ACCURATE MEASUREMENT

Technical Library

As A Service to the HydroCarbon Measurement Industry, CRT-SERVICES Curates this collection of Digital resources.

WWW.CRT-SERVICES.COM
WWW.CRTSUPPLY.COM

11133 Interstate 45 S Suite O
Conroe, Texas 77302
(713) 242-1190

NGL Terminal Operations and Measurement
Class 2500

Blake Stinson
Terminal Manager
Murphy Energy
Kingfisher, OK

Surely one of the most difficult liquid petroleum products to store, handle, and measure with accuracy is natural gas liquid, or NGL. Historically thought of as a nuisance byproduct, many companies within the petroleum industry once ignored this product and the attention to detail that it requires. With today's ever expanding natural gas production, increasing volumes of NGL are demanding further consideration. In addition, as each penny of the industry becomes pinched, more companies are realizing the profit and extended cash flow that NGL's can produce. Natural gas liquids present several obstacles when trying to store, transport, and accurately measure the product. Most of the components that make up natural gas liquids are in a gaseous state at atmospheric conditions, and thus create the largest misunderstanding of the product.

As the volume of NGL's continues to rise, more terminals are being constructed in order to facilitate the transportation of the product to market. Traditionally, NGL was primarily produced at a gathering separation facility that was connected via pipeline to a natural gas liquid market. With increasing volumes being separated at the wellhead in the field, and with separation facilities reaching allocations of volume on their connected pipeline, NGL's are constantly "searching for a home". New NGL terminals allow volumes of natural gas liquid from the field and over producing separation facilities to be transported by truck to a central location and injected into an alternative pipeline system. However, with the volatility, difficult handling, and complex measurement of NGL, these terminals can be quite cumbersome to operate.

Natural gas liquid is primarily composed of ethane, propane, butanes, pentanes, and other heavier natural gasoline components. All of these products have extremely low flashpoints and high Btu values. Simply put, they ignite very easily and burn exceptionally hot. For this reason the primary concern of handling NGL is, and should always be, safety. NGL is a colorless and odorless liquid while contained under pressure. Once released into the atmosphere, it quickly becomes a vapor that is heavier than air and can settle to the ground in still air. Depending on outside conditions, such as wind and humidity, the vapor cloud that is produced by released NGL may be visible or invisible. However, this vapor cloud is most definitely dangerous. Any and all ignition sources should be kept far away from any area in which NGL may be released. Open flames, electrical sparks, vehicles, and especially static electricity, are all examples of possible ignition sources for natural gas liquid. The first two of these examples are basic everyday points of every safety official for any company. The other two examples, though common, require additional explanation while handling NGL in and around a terminal.

Vehicles are a necessity in the transportation of NGL's. Whether it's a vehicle used by an operator around a terminal or the tractor / trailer that is picking up and delivering the product, caution and a heightened awareness should always be used around the presence of NGL. Within the petroleum industry, a diesel powered vehicle has always been the preferred choice for use. As gasoline driven engines produce a known spark and diesel engines are driven by compression alone, the thought has always been that diesel engines are safer. However, is this truly the case? Don't both types of engines require an alternator for charging purposes? Furthermore, are the alternators of these vehicles intrinsically safe like all other electrical equipment must be within a hazardous area? The answer is no. Any and all vehicles present a possible source of ignition to a release of NGL. In addition, the release of NGL itself can be a potential hazard to the diesel engine. As the natural gas liquid turns from liquid to gas, an expanding cloud of vapor is produced. As a diesel engine is running it is constantly pulling air into the intake of the engine. If this air is replaced by NGL vapor, the diesel engine will pull the flammable vapor into the engine causing the motor to over accelerate to the point of catastrophic failure. Literally, pieces of the engine can become projectiles and spark creating hazards. For this and other reasons all vehicles should be kept from areas of potential NGL release. But what about terminals that require a tractor / trailer to usually pull into a loading or unloading area and connect to a bulkhead where a release, though small, is certain to occur? This answer is simple; NEVER leave a tractor running while loading or unloading NGL in a terminal. Only allow the tractor to pull into the designated loading and unloading areas while no release is present, then immediately stop the engine. In retrospect, only allow the tractor to start up and exit the load / unload area after all connections have been uncoupled and all releases have been given sufficient time to dissipate.

