



**Mustang Sampling<sup>®</sup>**

**NATURAL GAS LIQUID SAMPLING  
LEVERAGING 60 YEARS OF EXPERIENCE IN TEXAS**

**Kenneth O. Thompson, Mustang Sampling**  
Appalachian Storage Hub Conference  
South Pointe, Pennsylvania  
June 5-6, 2019

# Outline



**Mustang Sampling**<sup>®</sup>

- Introduction to Mustang Sampling<sup>®</sup>
- Global Energy & North America Natural Gas Landscape
- Determination and Product Analysis
  - Composition of Natural Gas Mixtures
  - Composition of Natural Gas Liquid Mixtures
- Standards for NGL
- Closing Comments

# Outline

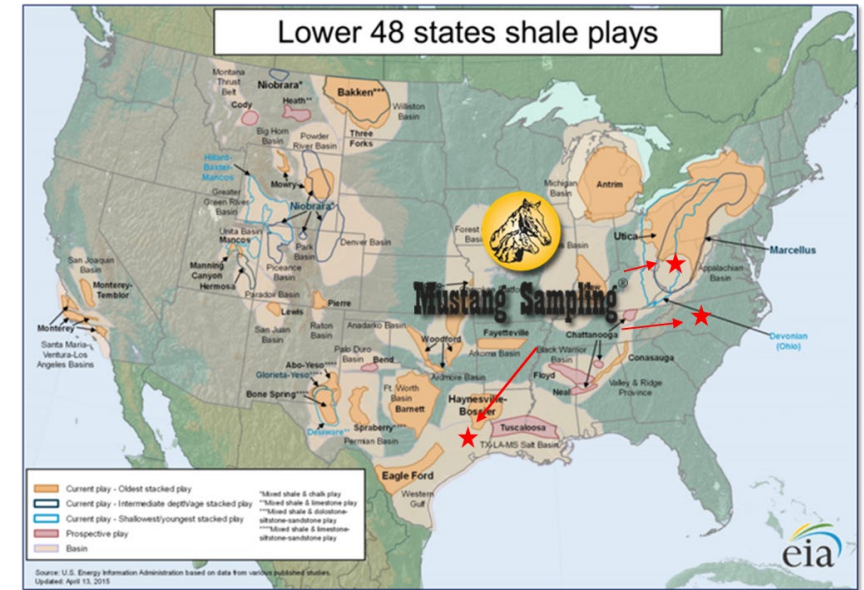


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# Mustang Sampling – Who We Are

- Mustang Sampling is dedicated to providing Analytically Accurate<sup>®</sup> solutions, products, systems, and services to all areas of the natural gas industry
  - Complete fiscal metering systems
    - Orifice, Ultrasonic, Coriolis, Turbine Meters
  - Sampling systems for natural gas, liquids, and LNG
  - Energy measurement systems
  - Design, Civil, Construction, Commissioning, Sales, and Maintenance support
- Product Development
  - Sampling products developed primarily from necessity
  - Virtually all products address specific customer need





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# Mustang Sampling Core Business

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# Mustang Sampling's Experience

- Natural Gas Liquid Analysis is Core Competency
  - Early experience developed in Texas in and around Mont Belvieu
    - Enterprise Products
    - ONEOK
  - Used vaporizing techniques to convert liquids to gas
  - Expanded to heavier liquids than ethane and propane
  - Created Intellectual property available globally
  - Appalachian Storage Hub will be similar to Mont Belvieu

# Outline



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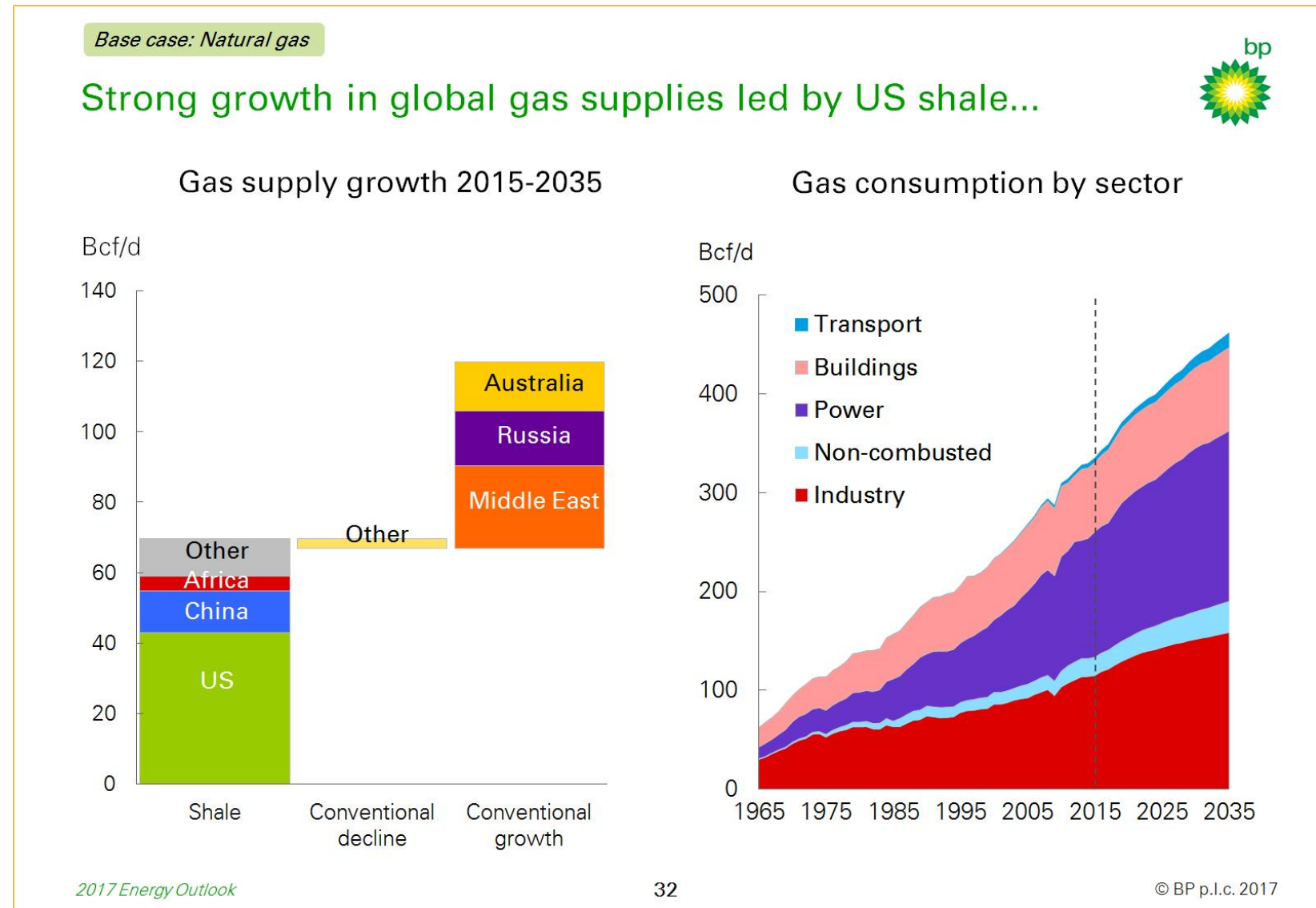
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# Global Natural Gas Growth Led by US Shale

## Key Features (BP Report)

- Global natural gas growth will be led by US Shale
- Largest single demand growth is LNG export
- Second largest demand is electricity production
- Energy consumption will continue to grow globally for decades (or longer)
- Competition from Qatar & Australia is urging US construction
- NGL production is linked to natural gas associated deposits





# Wide Distribution of Energy Values

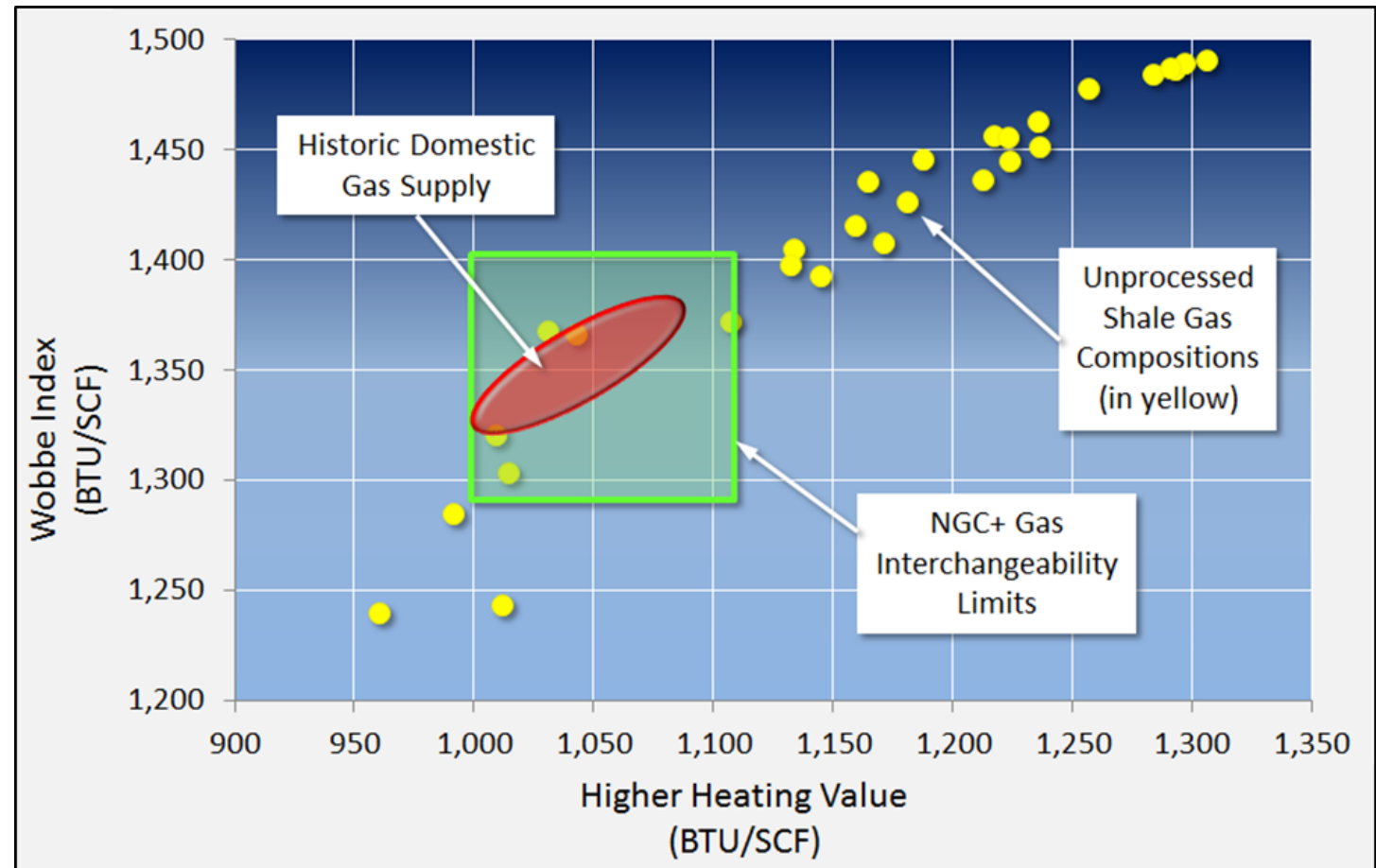
## Typical Shale Gas Heating Values



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### Shale Features

- Gas composition is strongly dependent on exact location and depth
- May not meet interchangeability requirements for fuel
- Liquid content has significant value
- Variations change with time from same locations

