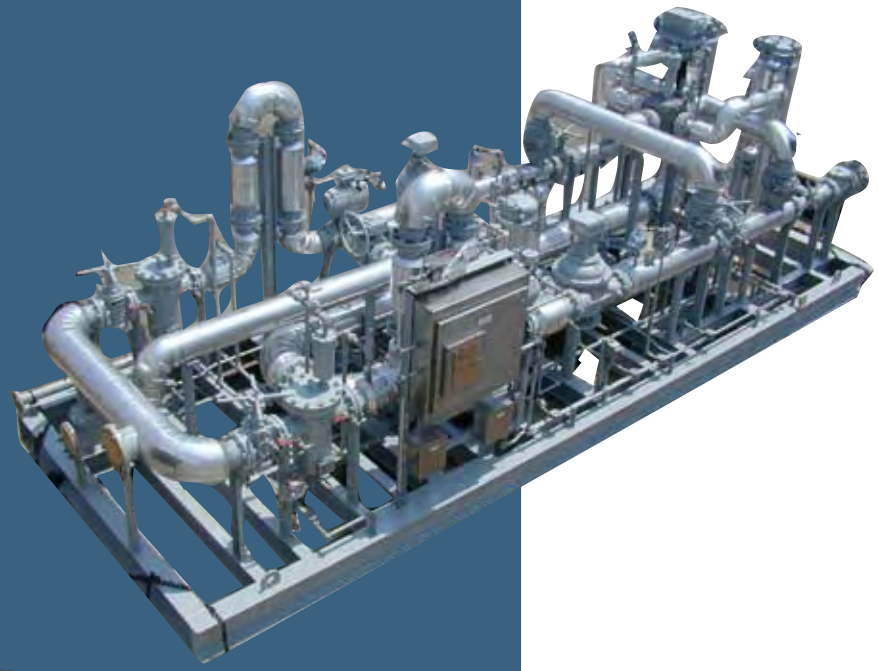
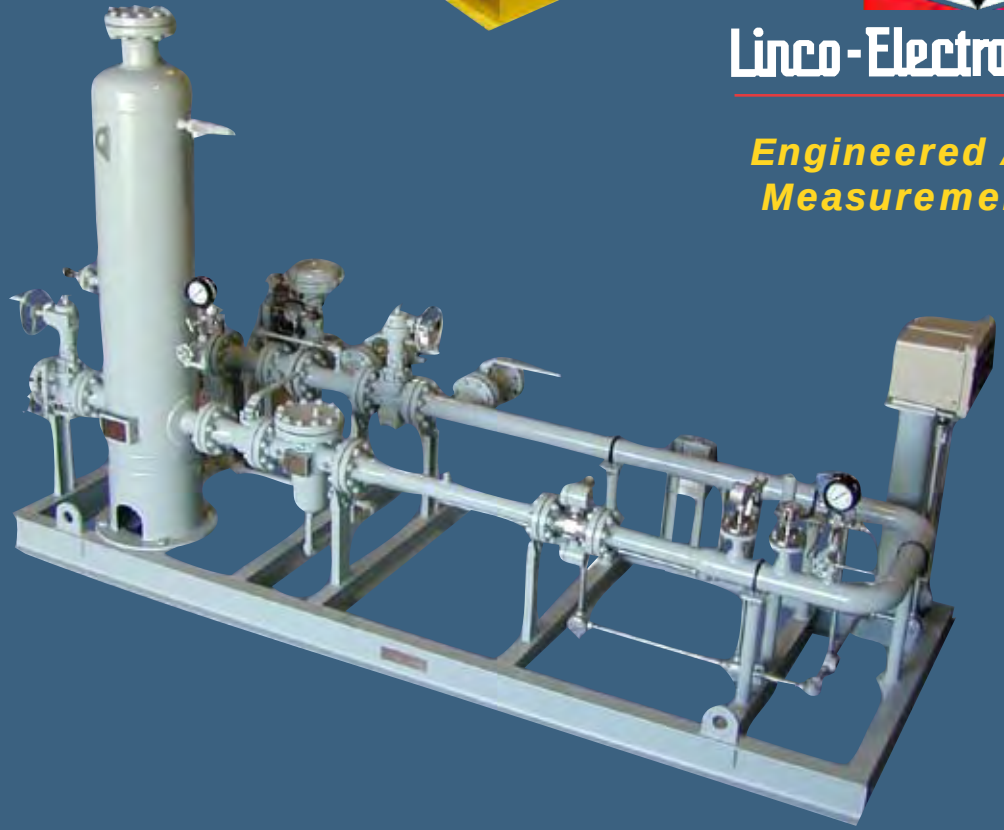


Linco-Electromatic, Inc.

Engineered Automated Measurement Systems



The concept of designing, engineering, manufacturing and commissioning of a complete "Custody Transfer" packaged system to specific customer performance specifications and API guidelines has received increasing attention by the Industry. Prefabricated units consisting of liquid and gas meters, instrumentation, control valves, SCADA, data acquisition, communication and remote accounting systems are among the many features available with Linco-Electromatic's "ENGINEERED AUTOMATED SYSTEMS" team.

