

**PERMIT DETERMINATION FORM  
SMALL PRODUCTION DEHYDRATION UNIT  
LANE SITE  
KANAWHA COUNTY, WEST VIRGINIA**

*Prepared for:*

**Reserve Oil & Gas, Inc.**  
929 Charleston Road  
Spencer, West Virginia 25276

*Prepared by:*

**Potesta & Associates, Inc.**  
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Charleston, West Virginia 25304  
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Project No. 0101-15-0343

October 2015

**POTESTA**

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**SECTION I**  
**PERMIT DETERMINATION FORM**



WEST VIRGINIA  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
DIVISION OF AIR QUALITY  
601 57<sup>th</sup> Street, SE  
Charleston, WV 25304  
Phone: (304) 926-0475  
www.dep.wv.gov/daq

**PERMIT DETERMINATION FORM  
(PDF)**

FOR AGENCY USE ONLY: PLANT I.D. # \_\_\_\_\_  
PDF # \_\_\_\_\_ PERMIT WRITER: \_\_\_\_\_

1. NAME OF APPLICANT (AS REGISTERED WITH THE WV SECRETARY OF STATE'S OFFICE):

Reserve Oil & Gas, Inc.

2. NAME OF FACILITY (IF DIFFERENT FROM ABOVE):

Lane Dehydration Unit

3. NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (NAICS) CODE:

211111 (SIC 1311)

4A. MAILING ADDRESS:

929 Charleston Road  
Spencer, West Virginia 25276

4B. PHYSICAL ADDRESS:

Off of Surface Drive  
Charleston, West Virginia

5A. DIRECTIONS TO FACILITY (PLEASE PROVIDE MAP AS ATTACHMENT A):

Take I-77/79 North from Charleston and exit at Westmoreland Road, Exit 102, and get on U.S. Route 119 going North (Pennsylvania Avenue). Drive approximately 1.25 miles and turn left onto Newhouse Drive. Drive approximately 0.84 miles on Newhouse Drive and turn left onto Surface Drive. Follow Surface Drive to the end and then onto the access road to the site (total distance of 0.65 miles).

5B. NEAREST ROAD:

Surface Drive

5C. NEAREST CITY OR TOWN:

Charleston

5D. COUNTY:

Kanawha

5E. UTM NORTHING (KM):

4,248.70004

5F. UTM EASTING (KM):

445.49497

5G. UTM ZONE:

17

6A. INDIVIDUAL TO CONTACT IF MORE INFORMATION IS REQUIRED:

Doug Douglass

6B. TITLE:

Land Manager

6C. TELEPHONE:

(304) 483-8340

6D. FAX:

NA

6E. E-MAIL:

ddouglass@reserveoilandgas.com

7A. DAQ PLANT I.D. NO. (FOR AN EXISTING FACILITY ONLY):

Not Applicable (NA)

7B. PLEASE LIST ALL CURRENT 45CSR13, 45CSR14, 45CSR19 AND/OR TITLE V (45CSR30) PERMIT NUMBERS ASSOCIATED WITH THIS PROCESS (FOR AN EXISTING FACILITY ONLY):

NA

7C. IS THIS PDF BEING SUBMITTED AS THE RESULT OF AN ENFORCEMENT ACTION? IF YES, PLEASE LIST: No

8A. TYPE OF EMISSION SOURCE (CHECK ONE):

NEW SOURCE     ADMINISTRATIVE UPDATE  
 MODIFICATION     OTHER (PLEASE EXPLAIN IN 11B)

8B. IF ADMINISTRATIVE UPDATE, DOES DAQ HAVE THE APPLICANT'S CONSENT TO UPDATE THE EXISTING PERMIT WITH THE INFORMATION CONTAINED HEREIN?