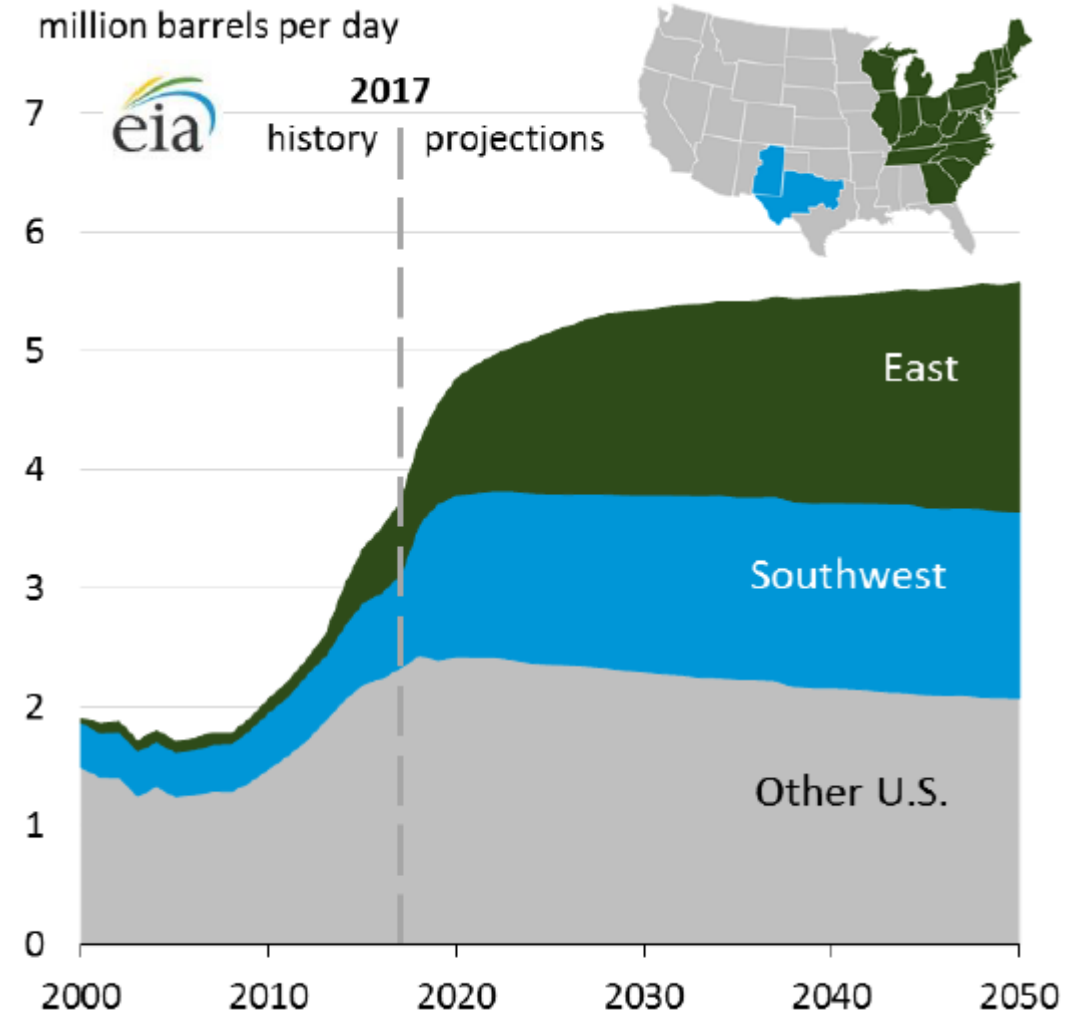


# Ethane Production Forecast & Fundamentals

## U.S.A. by Region

### Key Features & Fundamentals (US DOE Report)

- NGL production is linked to natural gas as associated deposits along with other heavier alkanes (propane, butane, ...)
- Ethane is used almost exclusively to produce ethylene, which is used in the petrochemical industry to produce plastics
- Ethane transportation requires dedicated pipelines and is difficult to move otherwise
- Supply and demand must be closely matched (due to last two bullet points), so large supplies of domestic NGL's dictate local storage be made available
- Petrochemical industry flourishes as supply grows



# NGL Production Forecast

## Production by Type

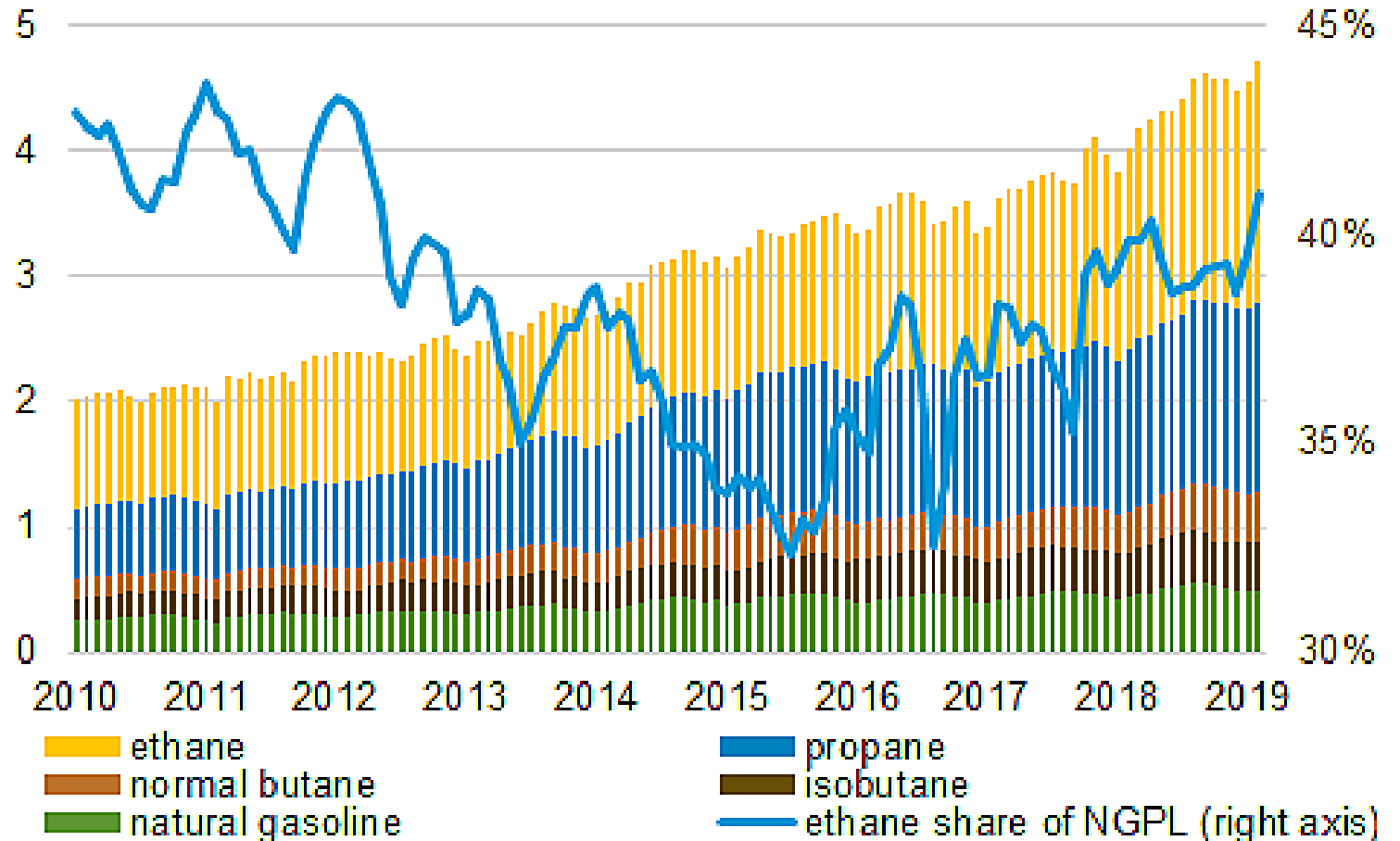
### Key Features

- NGL production has continued to increase with natural gas production for almost ten years
- Ethane represents about 40% of the total NGL market by volume
- Associated liquids often dictate drilling, financial dynamics

### U.S. production of natural gas plant liquids

million barrels per day

ethane share of total NGPL

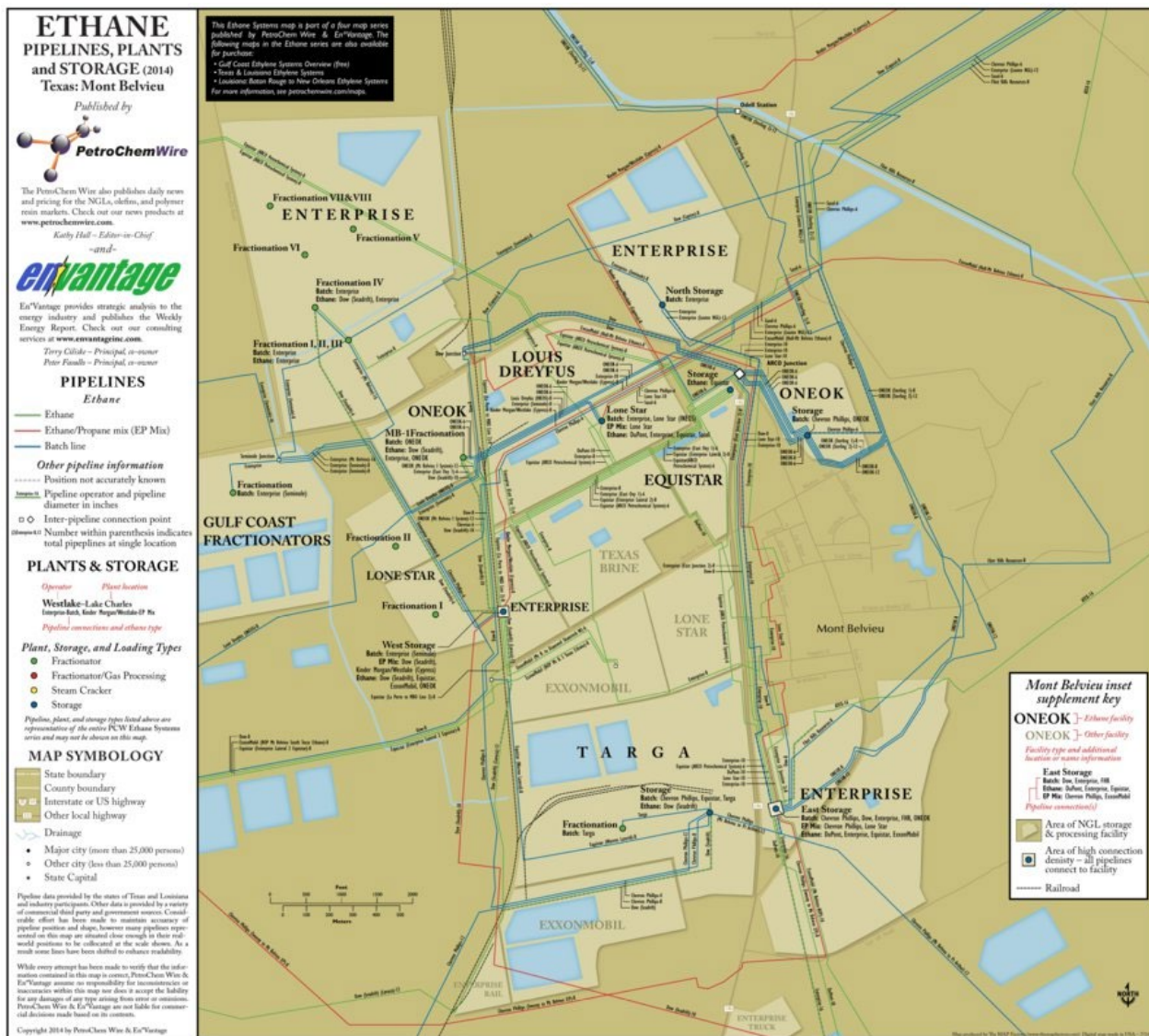


Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*

# Mont Belvieu, TX Storage Hub

## Key Features Associated with NGL

- Map is approximately 10 square miles
- Facility has roots more than 60 years old
- Enterprise, ONEOK, Lone Star NGL, & Targa Resources have major facilities
- Area includes Natural Gas Processing Plants, Fractionation Plants, NGL Pipelines, NGL Storage, Import & Export Facilities, Rail & Truck Facilities
- Facility is located within 30 miles of Houston, Texas (4.7M people)
- Facility is often confused with Strategic Oil Reserve due to its size and location