Static electricity is another potential hazard that poses an increased and unique risk to NGL and terminals that handle the product. The components that make NGL are mostly gases that, when compressed by pressure, become liquid. This liquid lacks lubricity when compared to other petroleum products such as crude oil or diesel fuel. Therefore, as NGL is pushed through piping, pumps, and loading hoses, it actually produces its own static electricity. For this reason, all piping, pumps, storage vessels, compressors, and transporting vehicles must be attached to a grounding bed or through ground permissive equipment. Terminals that receive tractor / trailers transporting NGL should use ground permissive equipment that allow valves and compressors or pumps to become operational only when an ensured ground is achieved on the transporting vessel. Another consideration around NGL, especially when handling or unloading, is clothing. Clothing should be a flame retardant fabric such as NOMEX or treated cotton. These types of clothing materials don't generate as much static electricity as other fabrics. Polyester and especially nylon, the common windbreaker jacket or rain coat material, should never be worn around a possible release of NGL. Movement from your body produces static within your clothing. As a precaution, those people handling hoses, sampling equipment or performing other duties involving connecting or disconnecting NGL equipment should always discharge the static they have built up prior to touching the connections. This can be done by simply touching a piece of metal, not near the connection, before coupling or uncoupling any connection.

The safe handling of NGL for a terminal should always be the primary goal of the facility. The next most important element, and possibly the most difficult, is measurement. There are several pieces of equipment that a terminal needs to accurately measure the NGL that comes through the facility. The first is a certified truck scale. Because NGL is a composition of many different products, the volume delivered by transport must be obtained first by determining the net weight of the product taken from the transporting vessel. When the transport arrives, first, a gross weight is taken. Then, after the transport is unloaded, it must weigh again to determine a tare weight. The tare weight subtracted from the gross weight gives us the net weight of the product that was unloaded. For example; If the truck weighs 80,000 pounds upon arrival, then 39,000 pounds after unloading, the net weight of the product is 41,000 pounds, (80,000 – 39,000 = 41,000). Truck scales should be able to weigh in at least 20 pound increments. The more precise the truck scale is the more precise the measurement will be. In addition, the scales should be certified accurate at least one time per year but preferably every six months.

Many people will argue whether unloading or loading NGL, a meter is a more accurate means of measurement. However, this is not the case. Vessels that store or transport NGL, commonly known as bullet tanks, hold the liquid NGL and must contain a vapor space above the liquid level in the tank. Also it is important to realize that this vapor space is not void or full of air but is actually NGL product that lacks the required pressure to remain a liquid and has therefore turned into a gas or vapor. This vapor, in other words, is product in its gas form, not liquid. Usually, there are two connections on the bullet tank. One of the connections is to the bottom liquid portion of the tank and the other is to a stand pipe that runs through the interior of the vessel to the vapor space in the top of the tank. Another important factor to understand is though a vessel or transport may be considered liquid empty it is still full of vapor and that this vapor is still product. When NGL is transferred from a storage vessel to a transporting vessel, both the liquid outlets and the vapor outlets are connected between the tanks. As the liquid from one vessel moves to the other, the vapor of the tank accepting the liquid is displaced back to the vessel that is losing the liquid. If a meter is used to measure the liquid that is transferred, the vapor being given back to the transferring vessel is not being accounted for. And to reiterate, the vapor is product and therefore if we don't account for the vapor, we are not realizing or measuring part of the product. For this reason weighing the net product by use of scales is the most accurate means of measurement for NGL when transporting by tractor / trailer. Note also, that even if we do measure and account for the vapors returning to the tank being emptied, the measurement error is higher than that of scales, which are typically capable of +/-0.1% accuracy, or better.

Once scales have been used to determine a net weight of the product, this weight can be used to determine the net gallons that were unloaded or loaded from the transport. During the loading or unloading process, a sample of the product should be taken into a pressurized hydrometer cylinder containing a certified hydrometer appropriate for the density of the product being sampled. This hydrometer should read in specific gravity not API gravity. Once an observed specific gravity and an observed temperature have been determined, the conversion to the product specific gravity at 60 degrees Fahrenheit (60F) should be calculated. This should be done using the ASTM abridged table 23-LPG. Now that we have a net weight and a representative specific gravity at 60F of the product, the net gallons can be calculated. This is done by taking the net weight divided by the weight of water at 60F according to GPA Standard 2145 (8.3372), and dividing that answer by the specific gravity of the product at 60F. This answer is the net gallons of the product loaded or unloaded. For example; if the net weight is 41,000 pounds, and the specific gravity at 60F of the product is .550, the net gallons calculated should be 8941.30578 gallons, (41,000/8.3372=4917.71818/.550=8941.30578).