Linco-Electromatic, Inc was established in 1967 and is headquartered in Midland, Texas with offices in Odessa, , Corpus Christi, Houston, Kilgore, Wichita Falls, Cold Springs, & Stockdale, Texas, offices also in Shongoloo, Louisiana, Tulsa, Oklahoma Denver, Colorado, Casper, Wyoming, and Seattle, Washington. Linco-Electromatic, Inc. offers single source responsibility and maintains a highly trained staff of designers, engineers, technicians, electricians, fabricators and ASME code welders. The complete shop fabricating complexes occupies over 10,000 square feet of totally enclosed facilities at two locations, with one of the shop facilities located on a fenced 10-acre tract. Both fabricating locations house the most up to date equipment and facilities, which includes inside flow testing that allows testing of pre-fabricated metering systems prior to shipment and commissioning. Also, complete mechanical and electrical checks are made on all units prior to shipment, helping to minimize start-up problems on the job site.

Linco-Electromatic, Inc's many years experience in "ENGINEERED AUTOMATED SYSTEMS" covers a broad range of applications. Successful systems designed and manufactured by us are, top and bottom Transport Loading Systems, LACT Units, Pipeline Metering Systems, Tanker Offloading Systems, liquid and gas Offshore Metering Systems, LPG Driver Attended Metering Systems and Bi-directional Meter Prover Systems.

SHOP FACILITIES

Fab East Facility - 7,500 Sq. Ft. with 2-15 Ton Cranes
4580 West Wall Midland, TX

Fab West Facility - 3,300 Sq. Ft with 2-10 Ton Cranes
11231 West County Road 127 Odessa, TX

Linco-Electrmatic, Inc. has been serving the petroleum industry since 1967 and has personnel with 100 years-combined experience to serve your requirements whether they are for component equipment or "Engineered Automated Systems."

We solicit your inquiries and invite you to visit our web site at www.lemc.com.

LEMC OFFSHORE LACT METERING SYSTEMS

Since offshore gas and liquid metering systems are usually installed on remote production platforms, component reliability and space design are critical. The key to a well-designed and engineered system is a unit that can provide "custody transfer" with the highest degree of accuracy in the harshest possible environment. The most practical approach is to provide duplicate or parallel meter runs to allow continuous measurement in the event of a major metering component failure.

Liquid offshore meters systems typically include:

Charge Pump - The charge pump and motor are the primary energy source for the entire system.

Valves - Provide component isolation as required.

Strainer - An inline strainer should be installed upstream of the sales meters to remove liquid entrained derbies to help prevent damage to the meter. It is recommended that a differential pressure gauge and alarm switch be installed across the strainer to electrically alarm the operator to a high strainer basket differential pressure.

Air Eliminator - An air eliminator is a float-operated device that is used to remove entrained air or vapor from the fluid stream before it enters the meter. Should air be allowed to enter the meter it would be measured as part of the flowing stream, resulting in meter inaccuracy. The air eliminator is installed upstream of the meter in the highest part of the piping system to allow air to migrate and accumulate until it is eliminated. To prevent the air eliminator from inhaling or sucking in air when the float is down and the LACT unit is not in operation, it is important to install a "soft seated" check valve on the discharge of the air eliminator.

BS&W Probe and Monitor - An electronic device that is capable of determining the amount of Basic Sediment and Water (BS&W) is an internal part of offshore metering systems. The system consists of an inline "BS&W Probe" that monitors the entire flowing stream and electronically communicates to a "BS&W Monitor". The ability of this system to accurately signal the LACT Unit on excess BS&W content insures that only the highest quality of "Merchantable Oil" is delivered to pipeline and the pipeline does not have to transfer undesirable BS&W. The BS&W Monitor is used to control a diverting valve, which diverts the fluid stream back to a retreating facility whenever the BS&W content exceeds the Monitor setting. If the BS&W content of the flowing stream drops below the Monitor setting, the diverting valve returns the fluid to the pipeline and normal automatic operation continues.

Static Mixer - An inline piping spool furnished with internal baffles designed to provide a homogenous mixture to help ensure accurate representative sampling.

Sampler System - The sampler system consists of a probe that is used to retrieve a representative sample of the flowing stream and a container that is used to store the collected samples over a specified time period proportional to metered flow. The contents are used to determine the true representative valve of the entire metered stream during the custody transfer. The representative sample contents will determine composite API Gravity and the total percentage of BS&W. The sample container is a storage vessel that is used to collect the contents of all the samples taken during the custody transfer. The container is sized to allow adequate storage during the total custody transfer period. It is important that the container be vapor tight to prevent the evaporation and loss of entrained vapors, which will directly affect average API gravity.

Divert Valve - A three-way valve that is used to direct flow when ever the BS&W content of the fluid stream exceed the setting of the BS&W monitor.

Sales Meter - The meter is used to accurately and precisely measure the total fluid stream and to accumulate the total throughput. The most accurate meter used is the positive displacement meter. In some cases a specially designed turbine type meter (multi-viscosity meter) that mechanically compensates for varying viscosity can be used, provided adequate flow conditioning is provided.