# Potential & Existing Ethane Impact in Appalachian Valley

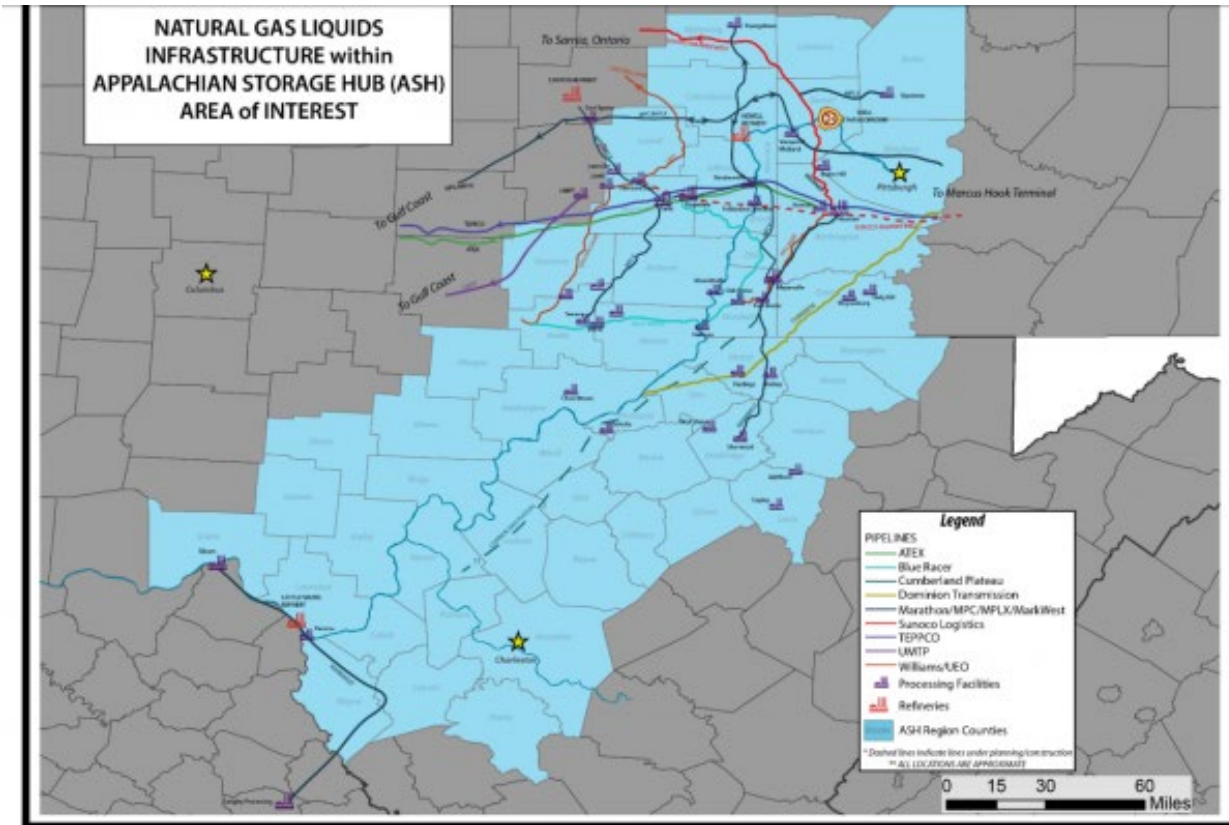
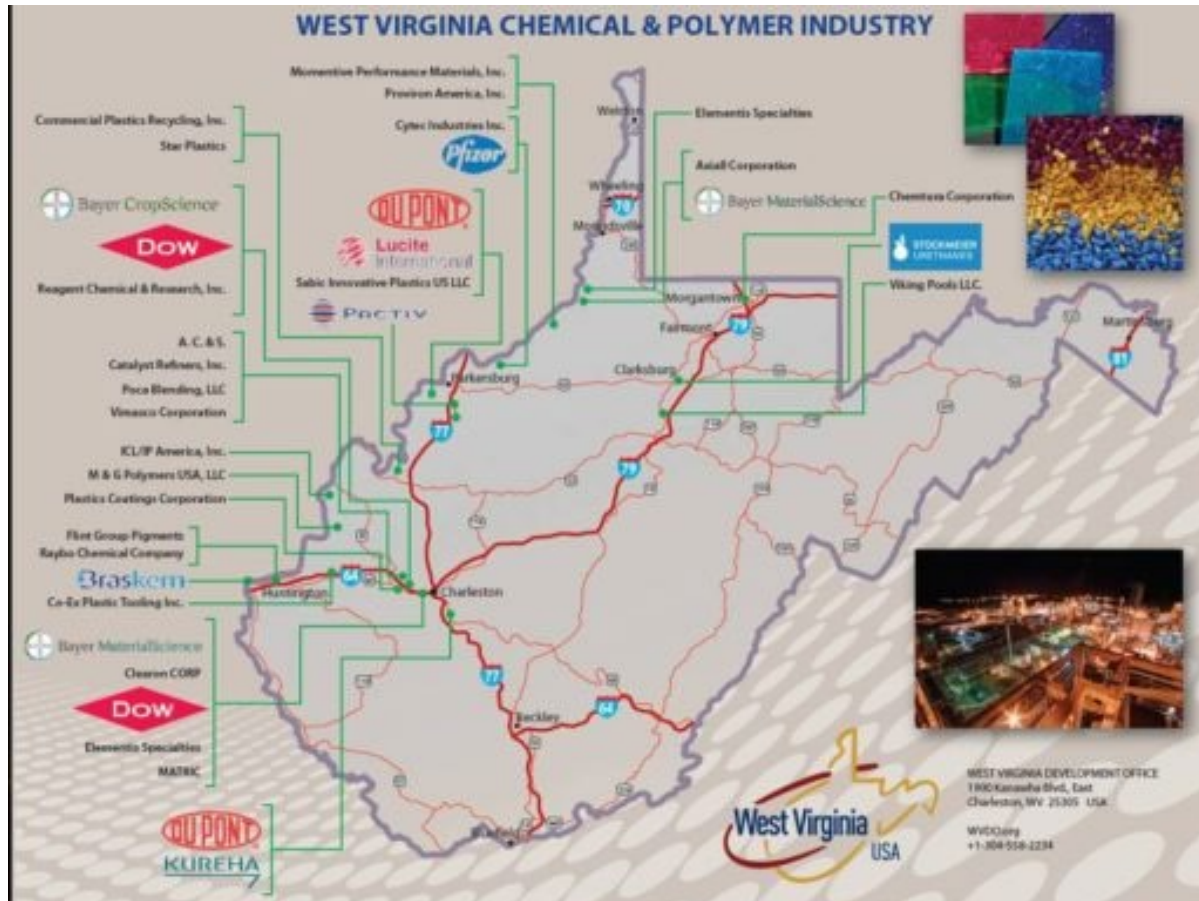


Figure 4-26. Natural gas liquids infrastructure (existing and planned) within the AOI. All locations are approximate.

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# What is Natural Gas? And Why is the Composition Important?

Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane, but commonly including varying amounts of other higher alkanes, and sometimes a small percentage of carbon dioxide, nitrogen, hydrogen sulfide, or helium (Petro-wiki)

- Natural gas is not all the same. Natural gas components vary with location, depth, and time.
- The behavior of natural gas depends on the composition and conditions of the gas.
- The value of individual components within natural gas are different, so more valuable components are often stripped from the mixture to sell separately (e.g. propane)
- The energy value of natural gas depends on the composition of the gas. Generally, higher methane values equate to lower energy values.
  - Monetization of natural gas requires full knowledge of the composition.
- Natural gas composition measurement is required for safety and compliance.



# Fundamentals of Sampling

## Analytically Accurate<sup>®</sup> Methods & Processes for Gas



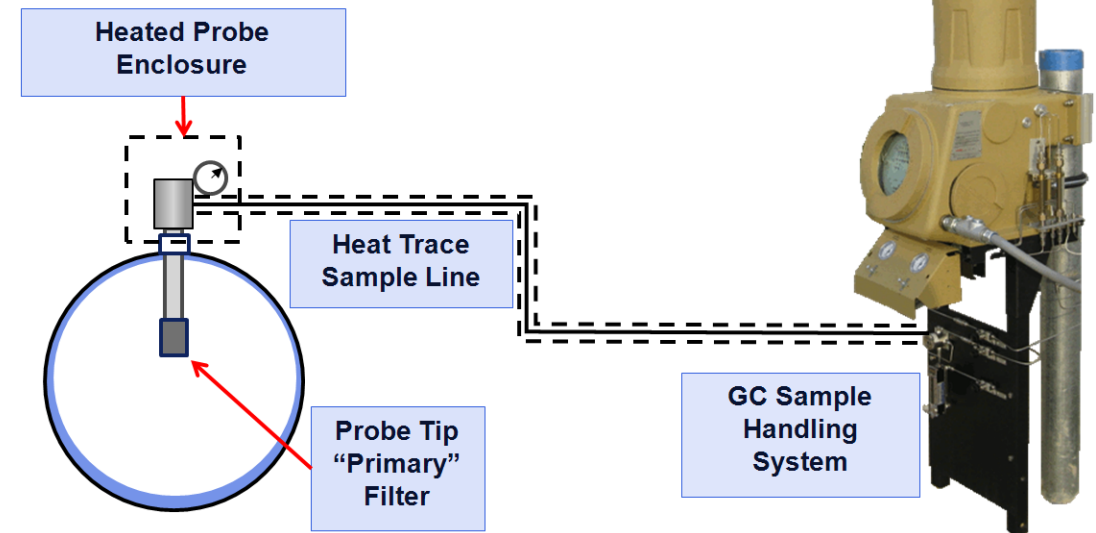
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### Fundamentals of Sampling

Sampling allows the user to understand the content of their vessel or pipeline

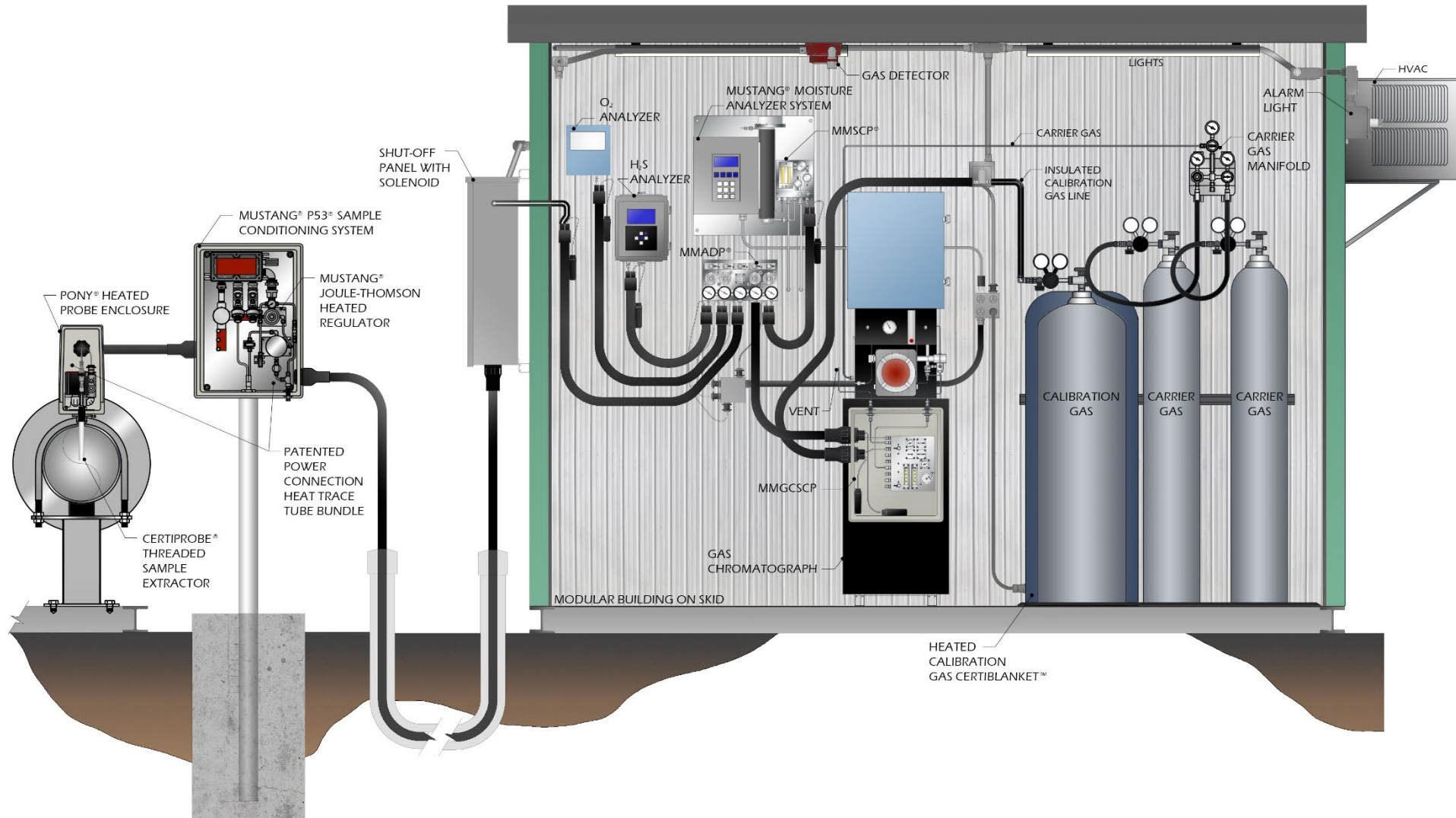
Analytically Accurate sampling requires all of the following:

- Tapping sample from reservoir contained in vessel or pipeline
- Extraction of a representative sample from a vessel or pipeline
- Transportation of sample to sample conditioning system
- Adjustment of sample pressure and temperature
- Transformation to gas phase of sample if needed
- Delivery of sample to analyzer



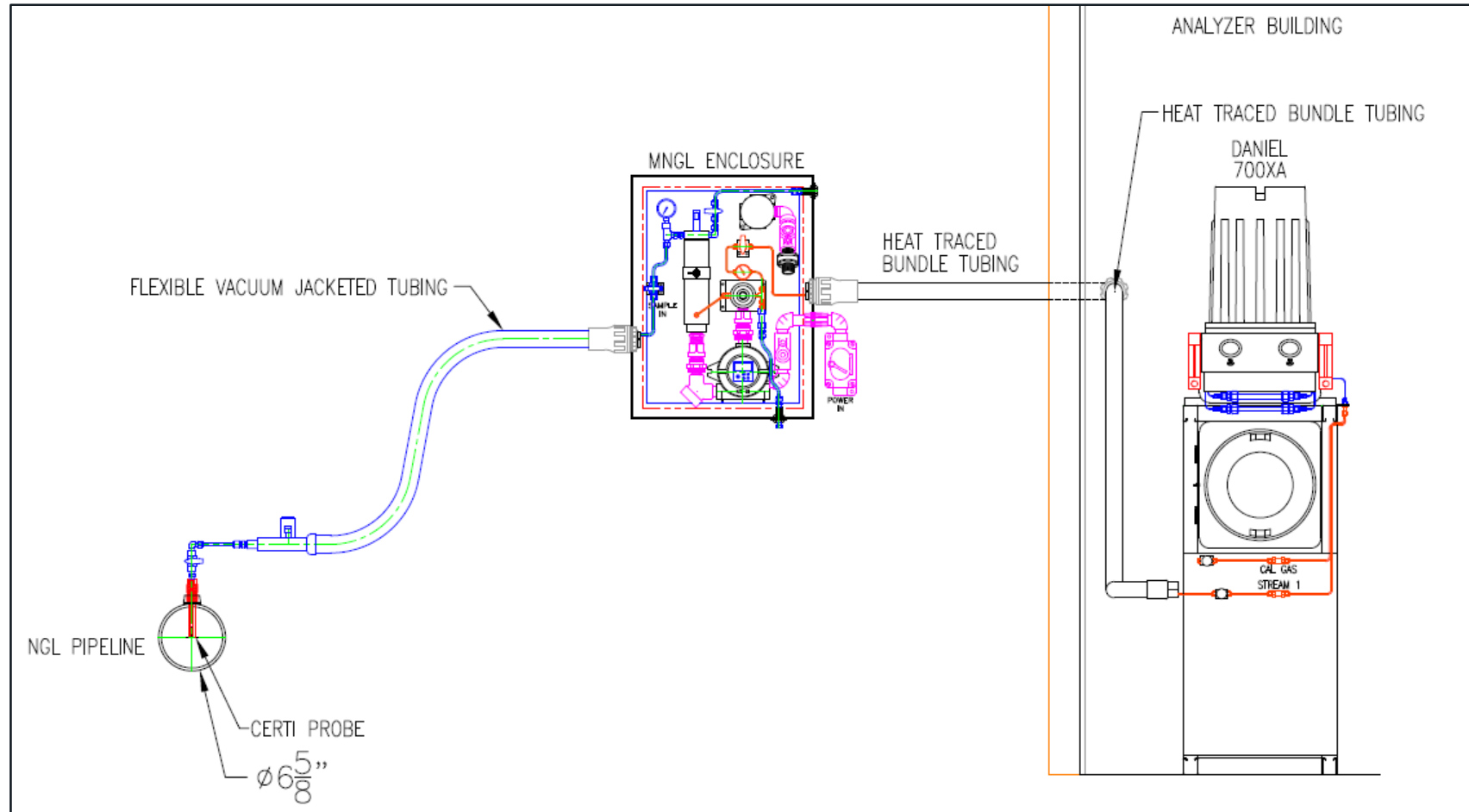
# Sampling & Analysis of Natural Gas

## Analytically Accurate<sup>®</sup> Methods & Processes



# Sampling & Analysis of Natural Gas Liquid

## Analytically Accurate<sup>®</sup> Methods & Processes

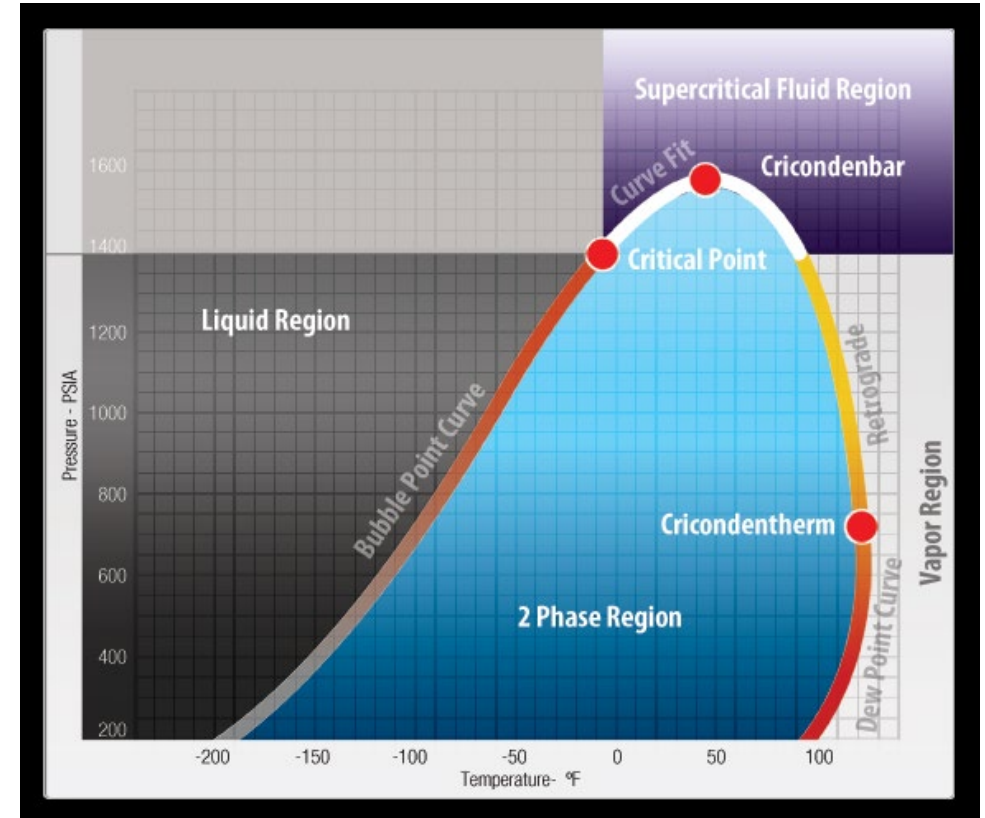
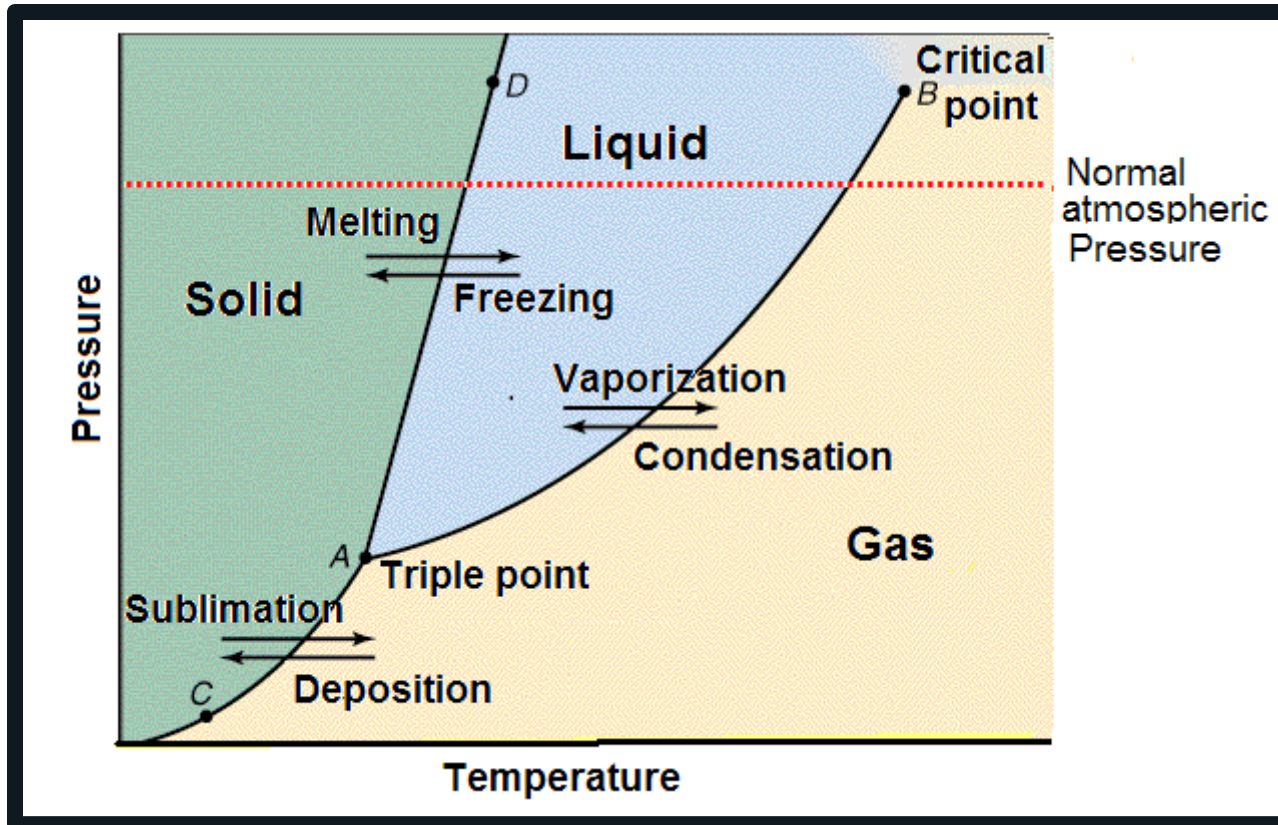