With the total net gallons of the product calculated, we now must realize that these net gallons are only accurate if the load was a uniform product such as propane. Because NGL is composed of several different types of products each with differing molecular sizes, the net gallons that were determined are not truly accurate. For better explanation, you must think of it like this. If you pour one gallon of marbles into a bucket, then pour one gallon of sand into the same bucket, the remaining result will not be two gallons of volume. Because the sand is a smaller particle than the marble, the sand will settle into the nooks and voids between the marbles. Thus the outcome of both gallons of larger and smaller particles will result in less than two gallons. NGL is the same way. Because the molecules of the propane, butane, ethane and other components are all of differing sizes, they must be separated in order to know how much volume of each component there actually is. This can be done by adhering to GPA Standard 8173 and with the use of a gas chromatograph or GC. When using a GC for liquid sample analysis it should be done in accordance with GPA Standards 2165, 2177, or the usual 2186, depending on stipulations of the contract between parties. A gas chromatograph takes a representative sample of the product and separates it into its respective molecular weight percentages. These molecular weight percentages are then calculated into volume percentages by use of GPA Standard 2145, which tells us the volume of each component at standard conditions. Once the liquid volume percentages have been calculated, these percentages of the representative sample can be applied to the net gallons that we previously determined.

When a GC separates a sample it is usually reported in molecular weight percentages and liquid volume percentages. Most gas chromatographs with today's technology have the ability to do the complex calculations from molecular to volume percentages for us. In addition, the report generated lists the components of interest in increasing carbon or C structures. This list is primarily in this order; Nitrogen, CO_2, C1 (methane), C2 (ethane), C3 (propane), IC4 (isobutane), NC4 (normal butane), IC5 (isopentane), NC5 (normal pentane), and C6+. Since each of these components varies in value to the producer and the buyer, it is necessary that a terminal possess a gas chromatograph or have easy access to a laboratory that can sample all of the incoming product streams. It is also necessary to understand that NGL produced at any one location can and will vary in composition. Having an accurate analysis of product delivered into a terminal is extremely important. Because this compositional breakdown is what a terminal depends on to pay their customer correctly and to get payment for themselves upon delivery into a pipeline, having good samples and accurate analysis is crucial to a terminal's successful operation.

Proper sampling of NGL determines the accuracy of analysis, density readings, and other testing common within an NGL terminal. More importantly, having the correct sampling equipment is a necessity. When taking samples for compositional analysis done by gas chromatograph, the best and most accurate equipment for containing your sample is a piston type cylinder. Samples taken into piston type cylinders should be in accordance with GPA Standard 2174. A piston type sample cylinder is the best way to ensure the sample is in complete liquid state while filling and especially for and during analysis. A piston type sample cylinder has two areas of fill space separated by a sealed piston, keeping the two areas of space separate from each other. On one side of the piston is a space usually filled with nitrogen, helium or other inert gas. On the other side of the piston is the space where the NGL sample will be filled into and contained. Before procuring a sample, the product side of the cylinder is flushed with an inert gas at least three times to ensure no residual product is left within the cylinder. After the product side of the cylinder is free of residue, the other or "pressure" side of the cylinder is filled with and inert gas such as nitrogen (an inert gas that is not part of the product). As this is done, you will notice by a magnetic gauge on the cylinder that the piston will move all the way to the bottom, into the product side of the cylinder. It is important to pressurize the cylinder to a psi above the vapor pressure and line pressure of the product or piping through which it travels. Now the cylinder is ready to fill with an NGL sample. Next, you must connect the product side of the cylinder to the piping or outlet where you wish to obtain the sample. When first connected, and with valves open to the product side of the cylinder, no product should begin to enter the cylinder. If product does begin to immediately enter the cylinder, you must stop and pressurize the cylinder to a higher psi or the sample is already in vapor form and inaccurate. Now, gently and slowly open the valve on the pressure side of the cylinder. As the inert gas is released from the cylinder, it should slowly allow product to enter the cylinder and the piston to travel towards the inert gas side. Allow the product to fill the cylinder to no more than 80% of the cylinder volume. Once the correct volume is achieved in the cylinder, you must shut the valve on the inert gas side of the cylinder and then close the valves on the product side. This will stop the product from filling the sample cylinder any further. Once the sample is contained in the cylinder, it is almost ready to be used for analysis. Now, the sample is contained in a piston cylinder and has been filled under pressure, however we must still increase the pressure of the piston type cylinder before we run through a GC. Because most samples of NGL contain components such as ethane, with vapor pressures as high as 600 psi, sufficient pressure needs to be placed on the cylinder to ensure the entire sample is in liquid form. For most analysis, a pressure of 800 psi is sufficient to ensure a pure liquid sample is being analyzed.

