NATURAL GAS LIQUIDS MEASUREMENT PROCEDURES

ENTERPRISE LOU-TEX NGL PIPEINES L.P

ARTICLE I
METERING EQUIPMENT

Section 1.1 General

A. Natural gas liquids or other products delivered or received by Enterprise shall be measured by either volumetric or mass measurement procedures using a turbine or Coriolis meter.

B. Chemical grade propylene, refinery grade propylene, propane, isobutane, normal butane, commercial butane and natural gasoline shall be measured by mass or volumetric measurement procedures.

C. Raw mix, ethane, ethane propane mix, and butane gasoline mix shall be measured by mass measurement procedures.

D. Polymer grade propylene may be measured utilizing either volumetric or mass measurement procedures.

E. The measuring facility shall be operated at a pressure greater than the equilibrium vapor pressure of the fluid at flowing conditions to ensure the stream is in a liquid state and contains no vapor. A backpressure regulator/control valve shall be considered at the outlet of the meter run if necessary to maintain sufficient pressure on the metering equipment to keep the metering pressure above the equilibrium vapor pressure. The meter backpressure requirements shall be calculated using the following equation:

$$P_b = (2 \times \Delta P) + (X \times P_e)$$

Where:

P_b = Minimum back pressure required on the meter run to prevent cavitation or flashing (psig).

ΔP = Pressure drop across the meter at the maximum operating flow rate for the product being metered (psig).

P_e = Equilibrium vapor pressure of the product being metered (psia).

X = 1.5 – For densities equal to or below 0.5100.
1.25 – For densities above 0.5100.

F. All equipment employed in metering and sampling shall be approved as to the type, materials of construction, method of installation, and maintenance by all parties involved

in the custody transfer of products. Due consideration shall be given to the operating pressure, temperature, and characteristics of the product being measured.

G. Reference to any API, ASTM, GPA or similar publication shall be deemed to encompass the latest edition, revision or amendments thereof.

H. References to specific chapters and sections within API, ASTM, GPA or similar publications are as of December 31, 2012. From time to time, these chapters and sections are subject to change by their respective publishers, and such changes shall supersede the specific references contained herein.

Section 1.2 Meters

A. Turbine meters shall be installed and operated in accordance with the API MPMS, Chapter 5, Sections 3 and 4. Each meter shall be proven when initially placed into service using a ball or piston-type or small volume prover in accordance with the API MPMS, Chapter 4, and Chapter 12, Section 2.

B. Coriolis meters shall be installed and operated in accordance with the API MPMS, Chapter 5, Section 6. Each meter shall be proven when initially placed into service using a ball or piston-type or small volume prover in accordance with the API MPMS, Chapter 4, and Chapter 12, Section 2. The prover will be additionally equipped with a densitometer installed and proved in accordance with the API MPMS, Chapter 14, Section 6. The meter proving shall be an Inferred Mass Proving in accordance with API MPMS, Chapter 5, Section 6.9.1.7.2.

C. Meter proving frequency shall be in accordance with Section 2.3.C below. The meter shall be proven immediately prior to and after any meter maintenance is performed.

Section 1.3 Densitometers

A. Densitometers and mass meters for determining flowing density may be installed and calibrated in accordance with the API MPMS, Chapter 14, Section 6. The output may be connected directly into a flow computer capable of internally converting frequency, or such other signal as the densitometer may generate, to corrected flowing density in gm/cc, or to a separate frequency converter and into the flow computer as a 4-20 ma signal. Proving is to be by entrapping a sample of the flowing stream at system conditions in a double-walled high-pressure vessel known as a pycnometer. The connections for the pycnometer shall be installed in the same manner as those of the densitometer. Thermowells shall be installed to allow monitoring of the inlet and outlet temperatures. Accuracy of the densitometer shall be verified at the time of the meter proving or when accuracy is in question. The accuracy of the densitometer shall be within +/- 0.001 gm/cc over its entire range and repeatable to +/- 0.0005 gm/cc.

B. For chemical grade propylene measurement, a calculated density may be used in lieu of a densitometer by using the API MPMS, Chapter 11.3.3.2 method for pure propylene and correcting it for 92 to 96 percent purity by applying a correction factor of 0.9987 to the prover mass volume at each proving.