Instruments – Electronic temperature and pressure transducers are provided to transmit to the remote control system to provide the measurement and control required to operate the metering system. In addition pressure gauges, temperature indicators and test thermowells are provided for calibration check of the electronic transmitters.

Meter Prover Loop - The meter prover loop is a manifold using three valves connected to two tees. The typical arrangement is to install the valves and tees so that two of the valves are side mounted and one high integrity double block & bleed valve is in line. This arrangement allows a "prover system" to be connected to the side mounted valves to determine the accuracy of the sales meter.

Back Pressure Valve - The back pressure valve is an automatic valve that is used to hold a minimum pressure against the entire metering system. This valve is required to ensure that the meter always operates against a pressure above the vapor pressure of the fluid being metered.

Check Valve - A check valve is used to prevent backflow of metered fluid from the receiving pipeline back through the metering system. The check valve is installed as the last device in the piping system.

Meter Prover System - A Bi-directional Meter Prover System is incorporated into the piping system to allow meter calibration under actual metering conditions. On larger metering systems it may be practical to consider the use of "small volume" provers in an attempt to

Pictured above:
SCADA Control Panel

Remote Control Panel - The Control Panel is the electrical brains of the metering system and controls the entire operation of the system. Basic systems include;

- One or more flow computers capable of electronic temperature compensation, back pressure control and automatic meter proving (if required).
- BS&W Monitor with divert valve controls.
- Meter Malfunction Control - used to shutdown the system in the event the meter does not register when the metering system is in operation.
- Remote communication to on-shore facilities.

LEMC TRANSPORT LOADING SYSTEMS

The basic transport loading system is designed to provide a completely assembled and tested driver attended, automatic metering station capable of loading one or more products into a multiple component transport. A single transport can be loaded simultaneously with one or more products with each sales meter acting independently.

All skids are custom fabricated and are available with a large variety of options. Basic components include:

Product Inlet Valve - recommended to isolate the strainer and meter for cleaning and maintenance

Strainer with Air Release Valve - recommended for removal of foreign material and small quantities or air that may be present in the product to protect the sales meter from internal damage.

Sales Meter - used to accurately meter various grades of gasoline, diesels or other distillate products. The two most widely acceptable meters are positive displacement and turbine meters depending upon customer preference and accuracy requirements..

Flow Control Valve - combination self controlled valve designed to provide:

- Two-stage control feature to prevent hydraulic "slamming".
- Backpressure to ensure pressure is above product vapor pressure.
- Rate of flow control to prevent loading rates in excess of recommended maximum meter flow rate.

Prover Return Header - used as a means of meter proving without a transport being present. The loading arms can be rotated and connected to the prover return header for proving while the product is returned to storage.

OPTION: ***A three - valve proving loop can also be furnished at each meter position.***

Spring Balanced Hose Loader - used as a reliable and safe means of attachment to a transport for loading within the API "loading envelope". The hose loader is furnished with a dry break coupler to prevent loading if the arm is not rigidly attached to the transport.

Vapor Return Header - used to displace transport vapor to a "vapor recovery" unit during a loading sequence. Header to include vapor hose, flame arrestor, and check valves.

Drain Header - used to drain a transport compartment prior to a loading sequence. Header to include drain hose, sight flow indicator and isolating valves.

Electronic Presets - suitable for local mounting in a hazardous environment designed to control all loading operations. Features include;

- Volume presetting of "water volume" tank capacity to allow for automatic compartment loading.
- Automatic electronic temperature compensation to provide meter registration corrected to 60 degrees F.
- Automatic additive and dye injection proportional to metered product
- Digital valve control to provide opening and closing speed control, rate of flow and differential back pressure (if required).
- Two-way serial communication with a remote accounting system (if required).
- Pulse output to a local printer (if required).
- High frequency output for meter proving (if required).

Local Loading Printer - used to record each metered transaction (if required).

Combination Truck Float Monitor and Electrostatic Ground Device - housed in an explosion proof enclosure with cable and a 7-pin API adapter used to shut down the loading operation on high compartment level in the transport and also used to provide electrostatic grounding of the transport.

Fire Detector - used to monitor the entire loading area and shut down all loading operations in the event fire is detected.

Remote Accounting System - a cabinet mounted system located in a non-hazardous location used to control, audit, monitor, and remotely communicate all loading operations.

LEMC BI-DIRECTIONAL METER PROVER SYSTEMS

The principal of operation of the Bi-Directional meter prover is to provide an accurate and repetitive displacement of liquid through a pre-calibrated volume between two detector switches. Accurate displacement of the liquid is accomplished by forcing an inflated spheroid through a calibrated section of pipe using fluid energy from the stream being metered and recording the metered volume under actual flowing conditions. Since the entire stream of fluid being metered flows through both the meter and the prover, a ratio known as "meter factor" can be determined between the known volume and the volume registered by the meter. This meter factor is used as a multiplier and applied to the volume shown on the meter register to determine true quantity of fluid passing through the meter.

Four-Way Diverter Valve - used to divert flow through the prover system without interrupting flow. Since there is not a closed position on the valve, flow can only be diverted.