An important part of operating an NGL terminal is ensuring that the product being delivered and shipped conforms to contract specifications. Most custody transfer contracts stipulate certain requirements that the product must meet to be considered acceptable. A few examples and the most common specifications for NGL are; composition requirements, copper strip testing to guarantee lack of corrosion, H_2S concentrations, color of product by Saybolt test, and absence of free water. All NGL terminals should have the equipment necessary to ensure that at least these requirements are met by the product that they are accepting and shipping.

Product composition specifications usually dictate certain allowable liquid volume percentages of particular components of NGL. Most contracts require that the compositional analysis be run in accordance with GPA Standard 2186. Usually there are about six requirements that the product must meet. First, the liquid volume percentage of carbon dioxide, or CO_2, must be no more than .35% of the total liquid volume of the ethane volume percentage. Also, the volume percentage of total ethane is a usual specification, but contracts vary widely as to what is acceptable. Next, the liquid volume percentage of methane must be no more than .5% of the total NGL volume, and simultaneously be no more than 1.5% of the total ethane volume. In addition, the total liquid percentage by volume of aromatics (benzene, toluene, and xylenes) within the product can usually be no more than 10% of the total, and lastly, the liquid volume percentage of olefins (ethylene, propylene, butylenes, etc.) must be less than 1%.

Copper strip testing in accordance with the ASTM Standard Method D-1838 is one of the most important and scrutinized specifications of an NGL product. The significance of corrosion matters not only to the terminal storing and shipping through metal piping and storage vessels, but also to the end user once the NGL has become fractionated and made into in-home use products such as propane. Corrosive product can and will harm storage tanks and pipelines that hold and transport the material. If corrosive, the NGL will actually deteriorate the metal causing pitting, erosion, and an overall shortened useful life of the piping and storage vessels. With in-home use, we must realize why the copper strip test was developed. Most homes that use propane deliver that propane throughout the house by use of copper tubing. The copper strip test was developed to determine the effects of corrosion within a home's copper tubing. Copper is more susceptible to corrosion than carbon steel, and will show signs of deterioration very quickly. When a copper strip test is run in accordance with ASTM D-1838, a freshly polished copper strip is immersed within the product being tested for one hour while the product's temperature is maintained at 100 degrees Fahrenheit. After only one hour the copper strip may show signs of discoloring from a bright shiny copper, meaning no corrosion, to a rainbow coloring, meaning moderate corrosion, or even a complete blackening of the copper strip, meaning the product is very corrosive. Now imagine if the product can corrode a copper strip within one hour of exposure, what the effects of the same product might do to copper tubing within a home and an exposure time of days, weeks, or months. Furthermore, imagine the effect the product will have to the interior of piping and storage vessels. Copper strip corrosion is based on a scale from 1-4, 1 being noncorrosive and 4 being very corrosive. Most contract specifications of NGL require a copper strip reading of no more than 1. This protects piping, vessels, and equipment used to transport and fractionate the product. In addition, this insures the end user of the products made from NGL.

One of the main causes of corrosion within NGL is hydrogen sulfide gas, or H2S. If H2S is present the product will most likely be corrosive. However, H2S should be measured and tested to levels that though present may not be such that are corrosive. Usually, the contract specification is .5 ppm by weight of allowable H2S, which is virtually none. Testing for presence of H2S should be done in accordance with ASTM D-2420. During this test, the NGL is passed over a lead acetate tape. While the tape becomes exposed to H2S, the tape will darken in color. Normally the tape is a bright white, but as varying levels of H2S contact the lead acetate tape, it will discolor from a light tan to a very dark brown. Normally, any discoloration of the tape means the product is nonconforming to product specification. Therefore, when using ASTM D-2420 the test is simply pass or fail. However, newer technologies have made testing for H2S within a flowing stream of NGL more precise and accurate. With use of light waves passed through product, newer on-stream analyzers can detect the presence and accurately measure the weighted concentration of H2S in thousandths of a ppm by weight. Such analyzers are becoming more prevalent within the industry, helping to determine the actual content of H2S instead of a simple yes or no indication of presence.