Section 1.4 Temperature and Pressure Transmitters

Temperature and pressure transmitters shall be verified at the time of the meter proving using a certified thermometer and reference gauge respectively to ensure current readings are within +/-0.2 °F and +/- 1.0 psi. A calibration shall be performed every 6 Months. All verification and calibration data shall be supplied to the customer. Accuracy of these transmitters shall be +/- 0.05 % of scale.

Section 1.5 Flow Computers

Flow computers shall be capable of accepting turbine pulses from a turbine meter transmitter or mass pulses from a Coriolis meter transmitter and signals from the pressure, temperature and density transmitters. The computer shall convert, as required, and totalize these signals into gross volume, mass, and net volume. For net volume determinations, the computer shall utilize the latest ASTM, API and GPA tables for temperature, pressure and specific gravity corrections that are applicable to the product being measured. The weight of water shall be as provided in the latest version of GPA 2145.

Section 1.6 Composite Sampling Systems

Composite sampling systems shall be installed and operated in accordance with GPA Standard 2174. The composite sampler shall be operated to collect flow-proportional samples only when there is flow through the meter. These samples shall be accumulated in and removed from single-piston cylinders with mixing capability.

ARTICLE II
ACCOUNTING AND MEASUREMENT PROCEDURES

Section 2.1 Custody Transfer Tickets

A. Enterprise shall furnish to the customer daily (0700 to 0700) custody transfer tickets unless otherwise provided for by separate agreement, for products measured on a volumetric basis. The ticket shall identify the product and state the net volume in Barrels of product measured.

B. For streams that are measured on a mass basis, custody transfer tickets shall be furnished stating the total mass measured in pounds. Total pounds mass shall then be converted to pounds of each component (if required) based on its weight fraction of the analysis of the product removed from the composite sampler for the same time period in which the mass was totalized. The component pounds shall then be converted to equivalent Gallons of each component (if required) utilizing the calculation procedure outlined in GPA Standard 8173. The component density in a vacuum shall be in accordance to GPA Standard 2145. Component Gallons shall be further reduced to Barrels. Unless otherwise provided for by separate agreement, custody transfer tickets for mass-measured products shall be generated on a weekly or batch basis. An unfinished batch shall be closed out at 0700 hours on the first Day of the calendar Month, unless otherwise provided for by separate agreement.

Section 2.2 Measurement Basis

A. Mass Measurement

1. Inferred mass measurement shall be accomplished utilizing a flow-proportional composite sampler, turbine meter, densitometer and flow computer to convert gross volumetrically measured barrels using density in gm/cc at flowing conditions to total pounds mass according to the following formula:

$$TotalPounds = GrossBBLS \times MeterFactor \times FlowingDensity(gm/cc) \times 350.506987$$

Where 350.506987 is a conversion factor to convert density in gm/cc to pounds/bbl.

For polymer grade propylene, the composite sampler and densitometer are not required.

2. Direct mass measurement shall be accomplished by utilizing a flow-proportional composite sampler, a Coriolis meter, Coriolis transmitter, and a flow computer to convert mass pulses from the Coriolis transmitter into pounds. Measured pounds mass is calculated according to the following formula:

$$MeasuredMass = \frac{MeterPulses}{KFactor} \times MeterFactor$$

For polymer grade propylene, the composite sampler is not required.

B. Volumetric Measurement

1. Volumetric measurement may be accomplished utilizing a flow computer, turbine meter, and temperature and pressure transmitters. A "fixed" specific gravity at 60^{o} F and vapor pressure at 100^{o} F may be entered into the flow computer in the case of "purity" products, if agreed to by both Parties. Temperature and pressure shall be referenced to the proper API, ASTM and GPA Tables to calculate and totalize net Barrels. An optional densitometer and flow-proportional composite sampler may be installed. If a densitometer is installed, the flow computer shall convert the density signal at flowing conditions in gm/cc to a specific gravity at 60^{o} F and use GPA TP-15 to determine EVP (Equilibrium Vapor Pressure).

2. Mass measurement may be accomplished utilizing a flow computer, mass meter, and temperature and pressure transmitters. A "fixed" specific gravity at 60^{o} F and vapor pressure at 100^{o} F may be entered into the flow computer in the case of "purity" products, if agreed to by both Parties. Temperature and pressure shall be referenced to the proper API, ASTM and GPA Tables to calculate and totalize net Barrels. In such case, the mass meter density shall be calibrated per API MPMS, Chapter 14.6. If density is determined using the mass meter, the flow computer shall convert the density signal at flowing conditions in gm/cc to specific gravity at 60^{o} F and use GPA TP-15 to determine EVP (Equilibrium Vapor Pressure).