# Phase Curve Elements

## Pure Substance vs. Mixture



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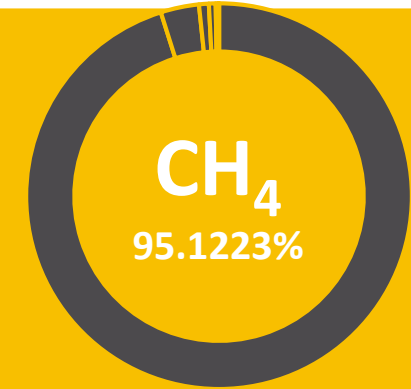
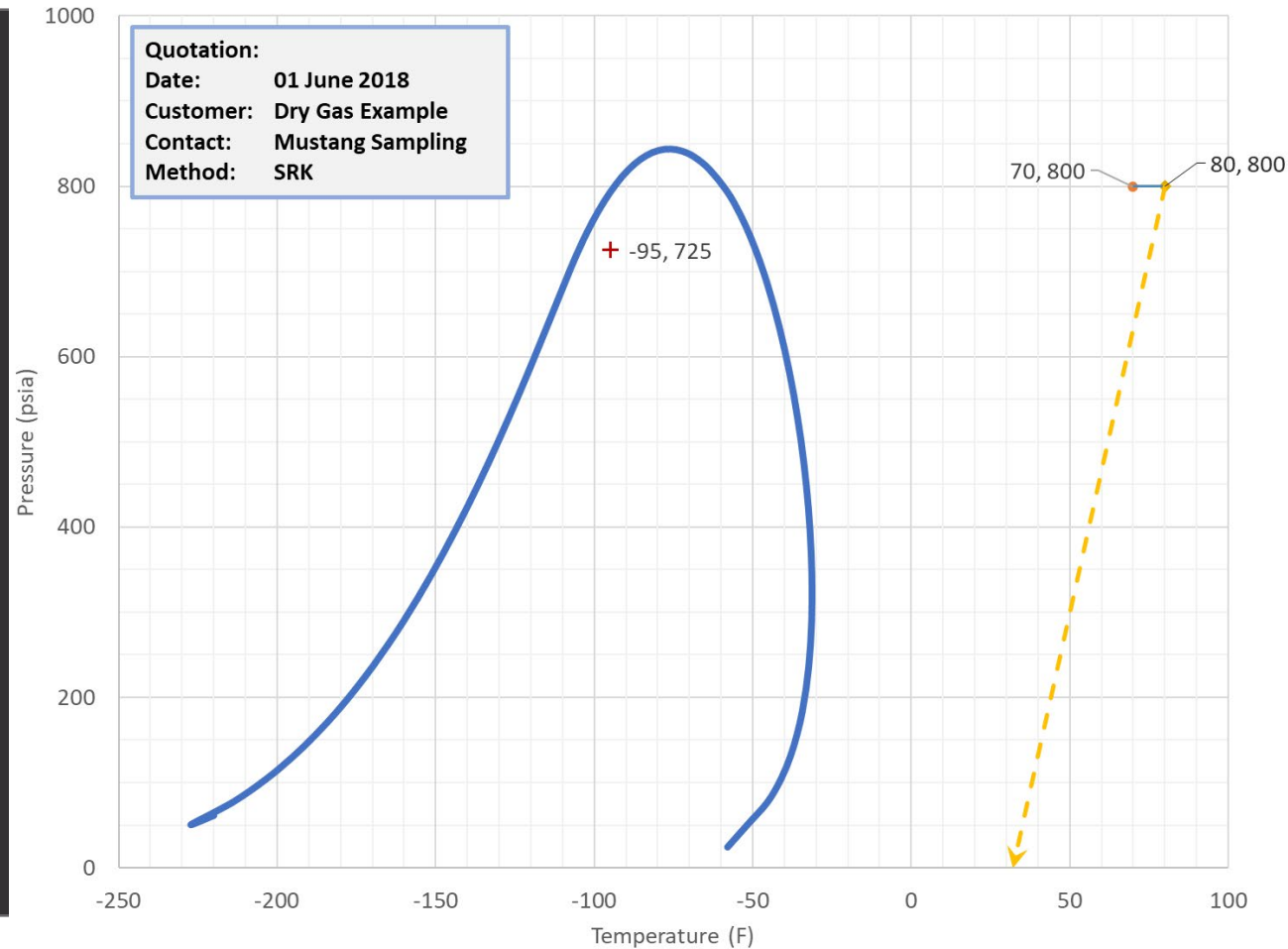


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# Phase Curve – Dry Gas

Phase Curve with Mustang<sup>®</sup> Heated Regulator at 80° F

-  Sample point
-  Critical point
-  Mustang Sampling Point






No.	Name	Formula	Molar %
1	Methane	CH <sub>4</sub>	95.1223
2	Ethane	C <sub>2</sub> H <sub>6</sub>	3.2142
3	Carbon Dioxide	CO <sub>2</sub>	0.8215
4	Nitrogen	N <sub>2</sub>	0.5663
5	Propane	C <sub>3</sub> H <sub>8</sub>	0.1977
6	n-Butane	C <sub>4</sub> H <sub>10</sub>	0.0263
7	Isobutane	C <sub>4</sub> H <sub>10</sub>	0.02385
8	Isopentane	C <sub>5</sub> H <sub>12</sub>	0.00885
9	n-Hexane	C <sub>6</sub> H <sub>14</sub>	0.00809
10	n-Pentane	C <sub>5</sub> H <sub>12</sub>	0.00536
11	n-Heptane	C <sub>7</sub> H <sub>16</sub>	0.00405
12	n-Octane	C <sub>8</sub> H <sub>18</sub>	0.00135

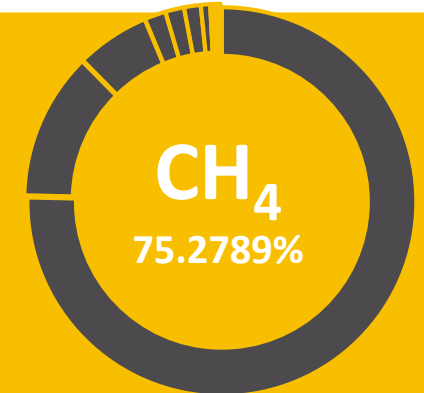
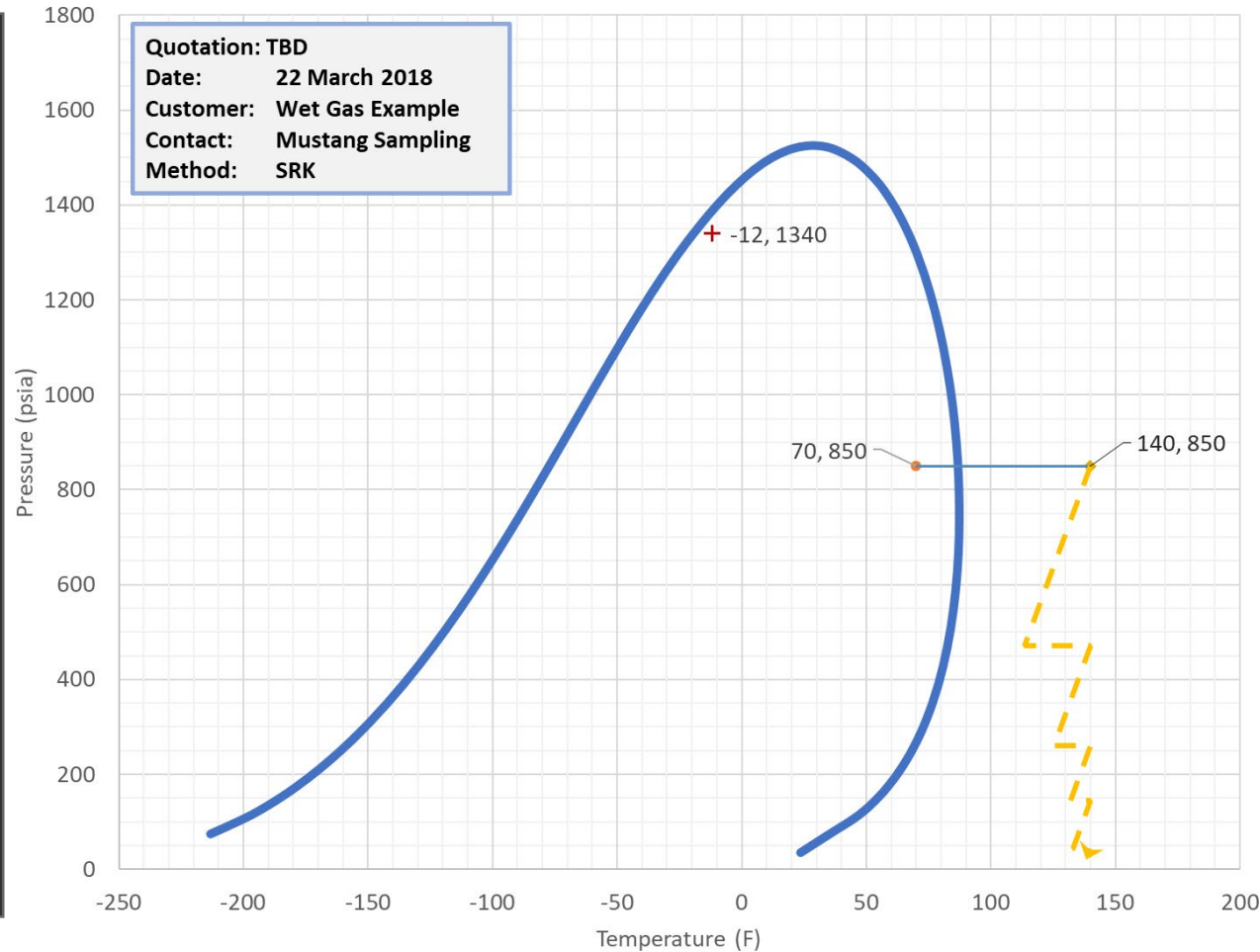


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# Phase Curve – Wet Gas

Phase Curve with Vaporizer and Mustang<sup>®</sup> Heated Joule-Thomson Regulator at 140° F

-  Sample point
-  Critical point
-  Mustang Sampling Point






No.	Name	Formula	Molar %
1	Methane	CH <sub>4</sub>	75.2789
2	Ethane	C <sub>2</sub> H <sub>6</sub>	12.2447
3	Propane	C <sub>3</sub> H <sub>8</sub>	6.0996
4	n-Butane	C <sub>4</sub> H <sub>10</sub>	1.7576
5	Carbon Dioxide	CO <sub>2</sub>	1.5436
6	Nitrogen	N <sub>2</sub>	1.3748
7	Isobutane	C <sub>4</sub> H <sub>10</sub>	0.7644
8	Isopentane	C <sub>5</sub> H <sub>12</sub>	0.354
9	n-Pentane	C <sub>5</sub> H <sub>12</sub>	0.354
10	n-Hexane	C <sub>6</sub> H <sub>14</sub>	0.00536
11	n-Heptane	C <sub>7</sub> H <sub>16</sub>	0.0834
12	n-Octane	C <sub>8</sub> H <sub>18</sub>	0.0429