YES     NO    N/A

9. IS DEMOLITION OR PHYSICAL RENOVATION AT AN EXISTING FACILITY INVOLVED?

YES     NO

10A. DATE OF ANTICIPATED INSTALLATION OR CHANGE:

11/15/2015

10B. DATE OF ANTICIPATED START-UP:

11/22/2015

11A. PLEASE PROVIDE A DETAILED PROCESS FLOW DIAGRAM SHOWING EACH PROPOSED OR MODIFIED PROCESS EMISSION POINT AS ATTACHMENT B.

11B. PLEASE PROVIDE A DETAILED PROCESS DESCRIPTION AS ATTACHMENT C.

12. PLEASE PROVIDE MATERIAL SAFETY DATA SHEETS (MSDS) FOR ALL MATERIALS PROCESSED, USED OR PRODUCED AS ATTACHMENT D. FOR CHEMICAL PROCESSE, PLEASE PROVIDE A MSDS FOR EACH COMPOUND EMITTED TO AIR.

**13A. REGULATED AIR POLLUTANT EMISSIONS:**

⇒ FOR A NEW FACILITY, PLEASE PROVIDE PLANT WIDE EMISSIONS BASED ON THE POTENTIAL TO EMIT (PTE) FOR THE FOLLOWING AIR POLLUTANTS INCLUDING ALL PROCESSES.

⇒ FOR AN EXISTING FACILITY, PLEASE PROVIDE THE PROPOSED CHANGE IN EMISSIONS BASED ON THE PTE OF ALL PROCESS CHANGES FOR THE FOLLOWING AIR POLLUTANTS.

PTE FOR A GIVEN POLLUTANT IS TYPICALLY BEFORE AIR POLLUTION CONTROL DEVICES AND IS COLLECTED BASED ON THE MAXIMUM DESIGN CAPACITY OF PROCESS EQUIPMENT.

POLLUTANT	HOURLY PTE (LB/HR)	YEARLY PTE (TON/YR) (HOURLY PTE MULTIPLIED BY 8760 HR/YR DIVIDED BY 2000 LB/TON)
PM	0.0015	0.0066
PM <sub>10</sub>	0.0015	0.0066
VOCs	1.2511	5.4806
CO	0.0168	0.0736
NO <sub>x</sub>	0.0200	0.0876
SO <sub>2</sub>	0.0001	0.0004
Pb		
HAPs (AGGREGATE AMOUNT)	0.3448	1.5101
TAPs (INDIVIDUALLY)* Formaldehyde	9.19E-6	4.03E-5
Benzene	1.77E-2	7.74E-2
OTHER (INDIVIDUALLY)*		

\* ATTACH ADDITIONAL PAGES AS NEEDED

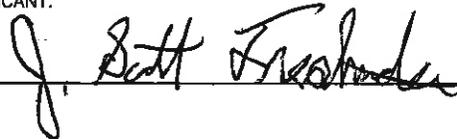
**13B. PLEASE PROVIDE ALL SUPPORTING CALCULATIONS AS ATTACHMENT E.**

CALCULATE AN HOURLY AND YEARLY PTE OF EACH PROCESS EMISSION POINT (SHOWN IN YOUR DETAILED PROCESS FLOW DIAGRAM) FOR ALL AIR POLLUTANTS LISTED ABOVE INCLUDING INDIVIDUAL HAP'S (LISTED IN SECTION 112[b] OF THE 1990 CAAA), TAP'S (LISTED IN 45CSR27), AND OTHER AIR POLLUTANTS (E.G. POLLUTANTS LISTED IN TABLE 45-13A OF 45CSR13, MINERAL ACIDS PER 45CSR7, ETC.).

**14. CERTIFICATION OF DATA**

I, Scott Freshwater (TYPE NAME) ATTEST THAT ALL THE REPRESENTATIONS CONTAINED IN THIS APPLICATION, OR APPENDED HERETO, ARE TRUE, ACCURATE, AND COMPLETE TO THE BEST OF MY KNOWLEDGE BASED ON INFORMATION AND BELIEF AFTER REASONABLE INQUIRY, AND THAT I AM A **RESPONSIBLE OFFICIAL**\*\* (PRESIDENT, VICE PRESIDENT, SECRETARY OR TREASURER, GENERAL PARTNER OR SOLE PROPRIETOR) OF THE APPLICANT.