3. On the basis of laboratory analysis, components of mixed streams may be determined by multiplying the totalized net volume by the liquid volume percent of each component, if so stipulated by contract.

   The following shall be utilized by the flow computer to reduce gross Barrels to net Barrels.

   For Temperature Reduction. API/ASTM/GPA Technical Publication TP-27 Table 23E and 24E shall be used when measuring propane, isobutane, normal butane, natural gasoline and mixes of the above.

   For Pressure Reduction (Compressibility).

   a. API MPMS, 11.2.2 (GPA 8286) shall be used for measuring propane, isobutane, normal butane, and mixes of the above.

   b. API MPMS, 11.2.1 shall be used when measuring natural gasoline.

   Temperature and Pressure Correction. API MPMS, Chapter 11.3.3.2 Subroutine "PROPYL" shall be used for temperature and pressure correction when measuring propylene and as a ratioed factor based upon propylene content in propane/propylene mix.

Section 2.3 Provings and Tolerances

A. Principles

During the proving cycle, turbine pulses (volumetric) from the turbine meter transmitter or mass pulses from the Coriolis transmitter are accumulated. Dividing the accumulated pulses by the prover volume or prover mass generates a "K Factor" in terms of volume or mass, respectively. After the initial proving, this "K Factor" is entered into the flow computer along with a meter correction factor of 1.0000. After subsequent provings, one can choose to adjust the "K Factor" or the meter correction factor. If the choice is made to adjust the "K Factor," then the meter correction factor remains at 1.0000. If the adjustment is made at the meter correction factor, then the established "K Factor" remains the same. The densitometer factor is entered into the flow computer to correct flowing density in gm/cc as determined by results of a pycnometer test. The pycnometer shall be installed so that flow through the vessel shall assure proper purging thus allowing temperature and pressure equalization with the densitometer being proved. Maximum allowable temperature differential between the contents in the pycnometer and the densitometer shall be no greater than +/- 0.2^{o} F. The pressure shall be equal to that of the densitometer at time of removal.

B. General

1. Meter provings, calibration of instruments, and maintenance of measurement equipment shall normally be performed by Enterprise personnel, but these functions may be delegated to responsible third-party contractors under the direction of an

Enterprise representative.

2. A customer's witness signature does not constitute the approval of the use of out-of-tolerance equipment, but said signature does attest to the validity of the proving report.

C. Proving Intervals

Each meter shall be proven when initially placed into service. Subsequent provings shall be made every thirty (30) Days, unless in accordance with the API MPMS, the consistency of the meter factor, as evidenced in meter factor control charts, may allow the proving interval to be extended to a maximum of sixty (60) Days.

D. Meter Factor

1. Volumetric meter proving calculations, inferred mass shall be in accordance with API MPMS, Chapter 12.2. The average of five (5) consecutive prover runs shall be taken to establish an initial or new meter factor, provided that the five (5) proving runs are within 0.0005 (0.05%) of each other and the meter factor is within 0.0025 of the previous meter factor under like operating conditions.

2. Volumetric meter proving calculations, direct mass shall be in accordance with API MPMS, Chapter 5.6. The average of five (5) consecutive prover runs shall be taken to establish an initial or new meter factor, provided that the five (5) proving runs are within 0.0005 (0.05%) of each other and the meter factor is within 0.0025 of the previous meter factor under like operating conditions.

3. Mass meter proving calculations shall be in accordance with API MPMS, Chapter 5.6. The average of five (5) consecutive prover runs shall be taken to establish an initial or new meter factor, provided that the five (5) proving runs are within 0.0005 (0.05%) of each other and the meter factor is within 0.0025 of the previous meter factor under like operating conditions.

4. As an option, a valid proving shall consist of a proving set as outlined in API MPMS, Chapter 4.8.3.6 "Assessment of Results". The use of alternate methods as outlined in API MPMS, Chapter 4.8 "Appendix A" Tables A-1 and A-2 shall not be used unless approved by the Regional Manager, Measurement and Material Balance.

5. The new meter factor shall be used after each successful proving if it meets the above proving criteria.

6. If the new meter factor deviates from the previous meter factor under like operating conditions by more than plus or minus 0.0025, then one half (1/2) of the volume measured since the previous proving shall be corrected using the new meter factor. If the time of malfunction can be determined by historical data, then the volume measured since that point in time shall be corrected using the new meter factor. The new meter factor shall not be used to correct volumes measured more than thirty-one (31) Days prior to the new proving.