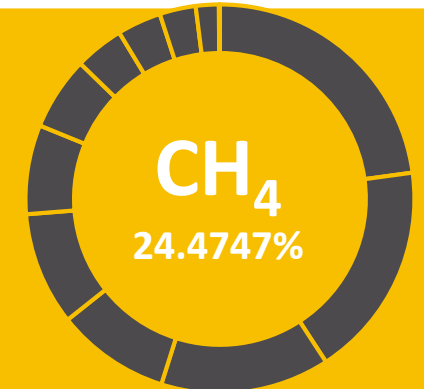
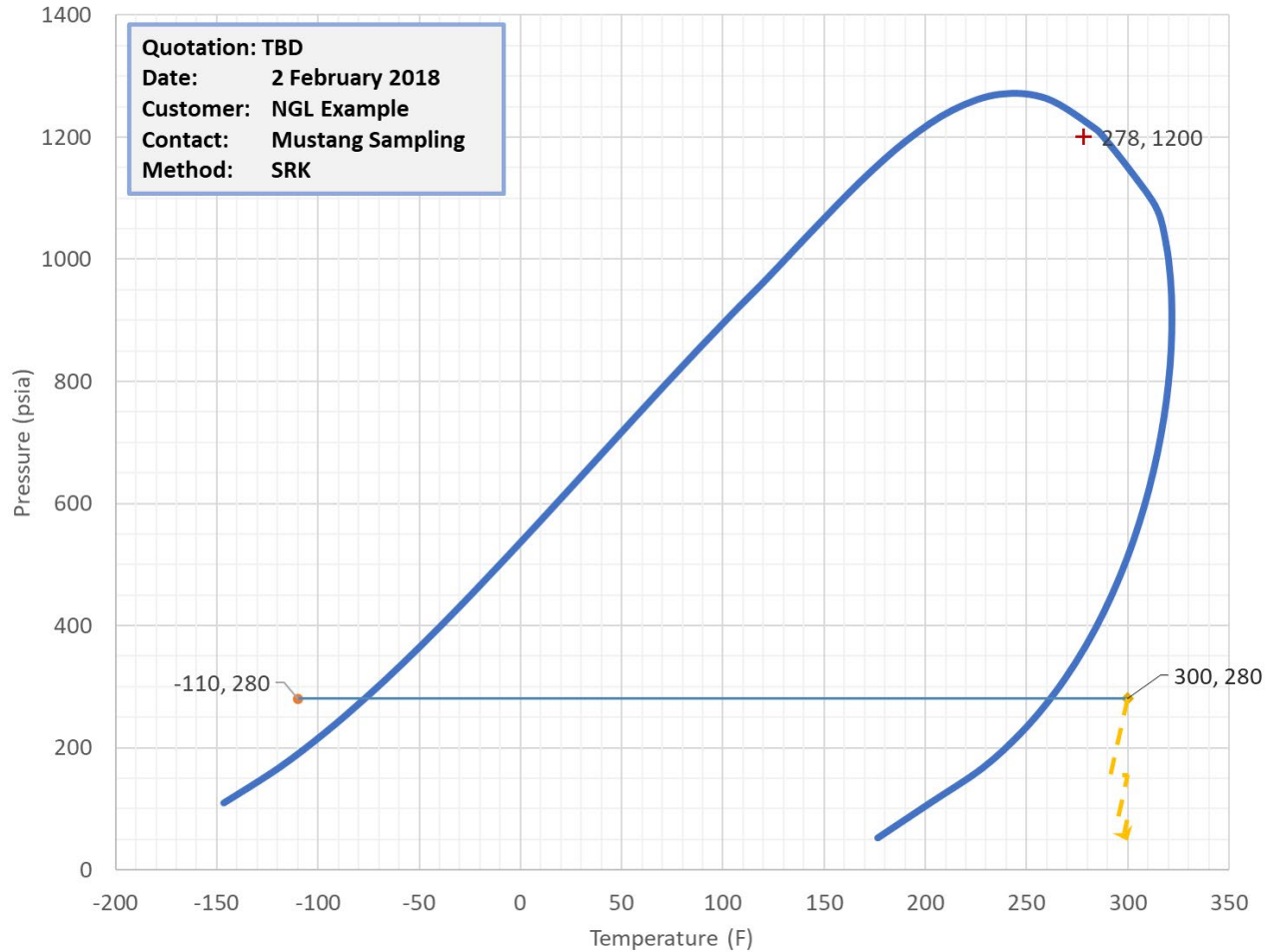


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# Phase Curve – Natural Gas Liquids

Phase Curve with Vaporizer and Mustang<sup>®</sup> Heated Joule-Thomson Regulator at 300° F

-  Sample point
-  Critical point
-  Mustang Sampling Point



No.	Name	Formula	Molar %
1	Methane	CH <sub>4</sub>	24.4747
2	Propane	C <sub>3</sub> H <sub>8</sub>	19.2648
3	Ethane	C <sub>2</sub> H <sub>6</sub>	15.0653
4	n-Hexane	C <sub>6</sub> H <sub>14</sub>	10.1277
5	n-Butane	C <sub>4</sub> H <sub>10</sub>	10.0901
Hydrogen Sulfide			
6	Sulfide	H <sub>2</sub> S	7.95
7	n-Heptane	C <sub>7</sub> H <sub>16</sub>	6.5355
8	n-Pentane	C <sub>5</sub> H <sub>12</sub>	4.3673
9	Isopentane	C <sub>5</sub> H <sub>12</sub>	3.9252
10	Isobutane	C <sub>4</sub> H <sub>10</sub>	3.2224
11	Carbon Dioxide	CO <sub>2</sub>	2.0488
12	Nitrogen	N <sub>2</sub>	0.0652
13	Water	H <sub>2</sub> O	0.0241

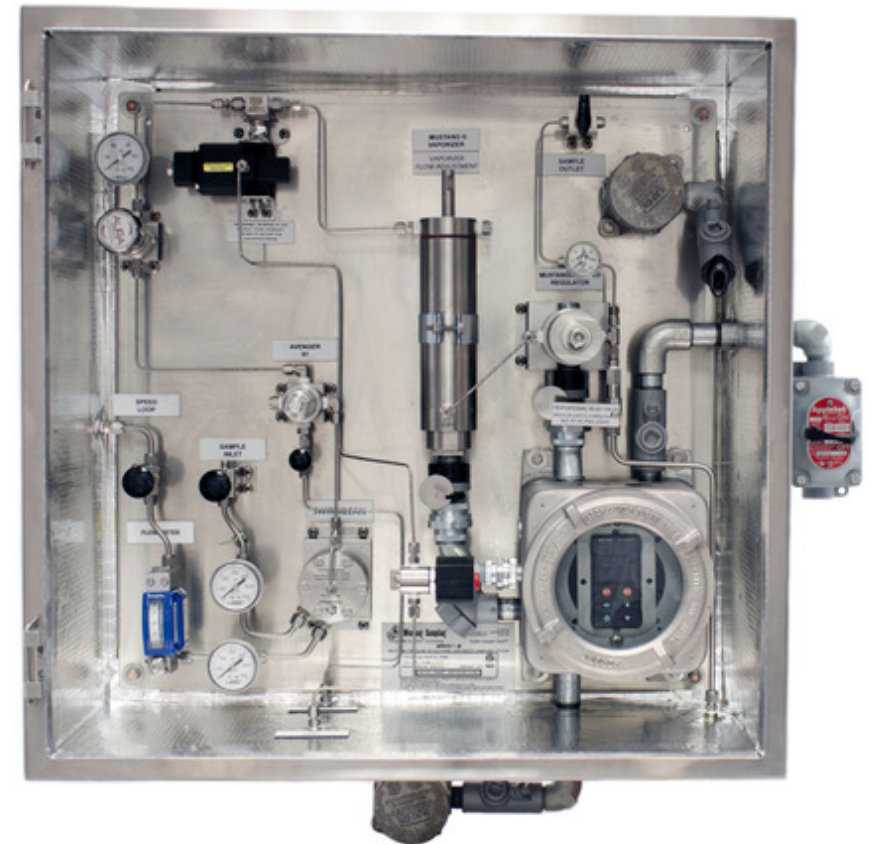


# NGL Sample Conditioning



**Mustang Sampling**<sup>®</sup>

- Vaporization is necessary for heavy or liquid samples
  - Boiling point determines requirement
  - Line between liquid and vapor not clear
- Required temperature may exceed limits of equipment in some cases
- Sample points may not be ideal
  - Sample point often inside two phase envelope
  - Liquid volume fractions fluctuate widely near critical points





**Mustang Sampling**<sup>®</sup>

# Mustang<sup>®</sup> Vaporizer – MV<sup>™</sup>

The Mustang Vaporizer (MV) flash vaporizes liquid samples for introduction into gas analysis systems. Liquid samples are maintained near line conditions until reaching a flash chamber within the vaporizer, preventing pre-vaporization. The energy for vaporization is provided by an electric cartridge heater with sufficiently large surface area to maintain a stable gas temperature throughout the process.



- Thermal cutoff
- Versatile conduit connections
- Integral heater and controller
- Integral flow restrictor on inlet

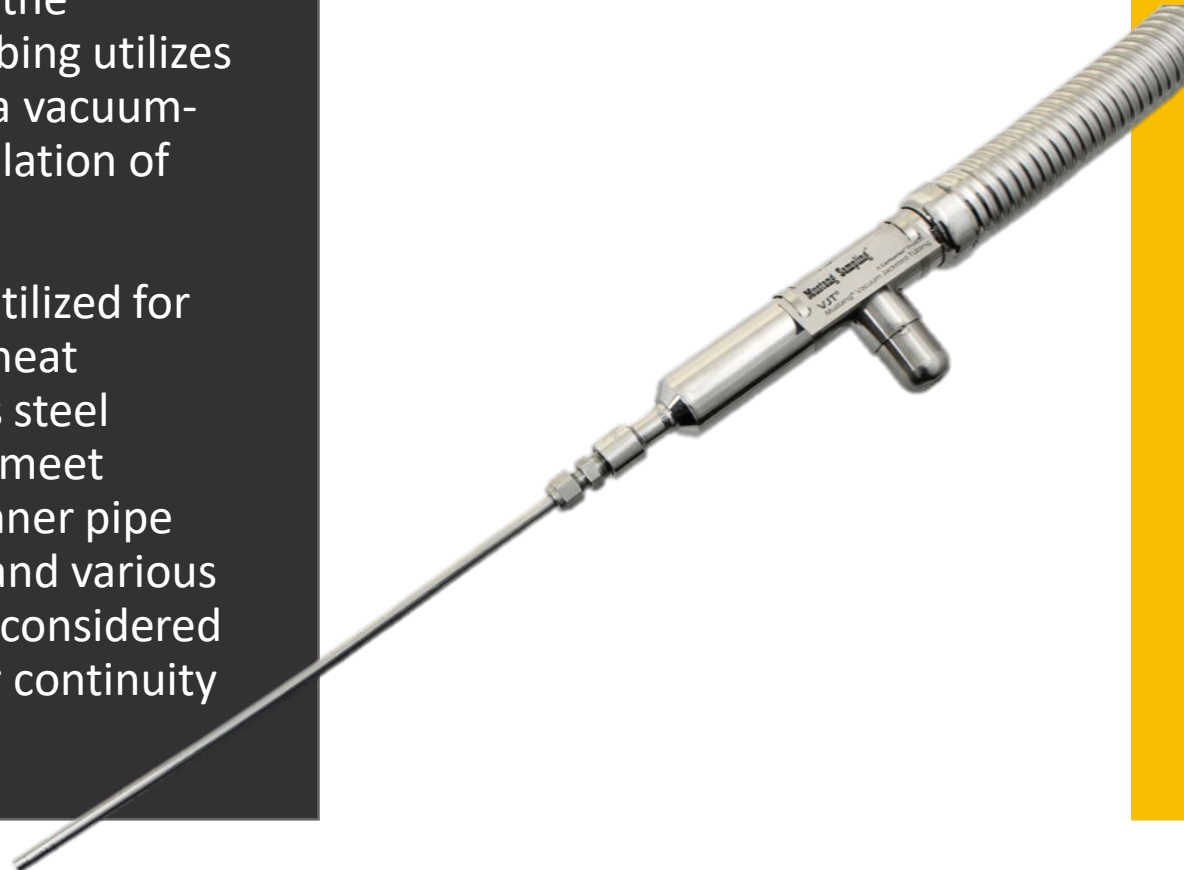
# Mustang Vacuum Jacketed Tubing – VJT®



**Mustang Sampling®**

This highly efficient design of the Mustang Vacuum Jacketed tubing utilizes multilayered material within a vacuum-sealed space for efficient insulation of the inner liquid transfer line.

Non-conductive spacers are utilized for the inner line which reduces heat transfer. This flexible stainless steel tubing is custom-designed to meet individual project needs for inner pipe size and overall length. Flow and various application requirements are considered with each engineered unit for continuity of quality.



- Multi-layered insulation
- Non-conductive spacers
- Flexible stainless steel tubing
- Patented gas-line probe adapter for connecting vacuum jacketed tubing

# Mustang Certiprobe® Threaded Sample Extractor



**Mustang Sampling®**

The threaded Mustang Certiprobe is the initial access point for a sampling system within a natural gas, natural gas liquid, chemical process, or biogas pipeline or vessel. The Certiprobe is available in a variety of lengths, materials, and pressure ratings to accommodate a wide range of applications in threaded configurations.

The Certiprobe sample extractor design includes Nondestructive Examination (NDE) of Positive Material Identification (PMI) and Dye Penetrant Inspection (DPI) for all welds. Stress analysis is performed, using pipeline conditions, prior to pipeline installation.