Launch Chambers - used to retrieve the spheroid after each run. Launch chambers are also used to help reduce the velocity of the spheroid after completion of a run.

Calibrated Measuring Section - referred to as the volume between detector switches and is expressed as a "round trip".

Pre-Run - a section of pipe located upstream of the detector switches to allow ample spheroid travel time (based on fluid flow rate) before contact with the first detector switch. Pre-run is required to ensure that the four-way valve is fully seated before the spheroid contacts the first detector switch.

Detector Switches - used to electrically detect the passage of the spheroid and to trigger a gating circuit in the electronic meter prover counter.

Spheroid - an inflatable device that is used to displace fluid through the calibrated measuring section.

Meter Pulse Generator - an electronic device that is attached to the gear train of the meter to be calibrated that is designed to transmit high resolution electrical pulses to the electronic meter prover counter.

Electronic Meter Prover Counter - used to receive high resolution electrical pulses from the meter to be calibrated. The prover counter is started and stopped by the actuation of the prover detector switches based on the passage of the spheroid.

Water Draw - a procedure used to calibrate a Bi-Directional meter prover by collecting water displaced by the spheroid into containers of known volume that have been certified by the National Institute of Standards And Technology (NIST).

LEMC PIPELINE ACT SYSTEMS

The simplest and most effective way to transfer the ownership of liquid hydrocarbons between a buyer and a seller is through the use of an accurate liquid meter. With the aid of additional components, the liquid meter is capable of unattended measurement with maintained accuracies of 0.25%, or better. This measurement system is commonly referred to as a Lease Automatic Custody Transfer (LACT) Unit when ownership is transferred at a production lease. When ownership is transferred away from a production lease, such as a transfer between Pipeline Companies, a measurement system may be referred to as an Automatic Custody Transfer (ACT) Unit.

Due to the higher volumes normally encountered on pipeline "custody transfer" deliveries, it is common practice to consider multiple parallel meter runs. The use of parallel runs will also reduce the size of the meter provers required. Basic components include;

Inlet header with multiple outlets.

Valves – Provide associated isolating valves as required.

Strainers - Individual inline strainers should be installed upstream of the sales meters to remove liquid entrained debris to help prevent damage to the meter.

Static Mixer – An inline piping spool furnished with internal baffles designed to provide a homogenous mixture to help ensure accurate representative sampling.

Sampler System - The sampler system consists of a probe that is used to retrieve a representative sample of the flowing stream and a container to store the collected samples over a specified time period. The contents of the sample container are used to determine the true representative valve of the entire metered stream during the custody transfer. The representative sample contents will determine composite API Gravity and the total percentage of BS&W. The sample container is a storage vessel that is used to collect the contents of all the samples taken during the custody transfer. The container is sized to allow adequate storage during the total custody transfer period. It is important that the container be vapor tight to prevent the evaporation and loss of entrained vapors, which will directly affect average API gravity.

Sales Meter - The meter is used to accurately and precisely measure the total fluid stream and to accumulate the total throughput. The most accurate meter used is the positive displacement meter. In some cases a specially designed turbine type meter (multi-viscosity meter) that mechanically compensates for varying viscosity can be used, provided adequate flow conditioning is provided. In addition, Coriolis or Ultrasonic meters may be considered.

Instruments – Electronic temperature and pressure transducers are provided to transmit to the remote control system in order to provide the measurement and control required to operate the metering system. In addition pressure gauges, temperature indicators and test thermowells are provided for calibration check of the electronic transmitters.

Meter Prover Loop - The meter prover loop is a manifold using three valves connected to two tees. The typical arrangement is to install the valves and tees so that two of the valves are side mounted and one high integrity double block & bleed valve is in line. This arrangement allows a "prover system" to be connected to the side mounted valves to determine the accuracy of the sales meter.

Back Pressure Valve - The backpressure valve is an automatic valve that is used to hold a minimum pressure against the entire metering system. This valve is required to ensure that the meter always operates against a pressure above the vapor pressure of the fluid being metered. When a centrifugal charge pump is used, the backpressure valve holds a constant pressure against the pump, which maintains a constant flow rate on the meter. Provided the backpressure setting is always above the vapor pressure of the fluid, it is possible to adjust flow rate through the meter by adjusting the valve.

Check Valve - A check valve is used to prevent backflow of metered fluid from the pipeline back through the metering system. The check valve is installed as the last device in the piping system.

Meter Prover System – A Bi-directional Meter Prover System is incorporated into the piping system to allow meter calibration under actual metering conditions. On larger metering systems it may be practical to skid mount the prover and locate adjacent to the metering skid with interconnecting piping.

Local Control Panel - The Control Panel is the electrical brains of the metering system and controls the entire operation of the system. Basic systems include;

- **One or more flow computers capable of electronic**

LEMC GAS METERING SYSTEMS

Linco-Electromatic, Inc designs and builds gas measurement systems in accordance with the latest Industry accepted practices. These include A.G.A. Report #3, API 14.3, ANSI B31.3 and ANSI B31.8. Gas Systems are designed for pipeline applications as well as offshore systems. Systems are available in operating pressure up to 900# ANSI ratings. Typical meter run components include:

Upstream section with flow conditioning as required.