SIGNATURE OF RESPONSIBLE OFFICIAL:



TITLE: Vice President

DATE: 10 / 21 / 15

\*\*THE DEFINITION OF THE PHRASE 'RESPONSIBLE OFFICIAL' CAN BE FOUND AT 45CSR13, SECTION 2.23.

**NOTE: PLEASE CHECK ENCLOSED ATTACHMENTS:**

ATTACHMENT A     ATTACHMENT B     ATTACHMENT C     ATTACHMENT D     ATTACHMENT E

RECORDS ON ALL CHANGES ARE REQUIRED TO BE KEPT AND MAINTAINED ON-SITE FOR TWO (2) YEARS.

THE PERMIT DETERMINATION FORM WITH THE INSTRUCTIONS CAN BE FOUND ON DAQ'S PERMITTING SECTION WEB SITE:

[www.dep.wv.gov/daq](http://www.dep.wv.gov/daq)

**ATTACHMENT A**

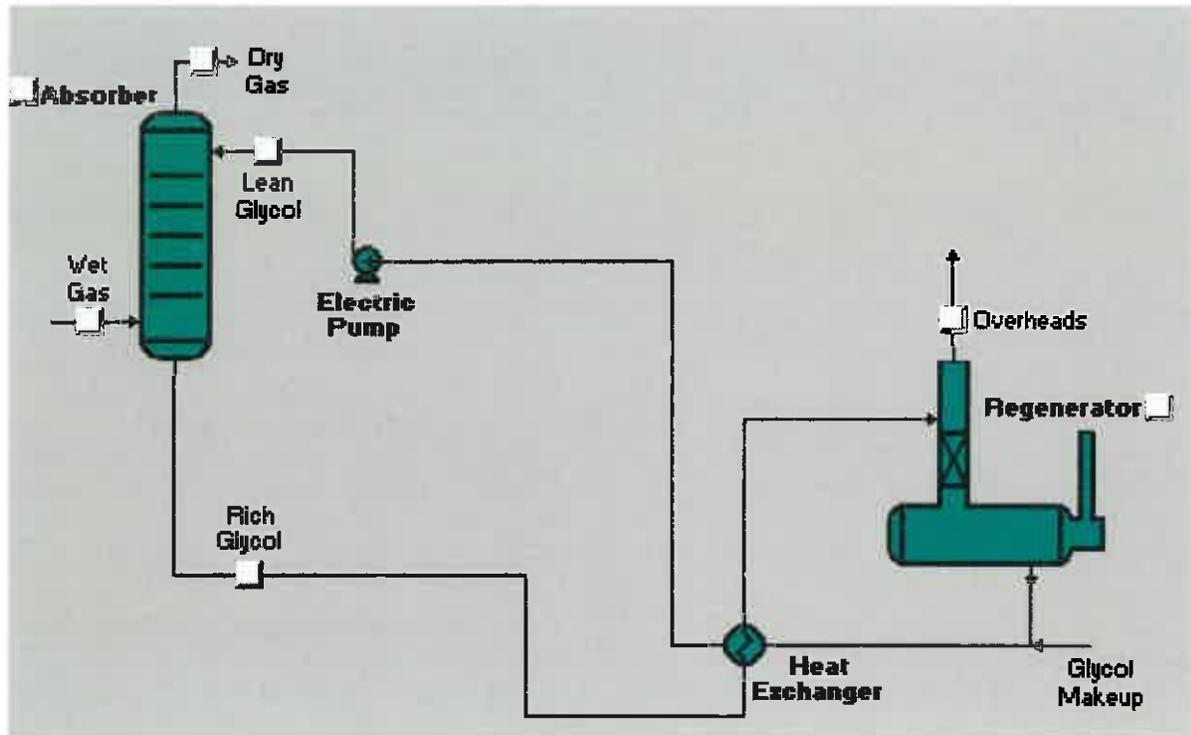
**AREA MAP**



7012 MacCorkle Avenue, S.E.  
Charleston, West Virginia 25304  
Phone: (304) 342-1400  
Fax: (304) 343-9031

**Area Map**  
**Lane Site**  
Reserve Oil & Gas, Inc.  
Kanawha County, West Virginia

**ATTACHMENT B**  
**PROCESS FLOW DIAGRAM**



Reference: TEG Dehydration Process Flow Diagram from GRI-GLYCalc Version 4.0



7012 MacCorkle Avenue, S.E.  
 Charleston, West Virginia 25304  
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 Fax: (304) 343-9031