Color requirements, or the lack thereof, are another specification applied to most NGL contracts. Normally, natural gas liquids are described as "bright and clear", meaning the liquid is transparent and free of color. However, some streams of NGL will have a slight tint of yellow, grey, or brown color usually meaning there is some contaminant within the product. Other streams may have a haze or be cloudy in appearance, normally indicating a trace of suspended moisture. Contracts between suppliers and customers of NGL generally specify the product be tested in accordance with ASTM D-156. This test indicates color of the product in terms of the saybolt color scale. This scale applies a number to the amount of tint or color that a product has. The saybolt scale is from -16 to +30. If a product is a -16 saybolt, then that liquid has a very noticeable and dark color. In retrospect, if a product is a +30 saybolt, then that liquid has no tint or color at all. Most contracts stipulate that the NGL be +25 saybolt according to ASTM D-156. Historically, ASTM D-156 was performed using an apparatus known as a chromometer. When using this device the user would be looking down through a tube filled with liquid and visually compare the color that was observed to a known saybolt standard. This method, though conforming to the standard method, was and is biased from user perspective. Notoriously, no two people performing the test would achieve the same result. However, devices known as tintometers have emerged into the petroleum industry. These devices follow the standard guidelines, report color values in saybolt scale, and have been adopted to replace the use of a chromometer in accordance with ASTM-156. The tintometer removes the human biased eye from determining the saybolt color value of a sample and instead passes a light wave though the sample. As the light is sent through the sample some of this light is reflected and absorbed by any color within the sample. By determining the amount of light wave that leaves the projector but that does not reach the receptor of the device, a known value of saybolt color can be produced. Because of better repeatability, tintometers are becoming the desired way of determining saybolt color.

One of the easiest specifications to test for is the lack of free water. Just as in most of the petroleum industry, buyers of NGL product simply don’t want to pay product price for water. Water can be tested for when accepting a transport by visual inspection of the product. Because water is much heavier than NGL, the two will usually separate from each other in a short period of time. When a transport arrives in a terminal to unload, let it sit stationary for 5-10 minutes. Then after ensuring the transport is grounded, gently open a bottom liquid outlet and allow a small amount of product to be collected into a white porcelain bowl or cup. This is usually known as the white cup test. If there is water or other impurities in the product they will be easily seen with the sharp contrast of the white porcelain. Testing for free water on the outlet side of a terminal is still straightforward but requires a piece of equipment known as a strainer basket. Strainer baskets are usually found on the outbound LACT unit of a terminal. These containers are filled with metal mesh screens that allow the product to be filtered through and allow impurities such as debris and some free water to collect in the bottom. Usually the strainer basket is a point of custody transfer and requires a bottom valve for draining purposes to be sealed. Normally upon completion of ticketing periods or batch deliveries, both the customer and supplier will inspect the strainer basket by opening the bottom valve and allowing it to drain into a grounded porcelain lined bucket. When this is done, any debris or free water is easily identifiable within the bucket, and any such material may allow the overall product shipped during the period to be deemed off-spec or nonconforming. Normally, the volume shipped for that period will be priced differently by the application of an off-spec fee, predetermined by the contracting parties. A usual specification for the amount of free water found in a strainer basket is less than one tablespoon, and there should be no debris such as rust or other foreign material.

Ensuring conformity of the product received and shipped by a terminal is essential to a terminal's operation and profitability. However, the most important aspect to a terminal's effectiveness is their accuracy of measurement. Previously, it was determined how to correctly account for the net gallons received by transport into a terminal. Now we need to understand how to properly account for the product being shipped out by pipeline as well as the product that is in storage.

First, NGL must be stored in an appropriate storage vessel. Even with an understanding of the volatility of NGL, some companies continue to store natural gas liquids, or as some will call it, "hot condensate" in atmospheric tanks. This type of storage is not designed to hold NGL with vapor pressures that can exceed the design specifications of thin atmospheric tanks. Approved tanks with certified allowable pressure capabilities to hold NGL should always be used to store such product. However, there are those who continue to store NGL in atmospheric tanks and allow the product to "weather off" out of the hatch. This is not only an unsafe practice but also an inefficient way of handling NGL. Remember, the vapor from NGL is also product, and with this vapor allowed to escape from the tank hatch, it's actually money being allowed to vanish into thin air. Appropriate "hard-shell" vessels that store NGL should also be equipped with liquid level gauges. Most all vessels designed for NGL storage will be equipped with a percentage gauge. This type of gauge should only be used for filling purposes or for a close estimate of the product contained within the vessel. Percentage gauges on NGL tanks are known for being very inaccurate and will differ in readings, depending on the composition of the product being stored. For the most accurate determination of liquid amounts in storage vessels, a liquid sight gauge attached from the bottom to the top of the storage vessel should be used. Also, this gauge whether electronically or manually, should be marked in at least .25" but preferably .10" increments. In addition, strapping tables calculated for each storage vessel in the corresponding increments must be used, as well as a temperature and pressure indicating devices for each vessel. Lastly, a known density of the product is needed. With this information, it is possible to get the most accurate measurement of net gallons contained in storage. With a known liquid level, the strapping table will give us gross gallons. We then must apply the volume correction factor for the temperature and density of the product found in ASTM abridged Table24LPG. Last we must apply a pressure correction factor determined from the ASTM-API tables for Light Hydrocarbons, to result in net gallons. However, remember that this will not account for the vapor that is in the storage vessel. Without net weight of the product and vapor contained in the vessel, NGL cannot be accurately and precisely measured.