Meter - Typical meters include single chamber or dual chamber fittings & multi path ultrasonic meters.

Downstream section

Instruments - Electronic temperature and pressure transducers are provided to transmit to the remote control system to provide the measurement and control required to operate the gas metering system. In addition pressure gauges, temperature indicators and test thermowells are provided for calibration check of the electronic transmitters.

Valves - Provide associated isolating valves as required.

Sampling Systems -

Remote Control Panel - The Control Panel is the electrical brains of the metering system and controls the entire operation of the system. Basic systems include;

- **Flow computers capable of determining flow quantities.**
- **Remote communication to on-shore facilities.**

LEMC LPG METERING SYSTEMS

The safest and most accurate method of transferring LPG from bulk storage to a transport is through a reliable metering system. The basic concept in designing an LPG Metering System is to provide dependable components, which can safely be operated by drivers or plant personnel. The system must provide a means to limit the filling of the transport and provide a hard copy of the total volume and the amount of odorant injected for each loading transaction.

Basic equipment and design considerations should include the following:

DESIGN CODES

The thorough review and understanding of Design Codes and Safety Standards are the first steps in planning a successful installation. Design Codes may vary slightly from state to state. Most states adopt National Codes and guidelines such as the Department of Transportation (DOT) covering transportation regulations, the American National Standards Institute (ANSI) covering pipeline and refinery locations, the American Petroleum Institute (API) covering custody transfer metering and proving and the National Fire Protection Agency (NFPA) covering safety design considerations.

DESIGN CONDITIONS

The following parameters should be considered in the design of an efficient and reliable metering system;

Flow Rate - Design flow rate is based on the size and type of filling connections furnished on the LPG transports to be loaded. Loading rates will also be affected by the LPG transports internal liquid and vapor connections and whether they are equipped with internal spray bars. Once design flow rate is established, the metering and piping system can be sized.

Working Pressure - Design working pressure is based on the vapor pressure of the product at the highest operating temperature and the total pressure drop between the storage facility and the transport loading manifold. Once design working pressure is determined, the LPG transfer pump rate and the piping ANSI rating can be established.

Operating Temperature - Product temperature, as well as ambient temperature, must be considered in order to prevent the possibility of measuring vapors instead of liquids.

Metering Location - After a location is selected, the line size and distance between the storage facility and the metering facility should be considered. Whether the product supply lines are to be buried, exposed or insulated should be evaluated.

Odorant Rates - Since LPG is colorless, odorless and heavier than air in the vapor state, it is necessary to add an artificial odor to warn users of its presence. The most common odorant in use today is ethyl mercaptan. Most states require a minimum of 1.0 pound of odorant be injected into 10,000 gallons of LPG. Due to a condition called "odorant fade", which occurs in new tanks and piping systems, and to allow a margin of safety, most installations agree on an odorant rate of 1.5 pounds of odorant per 10,000 gallons of LPG loaded.

Emergency Shut-Down Valves (ESD) - An ESD valve is a self- contained, normally closed valve which can be actuated on loss of a control signal to automatically shut-down product flow any time there is an emergency condition. These valves are installed at the storage facility, at the inlet to the metering system, at the outlet of the metering system or at all locations. When used at the inlet to the metering system, the ESD valve can also be used for product isolation and for strainer cleaning purposes.

Strainer - A strainer is a device which houses a removable perforated basket designed to collect solid materials present in the flowing stream. A strainer is not designed to filter the product, but to collect large contaminants, which may cause damage to the meter.

LPG Condensing Tank - Condensing tanks are used to ensure a liquid head on the meter at all times and to provide for product condensation by condensing vapors as they are formed during product flow. Condensed liquids are also used to fill voids created by product contraction during idle periods. Depending upon the distance from the storage facility to the metering and loading system, it may be necessary to consider the use of an LPG condensing tank.

Meter - The meter is the most critical component of an LPG Transport Loading System and care should be given in selecting only the most accurate meter. The most common types of meters in use today are the turbine meter, the positive displacement meterand the Coriollis meter.

- The turbine meter is an inference type meter that derives flow based on properties of the flowing stream, such as angular velocity, which is proportional to flow. Since the turbine meter depends upon properties of the flowing stream, it is necessary to condition flow into the meter using doweled upstream and downstream piping sections in accordance with API Guidelines. Turbine meters use an electronic pick-up coil and preamplifier to transmit meter pulses to an electronic counting totalizer. The turbine meter can be an accurate LPG metering device provided flow parameters are controlled and suitable electronics are used. The advantage of the turbine meter over the positive displacement meter is that it does not use an external packing gland and is less expensive to install and repair. In most cases a turbine meter will be one pipe size smaller than an equivalent positive displacement meter. The disadvantage of the turbine meter is a lower accuracy based on fluctuating flows during start/stop loading. It also develops a higher pressure drop compared to the positive displacement meter.

- The positive displacement meter determines flow through the use of an internal rotating device by dividing the flowing stream into discrete volumetric segments using a small amount of energy from the flowing stream. Metered volume is transmitted using a mechanical gear train through a packing gland. Meter accessories may be attached to the meter to provide electrical pulse outputs and mechanical totalization. The advantage of the positive displacement meter over a turbine meter is that it is more accurate, does not require flow conditioning pipe spools and is a low pressure drop device.