**Process Flow Diagram**  
**Lane Site**  
 Reserve Oil & Gas, Inc.  
 Kanawha County, West Virginia

**ATTACHMENT C**  
**PROCESS DESCRIPTION**

# ATTACHMENT C

## PROCESS DESCRIPTION

Reserve Oil & Gas, Inc. (Reserve) owns and operates a natural gas gathering system located in Kanawha County, West Virginia. The natural gas is collected and delivered to a transmission pipeline at a meter where the proposed facility will be located as shown on the area map. The proposed dehydration system will be placed prior to the existing meter. The natural gas gathering system and the transmission pipeline already exist.

The transmission pipeline operators are requiring that Reserve reduce the water content of the gas to the standard level of seven pounds per thousand cubic feet of gas delivered to the pipeline. The water content in the gathering system can run up to approximately 250 pounds per thousand cubic feet. To reduce the water content of the natural gas a small triethylene glycol (TEG) dehydration unit is being proposed.

The TEG dehydration unit is made by Energy Weldfab with a model number of GDU166T125M. The dehydration unit comes with a reboiler rated at 125,000 Btu/hr. The unit is designed to process a maximum of 1.0 million cubic feet of gas per day with an average expected rate of 250,000 cubic feet per day. The glycol pump is rated to 3.0 gallons per pound of water. There are no control devices for this unit so the system has two point source emissions (still vent and reboiler stack) and fugitive emissions from equipment leaks.

A natural gas sample was obtained and analyzed to aid in estimating the emissions. The still vent emissions were estimated with GRI-GLYCalc Version 4.0. The natural gas analysis results and the GRI-GLYCalc Aggregate Report are included at the back of Attachment E of this application. The reboiler emissions are based on natural gas combustion contained in AP-42, Section 1.4, Natural Gas Combustion. Fugitives have been estimated based on an estimate of the count of connections, etc. using the Protocol for Equipment Leak Emission Estimates contained in Chapter 5 of AP-42.

The following is a review of the regulations for emissions levels triggering permitting and a substantive requirement requiring a permit:

- The total emissions for the site are less than 6 pound per hour and 10 tons per year for criteria pollutants (NO<sub>x</sub>, CO, PM, SO<sub>2</sub>, and VOC), less than 2 pounds per hour or 5 tons per year for total hazardous air pollutants, and less than the Table 45-13A toxic emissions thresholds. Therefore, we do not believe a permit is required based on Regulation 13, "Permits for Construction, Modification, Relocation, and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permit.

- The reboiler heat input is 125,000 Btu per hour. Regulation 2, “To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers” and Regulation 10, “To Prevent and Control Air Pollution from the Emission of Sulfur Oxides” have exemptions from most of the requirements in the rules for sources that are less than 10 million Btu per hour. The reboiler meets the exemptions under Regulation 2 and 10 based on heat input. Therefore, the rules are not considered substantive requirements under Regulation 13.
- Additionally, the TEG dehydration unit has benzene emissions of less than 1.0 tons per year (0.90 Mg/yr) and has a throughput of less than 3.0 million cubic feet per day (85,000 standard cubic meters per day). The unit meets both of the requirements for exemptions under Section 63.764.e.1. of 40CFR63 Subpart HH, “National Emission Standards for Hazardous Air Pollutants from Oil and Natural Gas Production Facilities”. Therefore, it is our understanding that the remaining recordkeeping requirements (required to keep records of the determinations that they are exempt) are not considered substantive requirements under Regulation 13.