- Customer-specified metallurgy & rating
- Includes NDE, Dye Penetrant (PT),
- Hydrotest, and PMI (if requested)
- Threaded design
- Large bore diameter
- Designed for high velocity gas stream



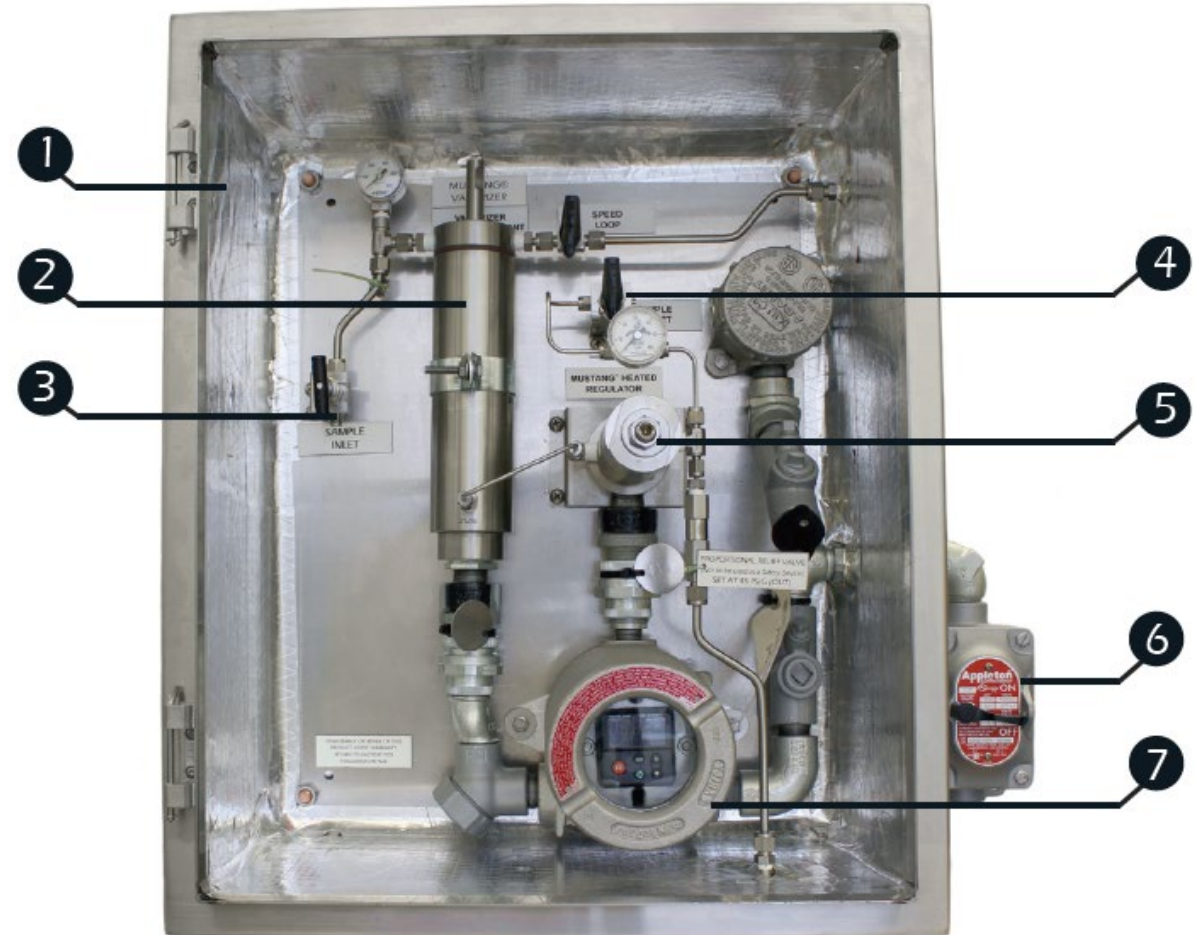
# Mustang<sup>®</sup> NGL Sample Conditioning System – MNGL<sup>®</sup>



Mustang Sampling<sup>®</sup>

## SINGLE TEMPERATURE CONTROLLER

Item Number	Description
1	Stainless Steel Insulated Enclosure
2	Mustang <sup>®</sup> Vaporizer
3	Sample Inlet (from process)
4	Sample Outlet (to analyzer(s))
5	Single or Multi-Stage Mustang <sup>®</sup> Heated Regulator
6	Power Switch
7	PID Temperature Controller



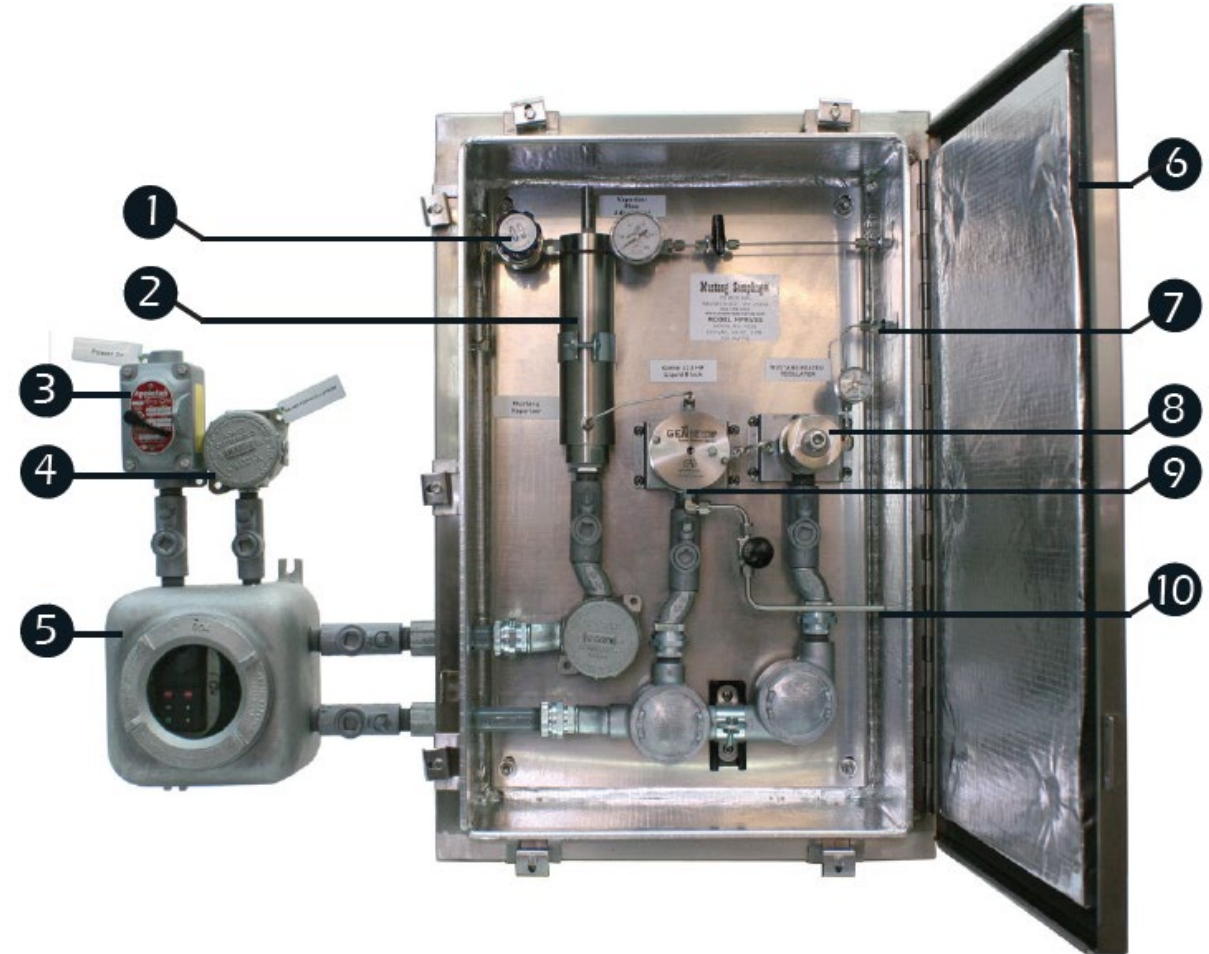
# Mustang<sup>®</sup> NGL Sample Conditioning System – MNGL<sup>®</sup>



Mustang Sampling<sup>®</sup>

## DUAL TEMPERATURE CONTROLLER

Item Number	Description
1	Manual Liquid Pressure Regulator
2	Single Path Mustang <sup>®</sup> Vaporizer
3	Power Switch
4	RS-485 Communications
5	Dual PID Temperature Controller
6	Stainless Steel Insulated Enclosure
7	Sample Outlet
8	Single or Multi-Stage Mustang <sup>®</sup> Heated Regulator
9	Heated Liquid Block
10	Drain



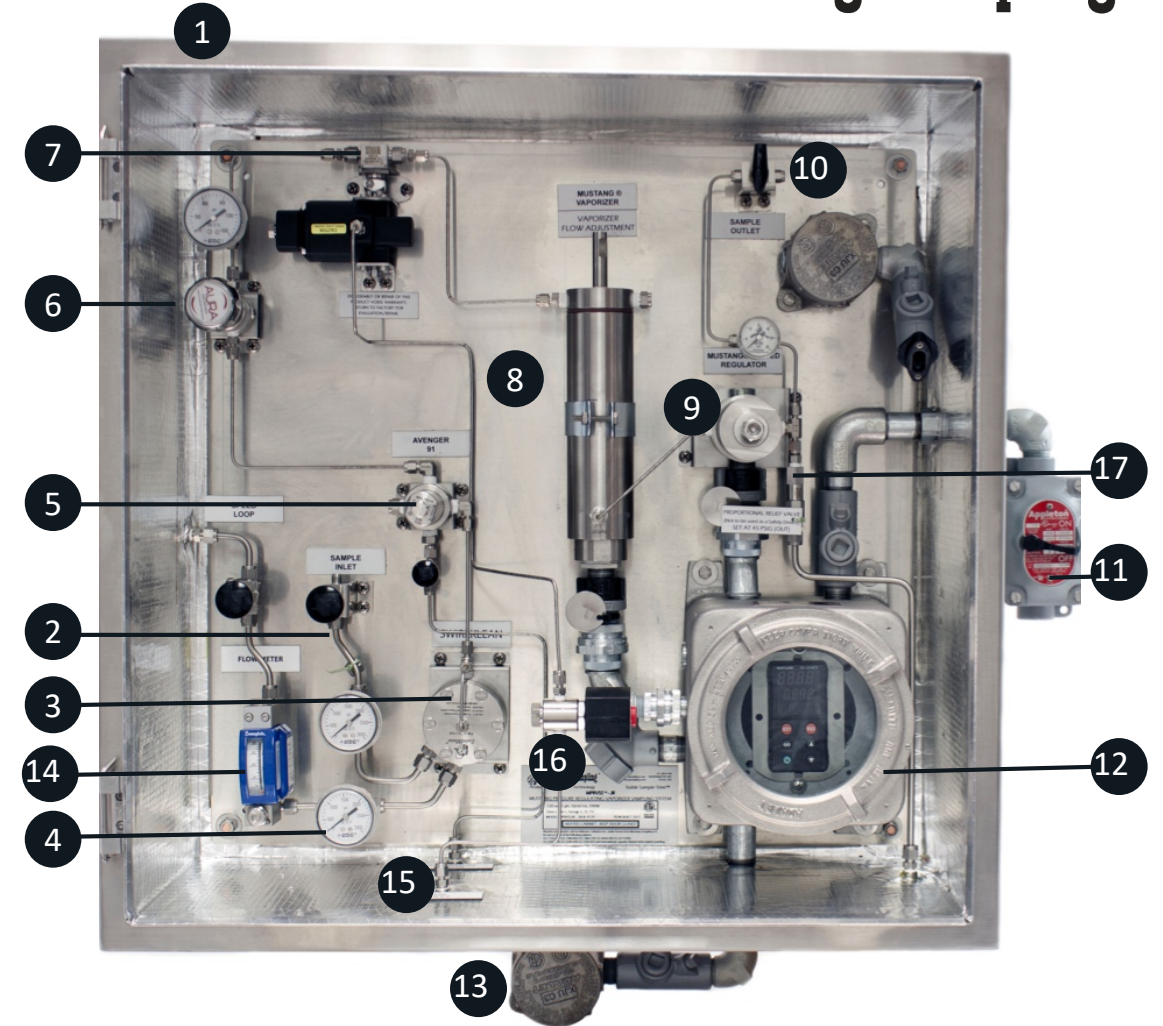
# Mustang<sup>®</sup> NGL Sample Conditioning System – MNGL<sup>®</sup>