- **Coriollis meter-is an interface meter that derives its flow based on Newton's second law, F-MA. A coriolis meter vibrates to cause fluid acceleration in a rotating plane of reference. The vibrating flow & tubes & fluid flow react and are deflected by the resulting forces. The amount of defection is representative of the mass flow rate. Actual volume= measured mass flow/measured density.**

Prover Manifold - Regardless of the meter selected for custody transfer, provisions must be made to allow meter calibration. A simple solution is to provide a three-valve prover manifold using two piping tees with two valves side-mounted between an inline valve. The inline valve must be a quality block and bleed type with provisions to determine seal leakage during a meter calibration, since every drop of liquid going through the sales meter must go thorough the prover system. The prover manifold allows the sales meter to be placed in series with a proving device of a traceable and known volume. The most common provers used for LPG meter calibration are the bi-directional prover, the small volume prover and, in some cases, the master meter.

Control Valve - Installation of a control valve that is capable of providing differential back pressure and flow control is the key to accurate metering. Differential back pressure control is accomplished by continually monitoring temperature and pressure during a transport loading and adjusting valve position to insure that product is always metered above vapor pressure, regardless of the product flowing temperature. The most desirable valve is easily and accurately controlled by either a mechanical or electronic preset system. It should also be capable of providing controlled opening (to prevent line surges), controlled closing (to prevent hydraulic shock) and of being used as an emergency shutdown valve. It is important to consider a dynamically stable "fail closed", pneumatically operated diaphragm valve rather than a self contained valve dependent upon LPG energy and differential pressure across the valve to provide control. Most self contained valves depend upon solenoids and pilots to provide valve control and they are difficult to control with fluctuating flows generally encountered in loading LPG transports. Maintenance problems are greatly reduced by using the diaphragm type valve, with the only disadvantage being that instrument air or nitrogen is required during operation.

Discharge Spool and Bulkhead - A discharge spool equipped with all necessary pressure gauges, thermal relief valves, an odorant injection point and a mechanical excess flow valve (if required by regulations) must be provided. A bulkhead is a fabricated steel or concrete structure that is used to rigidly mount and install the load arms to prevent damage to the piping system in case a transport accidentally drives away with an arm connected. It is important to install the arm in a vertical position because it is easier to control an LPG fire in the vertical position should a transport separate a loading arm from a bulkhead and a fire develop. Some states require that a mechanical excess flow valve be installed upstream of the bulkhead to limit the amount of LPG that escapes if a loading arm is accidentally separated from the bulkhead. Some states also require that the outlet piping to the bulkhead be furnished with a length of flexible hose to help absorb the shock should a loading arm be pulled away from the bulkhead.

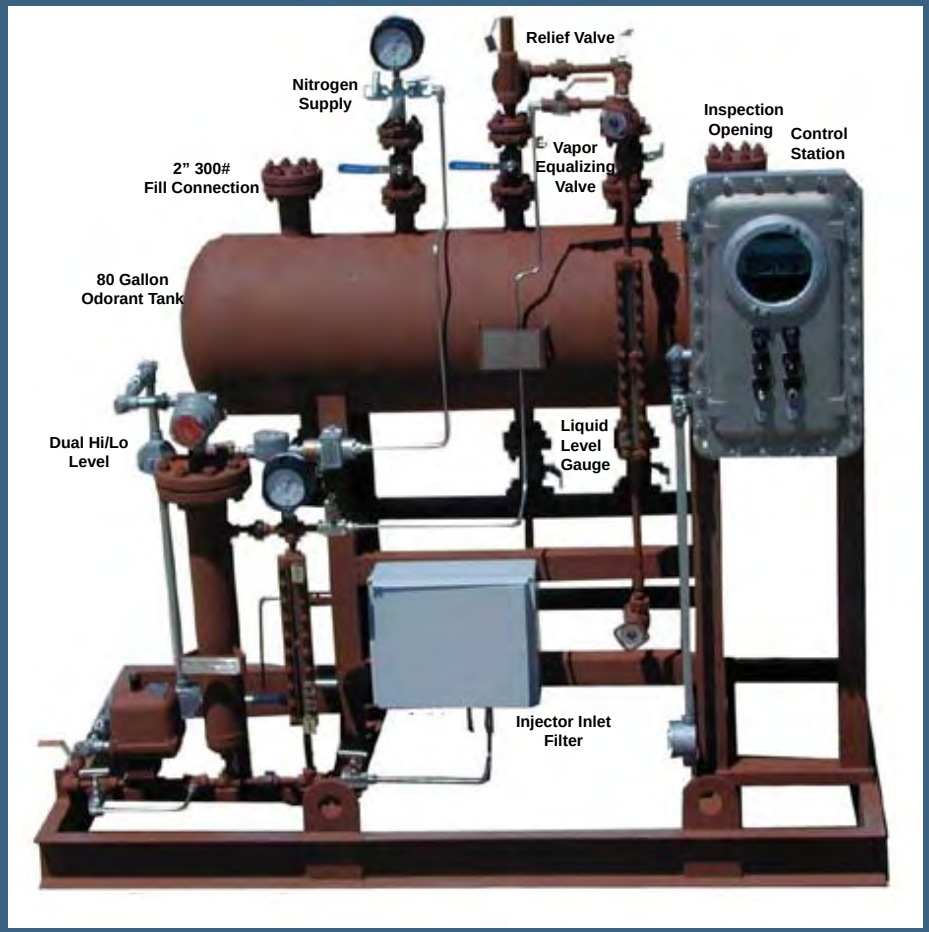
Rigid Loading Arms Vs Hoses - A rigid loading arm is constructed of piping sections connected to several swivel joints to allow manipulation. The weight of a typical arm is offset using a counterbalance or spring-balance assembly. An advantage of the rigid loading arm is that it is an extension of the piping system and a manual shutoff valve can be installed on the outlet end. Many installations prefer to use hoses in lieu of rigid loading arms due to their flexibility and ease of attachment to an LPG transport. The disadvantages of the hose are the low rated working pressure (usually 350 PSIG maximum) and the potential damage to the hose due to high thermal expansion of LPG if a hose is left pressurized. Even with the use of thermal relief valves, most installations prefer to bleed the hoses to a flare header after each loading sequence to prevent possible over-pressurization due to thermal expansion. Should hoses be considered, use only hoses which are Underwriters Laboratories (UL) approved and stamped for LPG service.