Based on this review, we are requesting that the Division of Air Quality concur with our request for no permit required based on the overall size and resulting emissions from the facility.

**ATTACHMENT D**  
**MATERIAL SAFETY DATA SHEETS**

MATERIAL SAFETY DATA SHEET – NATURAL GAS (PIPELINE QUALITY - MSDS #526)



Revision Date: February 05, 2015  
Supersedes Date: January 26, 2012

**Section 1: PRODUCT AND COMPANY IDENTIFICATION**

FortisBC  
16705 Fraser Highway  
Surrey, BC  
V3S 2X7

Company Phone Number: (604) 576-7000  
Emergency Phone Number: 1-800-663-9911

Product Name: Natural Gas (Pipeline Quality)  
Material Use: Fuel

Manufacturer: Duke Energy Inc.  
1333 West Georgia Street  
Vancouver, BC  
V6E 3K9

Supplier: FortisBC  
16705 Fraser Highway  
Surrey, BC  
V3S 2X7

WHMIS Class: A – Compressed Gas;  
B1 – Flammable and Combustible Material – Division 1 Flammable Gases  
UN/PIN Number: 1971  
TDG Classification: Class 2.1 Flammable Gases  
TDG Shipping Name: Natural gas, compressed with high methane content  
Chemical Family: Simple hydrocarbon  
Chemical Formula: Natural gas (considered a complex mixture)  
Molecular Weight: Not applicable (natural gas is considered a complex mixture)  
CAS Number: 8006-14-2  
Trade Names / Synonyms: Methane, marsh gas

**Section 2: HAZARDS IDENTIFICATION**

**EMERGENCY OVERVIEW**

Appearance/Odour: Gas like odour and colourless gas  
Flammable: Yes. Can cause flash fire  
Potential Health Effects: See Section 11 for more information  
Potential Environmental Effects: See Section 12 for more information  
Likely Routes of Exposure: Acute inhalation  
Acute Inhalation: At high concentrations, natural gas can displace oxygen causing asphyxiation and cause central nervous system (CNS) depression and cardiac sensitization.  
Eye and Skin Contact: None  
Chronic- Inhalation: None  
Ingestion: None  
Skin Adsorption: None

**Section 3: COMPOSITION / INFORMATION ON INGREDIENTS**

Component	CAS #	% by Wt.	Exposure Limits <sup>NOTE 1</sup>
Methane	74-82-8	95	Simple asphyxiant
Ethane	74-84-0	3	Simple asphyxiant
Propane	74-98-6	1	Simple asphyxiant
Inert Gas	Not available	<1	Not available
Sulphur Compounds	Not available	Trace	Not available
Mercaptan Odourant	Mixture	3 ppm	0.5 ppm (ethyl mercaptan) 0.5 ppm (methyl mercaptan)

## MATERIAL SAFETY DATA SHEET – NATURAL GAS (PIPELINE QUALITY - MSDS #526)

NOTE 1. See Section 8 for additional exposure limit information for C<sub>1</sub> to C<sub>3</sub> Aliphatic Hydrocarbon Gases (i.e., methane, ethane, propane).

### Section 4: FIRST AID MEASURES

**Skin Contact:** First aid is not normally required.  
**Eye contact:** If irritation/redness develops, move victim away from exposure into fresh air and flush eyes with clean water.  
**Inhalation:** Ensure your own safety before attempting rescue. Move victim to fresh air. Administer oxygen if breathing has stopped. If heart beat can not be detected begin CPR. If person is overcome or been adversely affected by the emergency, obtain medical attention immediately.  
**Ingestion:** Unlikely route of exposure as this is a gas at normal room temperature and pressure.  
**General Advise:** Use extreme care in handling due to high flammability.