Finally, for accurate measurement of product into a pipeline, a properly designed meter skid and appropriate pumping for the NGL is a certain requirement. The biggest obstacle of measuring NGL across a meter skid is the ability to maintain the product in its liquid form. To ensure the product remains in liquid state and not "flashing" or turning into a vapor within the piping system, sufficient pressure must be exerted on the product in accordance with API chapter 5. The proper backpressure needed to maintain NGL in liquid form can be calculated as follows; Minimum backpressure= (max vapor pressure of product at flowing conditions x 1.25) + twice the differential across the meter. This is usually achieved by use of a backpressure control valve located downstream of the meter. However, some systems include a booster pump which maintains adequate pressure across the meter before being injected into a pipeline by additional pumping. With this type of system no backpressure valve is needed.

There are many different types of meters able to measure NGL. However, there are two types of meters that are the preferred choice within the industry. The first is a turbine meter. This type of meter employs a turbine that is turned by the product as it flows through the meter. The turns of the turbine can be calculated into volume that has passed through the meter. Though accurate, this type of meter produces volumetric measurement and must be used in conjunction with a flow computer and densitometer to calculate inferred mass in accordance with API Chapter 14.7.4.1. This calculation is as follows; (Total Mass = Indicated Volume x Meter Factor x Density in Mass per Unit Volume x Density Correction Factor). The other type of meter becoming more commonly used is a coriolis meter. This type of meter uses two vibrating tubes that when fluid passes through slows the tubes' vibration so that the mass flow rate, and often the density of the product can be determined. These types of meters, in unison with a calculating computer, produce mass measurement and use calculations to determine the volume of the product. Because this type of meter is a densitometer in itself, no additional densitometer is needed. However, both types of metering systems require both the meter and the density readings be proven for accuracy if the proving system uses inferred mass measurement. Meters should be proven in accordance with API Chapters 4 & 5. The interval of meter proving should be no less than once a month. Densitometers or density derived by coriolis meters should also be proven at least once per month and require a pycnometer to do so. Proving with a pycnometer should be done in accordance with API Chapter 14.6.12. Most importantly, the slip stream pycnometer loop, though which the product flows for proving, should be insulated to maintain constant temperature between the main line and the loop. The max allowable difference between temperature of the pycnometer's volume and the temperature of the main line is +or- .2 degrees Fahrenheit. Without the pycnometer loop being insulated, this control of temperature is virtually impossible to achieve.

Meters, no matter the type are sensitive pieces of equipment. Special considerations should be taken when designing a metering system. Meters depend on a smooth uninterrupted flow of product to be passed through. In some applications flow conditioners upstream of the meter must be installed to achieve a smooth homogenous flow of product. Bends and twists in piping upstream can also affect the flow and accuracy of a meter. 90 and 45 degree turns of the piping upstream of the meter can cause swirling and an inconsistent flow of product. Normally these obstacles can be overcome by the aforementioned flow conditioner. Pulsation and vibration caused by pumps may also impede the precision of a meter. With excessive pulsing and vibration, meters can lose the harmonious spin of the turbine or vibration of tubes. Pulsation dampeners may be installed to limit the pulsation and vibration caused by pumps throughout a piping and metering system. The most important consideration to ensure for any meter is a smooth constant flow of product.

In summary, NGL terminals require attention to detail. Whether its scrutinizing the incoming product, determining the volumes of NGL delivered, or ensuring the accuracy of the metering equipment, certain requirements and standards must be adhered to.

References:

API Chapter 14.4

API Chapter 14.6

API Chapter 14.7

GPA Standard 2145-09

GPA Standard 2174-93

GPA Standard 2140-97