Vapor Return Arms or Hoses - Should a vapor return arm or hose be required to relieve transport pressure buildup during loading, it should be installed using a bulkhead. A check valve should be furnished immediately upstream of the bulkhead to prevent backflow of product to the atmosphere in the event an arm or hose is pulled away by the transport.

Odorant Injection System –Since LPG is colorless, odorless and heavier than air in the vapor state, it is necessary to add an artificial odor to warn users of its presence. The most common odorant in use today is ethyl mercaptan. Most states require a minimum of 1.0 pound of odorant be injected into 10,000 gallons of LPG. Due to a condition called "odorant fade", which occurs in new tanks and piping systems, and to allow a margin of safety, most installations agree on an odorant rate of 1.5 pounds of odorant per 10,000 gallons of LPG loaded.

The basic design of all LEMC Automatic Odorant Injection Systems is to provide a simple, reliable, "leak free" and fail-safe means of injecting odorant into an LPG stream proportional to metered flow. A basic requirement is to provide a "hard copy" of the amount of odorant injected on the same printer as used to record total LPG volume in order to protect LPG Plant Facilities with an "audit trail". The LEMC Automatic Odorant Injection System is well suited for LPG Transport Loading, Rail Car Loading or Pipeline Odorant Injection. All components used in the LEMC Automatic Odorant Injection Systems are suitable for installation in Hazardous Areas and meet National Fire Protection Agency (NFPA) and Department of Transportation (DOT) Requirements.

A fail-safe automatic odorant injection system should be selected that injects odorant proportional to flow and provides a printed record of the odorant injected for each loading transaction. The system must be designed to alarm and shut down loading any time an odorant malfunction



Through good design and planning, a safe and reliable system can be provided for LPG Driver Attended Transport Loading.

glass assembly be provided to give operators a visual indication of the total amount of odorant injected for each loading transaction. Refer to the drawing below for a typical odorant system design using a pressurized nitrogen storage tank, a calibrated sight glass assembly and an odorant injector.

Electronic Presets - Provisions should be made to allow operators to preset the volume of product to be loaded. This is best accomplished using electronic or mechanical preset counters. Electronic presets should be capable of presetting either temperature corrected (net) volumes (using a temperature transmitter input), non-temperature corrected (gross or water volume) and pressure compensation (using a pressure transmitter input). An electronic preset should provide visible indications of all phases of operation, including alarms and safety shutdowns. In addition, they should provide full valve control by manipulation of simple solenoid controls installed on the conback pressure (using a pressure transmitter input), flow rate, slow speed start and zero no-slam shutoff. Most electronic presets have multiple transmitter outputs as well as RS-232 and RS-485 communication outputs, which lend themselves to both simple and sophisticated automation systems.

Printer - A printer capable of providing a record of each transaction should be provided. The printer should be capable of printing the amount of LPG metered as well as the amount of odorant injected for each loading transaction.

Electrostatic Grounding - Electrostatic grounding is used to discharge or dissipate a static buildup, which may develop on an LPG transport prior to loading. The electrostatic grounding system should provide a visual indication, as well as an electrical permissive signal, when an LPG transport has been satisfactorily grounded. If a grounding connection is interrupted during a loading sequence, the system should be designed to shut down loading until the ground is re- established.

Safety Features - Safety features should include automatic "ESD" valves, which are designed to shut down all loading when activated locally or from a remote location. Additional safety devices should include fire sensors and combustible gas detectors.

Weather Protection - A drivers' building with insulation and heating should be considered in colder climates. As a minimum, a canopy should be considered to help minimize the effect of the sun on piping thermal expansion in warmer climates.