7. Turbine Meters:

    a. No work shall be performed on the measuring element of a turbine meter without first proving the meter. If any work is performed, a new meter factor shall be established.

    b. If the new meter factor deviates more than 0.0025 but less than 0.0050 from the previous meter factor, the field representatives of Enterprise and the customer shall determine the corrective action, if any, to be taken.

    c. If the new meter factor deviates 0.0050 or more, the element shall be removed and inspected. If there is build-up on the internals, then the element shall be cleaned and the meter re-proved. If excessive wear is found, then the element shall be repaired or replaced and the meter re-proved to establish a new initial meter factor. After a 24-hour wear-in period, the meter shall be re-proved and if the meter factor changes more than +/- 0.0025 from the new initial meter factor, then one-half (1/2) of the volume measured shall be corrected using the latest meter factor.

8. Coriolis Meters:

    a. No work shall be performed on the Coriolis meter without first proving the meter.

    b. If the new meter factor deviates more than 0.0025 but less than 0.0049 from the previous meter factor, the field representatives of Enterprise and the customer shall determine the corrective action, if any, to be taken.

    c. If the new meter factor deviates 0.0050 or more, the meter or transmitter may be zero verified, cleaned, repaired or replaced as required. If the zero changes, or the meter is cleaned, repaired or replaced, the meter shall then be re-proved to establish a new initial meter factor. The meter shall be zero verified and, if necessary, re-proved. If the meter factor changes more than +/- 0.0025 from the new initial meter factor, then one-half (1/2) of the volume measured shall be corrected using the latest meter factor.

9. The measurement technician shall record all required corrections to measured volumes and shall describe the findings, method of repair, and calculations used in making the correction on the meter proving report. A correction ticket for the amount of the correction shall be issued.

E. Density Factor

The proving intervals, tolerances, repairs and methods of correction are the same as those provided for in Section 2.3.D above, except that the average of two (2) successive pycnometer provings shall establish product flowing density, provided the two (2) successive provings agree within 0.0005 (0.05%).

Section 2.4 Custody Measurement Station Failure

A. If a failure occurs on a custody measurement station or the station is out of service while product is being delivered, then the volume shall be determined or estimated by one of the following methods in the order stated:

1. By using data recorded by any check measuring equipment that was accurately registering; or

2. By correcting the error if the percentage error can be ascertained by calibrations, tests, or mathematical calculations; or

3. By comparison with deliveries made under similar conditions when the measurement station was registering accurately; or

4. By using historical pipeline gain/loss; or

5. By using such other method as the Parties may agree.

Section 2.5 Sampling Procedures

A. Flow proportional composite samples shall be removed from the composite sampler at the same time the meter is read and a custody ticket issued. Samples of finished LPG product streams shall be analyzed in accordance with ASTM D-2163 and raw mix streams shall be analyzed by GPA 2186 extended analysis for C6+ streams.

B. Three samples shall be taken from the composite sampler. One sample shall be retained by Enterprise for analysis, the second sample shall be retained by the customer for analysis, and the third shall be held as a referee. If Enterprise has taken custody, its sample shall be analyzed and the analysis used to account for transfer. If the customer has taken custody, its sample shall be analyzed and the analysis used to account for transfer. After analyzing their respective samples according to the most current version of GPA 2177, if the customer and Enterprise are in disagreement, then the referee sample shall be taken to a mutually agreed upon laboratory which shall analyze the sample in accordance with the proper GPA Standard. This analysis shall be accepted by the customer and Enterprise as final and conclusive for proportions and components contained in the stream. Charges for such referee sample shall be borne by the customer and Enterprise equally.

C. The referee samples shall be held for a period as agreed upon by the connecting parties or a minimum of thirty (30) Days from the date of sampling.

D. If a malfunction of the sampling occurs resulting in no sample being taken or in an unrepresentative sample being obtained, the following procedure shall be utilized in the order stated.

1. The sample collected by any on-stream back-up sampling device that has extracted a sample in proportion to the volume delivered shall be used.

2. An average of the composite samples taken over a mutually agreed time frame {not to

exceed the last three (3) Months of properly sampled deliveries} shall be used.