Mustang Sampling<sup>®</sup>

## DUAL TEMPERATURE CONTROLLER with FILTRATION & SHUT DOWN

#	Description	#	Description
1	Stainless Steel Insulated Enclosure	10	Sample Outlet (to analyzer)
2	Sample Inlet (from process)	11	Power Source Switch
3	Particulate Filter	12	Dual PID Temperature Controller
4	Filter Drain to Speed Loop	13	Communications Port
5	Coalescing Filter	14	Armored Flow Meter
6	Manual Liquid Regulator	15	Liquid Drain
7	Shut-off Valve	16	Thermal Shut-off Valve
8	Single Path Mustang Vaporizer	17	Relief Valve
9	Single or Multi-stage Mustang Heated Regulator		





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# NGL Specification (Y-Grade)



**Mustang Sampling<sup>®</sup>**

Lone Star NGL Pipeline LP Lone Star NGL Mont Belvieu LP Lone Star NGL Fractionators LLC		Version: November 16, 2012
<b>Y-GRADE PRODUCT SPECIFICATIONS</b>		
Acceptable Y-Grade shall be a mixture of constituents or component products of natural gas liquids (NGLs) composed principally of ethane, propane, butane and natural gasolines, meeting the following product specifications:		
CHARACTERISTIC	PRODUCT SPECIFICATIONS	TEST METHOD
Composition: Methane, maximum Aromatics, maximum Olefins, maximum	See Note 1 See Note 2 1.0 L.V. %	GPA 2177 GPA 2186 GPA 2186
Carbon Dioxide: PPM by Volume in Liquid	500 maximum	GPA 2177
Vapor Pressure: psig at 100° F	600 maximum	ASTM D-6378
Corrosiveness: Copper strip at 100° F	No. 1	ASTM D-1838
Total Sulfur: PPM by weight, maximum	150	ASTM D-2784
Hydrogen Sulfide: Pass/Fail	Pass	ASTM D-2420
Distillation: End point at 14.7 psia, maximum See Note 3	375.0° F	ASTM D-7344
Color: Saybolt Number, minimum See Note 3	+25.0	ASTM D-6045
Existing Gum: Washed Unwashed	<=1mg/100ml <=1mg/100ml	ASTM D-381
Dryness: Free Water at 34° F	None	Visual Inspection
Product Temperature: Minimum Maximum	60° F 100° F	
<p><b>Note 1:</b> Methane not to exceed either 0.5 L.V. % of the total stream or 1.5 L.V. % of the ethane content. For accounting purposes a maximum of 1.5 L.V. % methane in the ethane will be considered ethane. Any excess above this specification shall not be accounted for.</p> <p><b>Note 2:</b> Aromatics not to exceed either 1.0 wt. % in the total stream or 10 L.V. % in contained natural gasoline</p> <p><b>Note 3:</b> Distillation and Color to be run on that portion of the mixture having a boiling point of 70° F and above at atmospheric pressure.</p> <p><b>General Contaminants Note:</b> The Y-Grade shall be commercially free from sand, dust, gums, gum-producing substances, oil, glycol, inhibitors, amine, caustics, chlorides, oxygenates, heavy metals, any other contaminants that make it unfit for its commonly used applications and any compound added to the product to enhance the ability to meet these specifications.</p> <p><b>Abbreviations:</b> ASTM = American Society for Testing and Materials, Standard Test Procedures; ° F = Degrees Fahrenheit; GPA = Gas Processors Association; L.V. % = liquid volume percent; mg = milligrams; ml = milliliters; PPM = Parts per Million; psia = pounds per square inch absolute; wt. % = percentage by weight.</p> <p><i>The aforementioned specifications may be modified from time to time in the sole discretion of the issuing entity.</i></p>		

<b>Y-GRADE PRODUCT SPECIFICATIONS</b>		
Acceptable Y-Grade shall be a mixture of constituents or component products of natural gas liquids (NGLs) composed principally of ethane, propane, butane and natural gasolines, meeting the following product specifications:		
CHARACTERISTIC	PRODUCT SPECIFICATIONS	TEST METHOD
Composition: Methane, maximum Aromatics, maximum Olefins, maximum	See Note 1 See Note 2 1.0 L.V. %	GPA 2177 GPA 2186 GPA 2186
Carbon Dioxide: PPM by Volume in Liquid	500 maximum	GPA 2177
Vapor Pressure: psig at 100° F	600 maximum	ASTM D-6378
Corrosiveness: Copper strip at 100° F	No. 1	ASTM D-1838
Total Sulfur: PPM by weight, maximum	150	ASTM D-2784
Hydrogen Sulfide: Pass/Fail	Pass	ASTM D-2420
Distillation: End point at 14.7 psia, maximum See Note 3	375.0° F	ASTM D-7344
Color: Saybolt Number, minimum See Note 3	+25.0	ASTM D-6045
Existing Gum:		

# Standards for NGL Measurement Combination of API, GPA, & ASTM Standards

This document is an ASTM standard and is intended only to provide the user of an ASTM standard an indication of what changes have been made to the previous version. Because it may be the subject of continuing revision, the year of last revision is shown in parentheses after the designation. A number in parentheses indicates the year of last approval. A superscript letter (a) indicates an editorial change since the last revision or approval.

**ASTM**  
INTERNATIONAL

Designation: **D2420 – 12a D2420 – 13**

**Standard Test Method for Hydrogen Sulfide in Liquefied Petroleum (LP) Gases (Lead Acetate Method)<sup>1</sup>**

This standard is issued under the fixed designation D2420; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript letter (a) indicates an editorial change since the last revision or approval.

**1. Scope<sup>2</sup>**

1.1 This test method<sup>3</sup> covers the detection of hydrogen sulfide in liquefied petroleum (LP) gases. The sensitivity of the test is about 4 mg/m<sup>3</sup> (0.15 to 0.2 grain of hydrogen sulfide per 100 ft<sup>3</sup>) of gas.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

**2. Referenced Documents**

2.1 ASTM Standards:<sup>4</sup>

- D1193 Specification for Reagent Water
- D1265 Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method
- D1835 Specification for Liquefied Petroleum (LP) Gases

2.2 GPA Standard:<sup>5</sup>

- GPA 2140 Liquefied Petroleum Gas Specifications and Test Methods

**3. Summary of Test Method**

3.1 Vaporized LP gas is passed over moist lead acetate paper under controlled conditions. Hydrogen sulfide reacts with lead acetate to form lead sulfide which produces a coloration on the paper varying from yellow to black, depending upon the amount of hydrogen sulfide present.

**4. Significance and Use**

4.1 Liquefied petroleum gases and their products of combustion must not be unduly corrosive to the materials with which they come in contact. The potential personnel exposure hazards of H<sub>2</sub>S also make the detection and measurement of hydrogen sulfide important, even in low concentrations. In addition, in some cases the odor of the gases shall not be objectionable. (See Specification D1835 and GPA 2140.)

**5. Interferences**

5.1 Methyl mercaptan, if present, produces a transitory yellow stain on the lead acetate paper that will fade completely in less than 5 min.

5.2 Other sulfur compounds present in liquefied petroleum gas do not interfere with the test.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.03 on Liquefied Petroleum Gas.  
Current edition approved Nov. 4, 2013 (Jan. 15, 2013). Published February 2013 (Jan. 2013). Originally approved in 1965. Last previous edition approved in 2012 as D2420-12a. DOI: 10.1520/D2420-13. <sup>2</sup> This test method is based on Edwards, L. H., and McBratne, B. S., "Lead Acetate Test for Hydrogen Sulfide in Gas," *Technology Papers 114*, National Institute for Standards and Technology, April 9, 1914.  
<sup>3</sup> For additional ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards online information, refer to the standard's Document Summary page on the ASTM website.  
<sup>4</sup> Available from: American Petroleum Association (API), 1400 15th St., Tulsa, OK 74103, www.api.org.  
<sup>5</sup> Available from: Gas Processors Association (GPA), 160 East 90th Street, Tulsa, Oklahoma 74103.

\*A Summary of Changes section appears at the end of this standard.  
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**Obtaining Liquid Hydrocarbons Samples  
For Analysis by Gas Chromatography**

Adopted as a Tentative Standard 2010  
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Gas Processors Association  
160 East 90th Street  
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Designation: **D 1266 – 98 (Reapproved 2003)<sup>1</sup>**

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Designation: **107/86**

**Standard Test Method for Sulfur in Petroleum Products (Lamp Method)<sup>1</sup>**

This standard is issued under the fixed designation D 1266; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript letter (a) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

<sup>1</sup> Non-Warning notes were editorially moved into the standard text in July 2003.

**1. Scope**

1.1 This test method covers the determination of total sulfur in liquid petroleum products in concentrations from 0.01 to 0.4 mass % (Note 1). A special sulfate analysis procedure is described in Annex A1 that permits the determination of sulfur in concentrations as low as 5 mg/kg.

Note 1.—The comparable lamp method for the determination of sulfur in liquefied petroleum gas is described in Test Method D 2784. For the determination of sulfur in heavier petroleum products that cannot be burned in a lamp, see the bomb method (Test Method D 129) the quartz tube method (IP 63), or the high-temperature method (Test Method D 1552).

1.2 The direct burning procedure (Section 9) is applicable to the analysis of such materials as gasoline, kerosene, naphtha, and other liquids that can be burned completely in a wick lamp. The blending procedure (Section 10) is applicable to the analysis of gas oils and distillate fuel oils, naphthenic acids, alkyl phenols, high sulfur content petroleum products, and many other materials that cannot be burned satisfactorily by the direct burning procedure.

1.3 Phosphorus compounds normally present in commercial gasoline do not interfere. A correction is given for the small amount of acid resulting from the combination of the lead anti-knock fluids in gasolines. Appreciable concentrations of acid-forming or base-forming elements from other sources interfere when the titration procedure is employed since no correction is provided in these cases.

1.4 The values stated in SI units are to be regarded as the standard.

1.5 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

**2. Referenced Documents**

2.1 ASTM Standards:

- D 129 Test Method for Sulfur in Petroleum Products (General Bomb Method)<sup>2</sup>
- D 1193 Specification for Reagent Water<sup>3</sup>
- D 1229 Test Method for Rubber Property—Compression Set at Low Temperatures<sup>4</sup>
- D 1552 Test Method for Sulfur in Petroleum Products (High Temperature Method)<sup>5</sup>
- D 2784 Test Method for Sulfur in Liquefied Petroleum Gases (Oxy-Hydrogen Burner or Lamp)<sup>6</sup>
- E 11 Specification for Wire Cloth and Sieves for Testing Purposes<sup>7</sup>
- E 63 Sulfur Content—The Quartz Tube Method

2.2 Institute of Petroleum Standard:<sup>8</sup>

- IP 63 Sulfur Content—The Quartz Tube Method

**3. Summary of Test Method**

3.1 The sample is burned in a closed system, using a suitable lamp (Fig. 1) and an artificial atmosphere composed of 70 % carbon dioxide and 30 % oxygen to prevent formation of nitrogen oxides. The oxides of sulfur are absorbed and oxidized to sulfuric acid by means of hydrogen peroxide solution which is then flushed with air to remove dissolved carbon dioxide. Sulfur as sulfate in the absorbent is determined acidimetrically by titration with standard sodium hydroxide solution, or gravimetrically by precipitation as barium sulfate (see Annex A2).

<sup>1</sup> Annual Book of ASTM Standards, Vol 05.01.  
<sup>2</sup> Annual Book of ASTM Standards, Vol 11.01.  
<sup>3</sup> Annual Book of ASTM Standards, Vol 09.01.  
<sup>4</sup> Annual Book of ASTM Standards, Vol 14.02.  
<sup>5</sup> Available from Institute of Petroleum (IP), 61 New Cavendish St., London, W1F 7AE, U.K.

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# Outline



**Mustang Sampling**<sup>®</sup>

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- Determination and Product Analysis
  - Composition of Natural Gas Mixtures
  - Composition of Natural Gas Liquid Mixtures
- Standards for NGL
- Closing Comments



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