Remote Data or Accounting System - The application may dictate the installation of a Remote Data or Accounting System utilizing a microprocessor or personal computer (PC) designed to interface with the loading system.

LEMC CONTRACT SERVICES

In addition to the distribution, manufacturing, design, engineering and consulting services provided to the liquid custody transfer measurement industry, Linco-Electromatic, Inc. offers a full range of contract field services. These services include field maintenance, repair and on-site liquid meter calibration using portable Bi-Directional Meter Provers. Linco-Electromatic operates and maintains 18 field service and meter calibration vehicles operating out of six different locations with the capability of providing service over a four state area. The portable Bi-Directional Meter Provers range in proving capacity from 10 to 2,200 barrels per hour and operating pressures up to 1,440 PSIG. Currently, the fleet of portable provers provides for the calibration of over 1,100 custody transfer meters each month in the refined product marketing terminals, production LACT Units, pipeline metering stations and petrochemical plants. Each portable prover contains state of the art electronic equipment that minimizes human errors and provides for printed proving reports. Most of the portable provers are automated to provide for automating proving with automatic report generation. All proving reports are computer generated using Windows based software developed in accordance with the latest practices of the API Guidelines. The software and the automatic proving design have been developed by and for Linco-Electromatic.

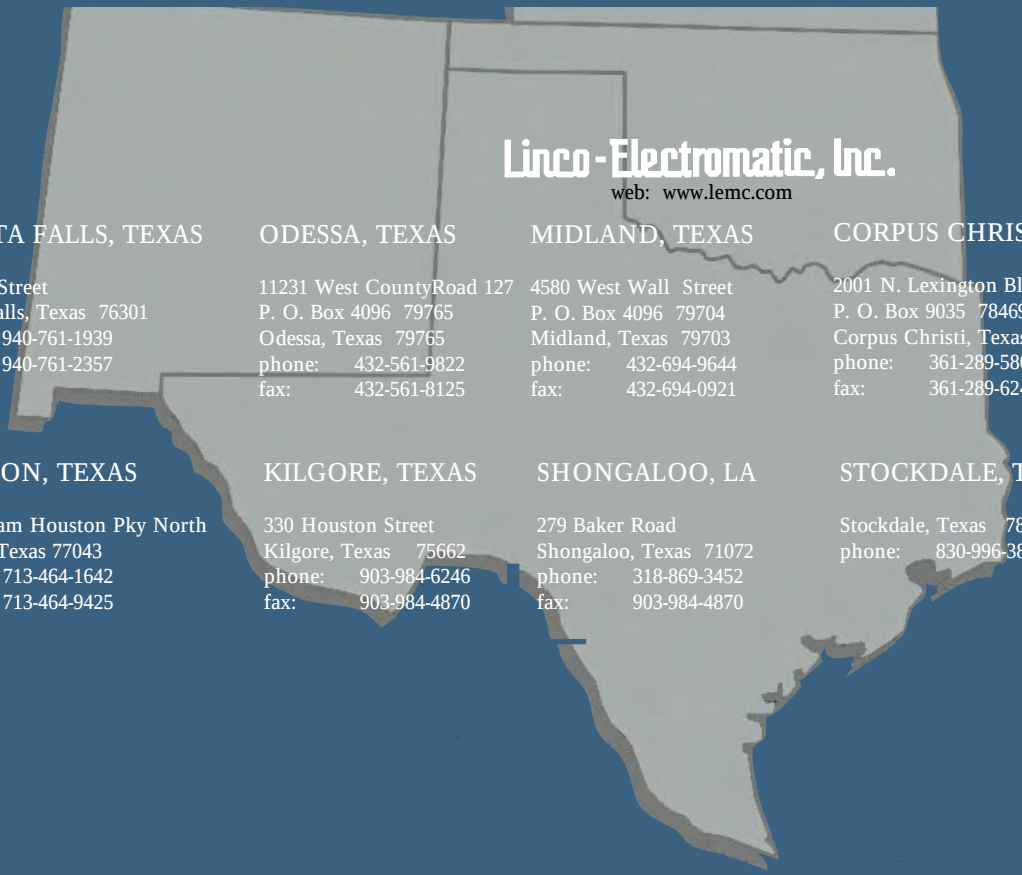
Should a meter fail to yield a satisfactory meter factor, our well trained staff of Service Technicians stand ready to handle either an on-site meter repair or an in-house cleaning, repair and testing at one of our facilities. Each of our five service locations maintains a large inventory of parts and complete metering assemblies. In addition, we maintain a large inventory of rebuilt meters and inner-mechanism available for sale or exchange.

For certified prover calibrations, Linco-Electromatic maintains a portable Water Draw System, which is available for in-house or field use. This service offers the utmost accuracy available through the use of volumetric containers, which are certified by the National Institute of Standards and Technology (NIST) out of Washington, DC.

If your next liquid meter requirement involves a new meter, rebuilt meter, service, re-calibration, engineered metering system or consultant services, Linco-Electromatic, Inc. is available to handle your needs.

LEMC LOCATIONS TO SERVE YOU

Service Areas Include: Texas, New Mexico,Oklahoma, Louisiana, Arkansas , Kansas & Rocky Mountain regions



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