3. Daily grab samples shall to be used for the time in question.

Section 2.6 Dispute Resolution

A. Mass and Volume Measurement: If both the Enterprise measurement facility and the Customer measurement facility are installed, operated and maintained according to their respective measurement standards, both of which shall meet or exceed API standards, and the difference in measurement of mass or volume is less than or equal to one-half percent (0.5%), Enterprise's measurement of mass or volume, whichever the case may be, shall be deemed correct. If the difference is more than one-half percent (0.5%), Enterprise and the Customer will resolve the dispute as provided in Article II Section 2.6C. herein.

B. Analytical: Analytical disputes must be based upon laboratory analysis, using the latest version of GPA 2177, of both the Enterprise sample and the Customer sample from the custody sampler (see Article II Section 2.5B. above). Analytical disputes shall be handled as specified in Article II, Section 2.5B. above.

C. All other disputes: Enterprise and Customer shall work together to resolve the dispute. If Enterprise and the Customer are unable to resolve the dispute within thirty (30) Days, unless extended in writing by both Enterprise and the Customer, the dispute shall be submitted to a mutually agreeable, independent measurement expert for final resolution. The determination of said measurement expert shall be accepted by the customer and Enterprise as final and conclusive.

Section 2.7 Definitions

A. "Day" shall mean a period of twenty-four (24) consecutive hours commencing at a local time agreed on by all parties involved.

B. "Gallon" shall mean a United States Gallon of 231 cubic inches of liquid at sixty degrees Fahrenheit (60^{o} F) and at the equilibrium vapor pressure of the liquid.

C. "Barrel" shall mean forty-two (42) United States Gallons.

Section 2.8 Technical Publications

A. Manual of Petroleum Measurement Standards, American Petroleum Institute, Washington, D.C.:

1. API Chapter 1, "Definitions."

2. API Chapter 4, "Proving Systems."

3. API Chapter 5.3, "Measurement of Liquid Hydrocarbons by Turbine Meters."

4. API Chapter 5.4, “Accessory Equipment for Liquid Meters.”

5. API Chapter 5.6, “Measurement of Liquid Hydrocarbons by Coriolis Meters.”

6. API Chapter 9.2, “Pressure Hydrometer Test Method for Density or Relative Density.”

7. API Chapter 11.2.2, “Compressibility Factors for Hydrocarbons: 0.350 - 0.637 Relative Density (60^{o} F/60^{o} F) and -50^{o} F to 140^{o} F Metering Temperature.”

8. API 11.2.1, “Compressibility Factors for Hydrocarbons: 0-90^{o} API Gravity Range.”

9. API Chapter 11.3.3.2, “Propylene Compressibility.”

10. API Chapter 12.2, “Calculation of Liquid Petroleum Quantities.”

11. API Chapter 14.6, “Continuous Density Measurement.”

12. API Chapter 14.7, “Standard for Mass Measurement of Natural Gas Liquids.”

13. API Chapter 14.8, “Liquefied Petroleum Gas Measurement.”

14. API Chapter 21.2, “Flow Measurement - Electronic Liquid Measurement.”

B. API/ASTM/GPA Technical Publication TP-27 Table 23E and 24E, “Correction of Volume to 60° F against Relative Density 60° F/60° F.”

C. ASTM-D-1250 (Table 24), “Volume Corrected to 60° F and equilibrium vapor pressure.”

D. ASTM-D-2163 “Standard Test Method for Analysis of Liquid Petroleum (LP) Gases and Propane Concentrates by Gas Chromatography.”

E. GPA Standard 2140, “Liquefied Petroleum Gas Specifications and Test Methods.”

F. GPA Standard 2145, “Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas.”

G. GPA Standard 2174, “Method of Obtaining Hydrocarbon Fluid Samples Using a Floating Piston Cylinder.”

H. GPA Standard 2177, “Method for the Analysis of Demethanized Hydrocarbon Mixtures Containing Nitrogen and Carbon Dioxide by Gas Chromatography.”

I. GPA Standard 2186, “Method for the Extended Analysis of Hydrocarbon Mixtures Containing Nitrogen and Carbon Dioxide by Temperature Programmed Gas Chromatography.”

J. GPA Standard 8173, “Method for Converting Natural Gas Liquids and Vapors to Equivalent Liquid Volumes.”

K. GPA Standard 8182, “Tentative Standard for the Mass Measurement of Natural Gas Liquids.”

References to any API, GPA, ASTM or similar publications shall be deemed to encompass the latest edition, revision or amendment thereof.