### Section 5: FIRE FIGHTING MEASURES

**Flammability:** Flammable gas and can be ignited by heat, flames, sparks or other sources of ignition (e.g., static electricity, pilot lights or mechanical/electrical equipment).  
**Suitable Extinguishing Media:** Dry chemical, carbon dioxide, water spray or fog.  
**Special Procedures:** Shut off flow of gas from a safe location. Use full protective equipment and self-contained breathing apparatus (SCBA). Do not extinguish flame until gas flow is shut off. Use gas detectors in confined spaces. Evaporate area if cooling of containers is not possible. For large fires nonessential personnel should be evacuated beyond 750 metres.  
**Products of Combustion:** Carbon dioxide and carbon monoxide  
**Protection of Firefighters:** Firefighters should wear SCBA in case of oxygen deficient atmosphere.  
**Sensitivity to Static Discharge:** Flammable  
**Sensitivity to Mechanical Impact:** None  
**Explosive Power:** Not available  
**Rate of Burning:** Not available  
**TDG Flammability Class** 2.1

### Section 6: ACCIDENTAL RELEASE MEASURES

**Personal Precautions:** Use personal protection recommended in Section 8.  
**Environmental Precautions:** Not applicable  
**Leak and Spill Procedure:** Evacuate area. Call emergency services and gas supplier. For large releases nonessential personnel should be evacuated beyond 750 metres. Eliminate any source of ignition.  
**Methods for Containment:** Stay away and upwind of spill/release.  
**Waste Disposal:** Vent to outside atmosphere.  
**Other Information:** Allow to vapourize and disperse to atmosphere.

In case of an emergency and no response at FortisBC, call SERVICE CENTER: 1 (800) 663-9911.

### Section 7: HANDLING AND STORAGE

**Handling:** Observe handling regulations for compressed gases and flammable materials. To be handled by trained personnel only and followed with approved operating procedures.  
**Storage:** Comply with storage regulations for compressed gases and flammable materials. No smoking or open flames in storage area.

## MATERIAL SAFETY DATA SHEET – NATURAL GAS (PIPELINE QUALITY - MSDS #526)

### Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

**Exposure Limits:** Simple asphyxiant - Maintain a minimum 19.5% oxygen (O<sub>2</sub>) content (below 19.5% O<sub>2</sub> is considered to be O<sub>2</sub> deficient).

Constituent <sup>NOTE 2</sup>	ACGIH (8-hour TWA)	WorkSafeBC (8-hour TWA)
Methane	Minimum O <sub>2</sub> content	1000 ppm
Ethane	Minimum O <sub>2</sub> content	1000 ppm
Propane	Minimum O <sub>2</sub> content	1000 ppm
Mercaptan Odourant	0.5 ppm (ethyl mercaptan) 0.5 ppm (methyl mercaptan)	0.5 ppm (ethyl mercaptan) 0.5 ppm (methyl mercaptan)

NOTE 2. Mercaptan odourant mixtures commonly contain ethyl mercaptan and/or methyl mercaptan (both ethyl mercaptan and methyl mercaptan have 8-hour TWA exposure limits of 0.5 ppm).

#### Personal Protective

**Equipment:** Ensure use of proper personal protective equipment (PPE) at all times when handling this product.

**Eye/face:** Eye protection (e.g., safety glasses) and/or face shields.

**Skin:** Safety work boots. Chemical resistant gloves are not required but recommended as good practice when handling chemicals. Flame retardant clothing should be worn in potentially flammable areas.

**Respiratory:** If engineering controls and work practices are not effective in controlling exposure to natural gas, then wear suitable respiratory protection. Supplied air or SCBA.

**Other Considerations:** None

**Engineering Controls:** All installations (i.e., mechanical ventilation) must conform to code requirements. Provide adequate ventilation to maintain below exposure limits and explosive limits.

### Section 9: PHYSICAL AND CHEMICAL PROPERTIES

<b>Physical State:</b>	Gas
<b>Colour:</b>	Colourless
<b>Odour:</b>	Gas odour
<b>Specific Gravity (Water = 1):</b>	Not applicable
<b>Odour Threshold (ppm):</b>	2500
<b>Vapour Pressure (mm Hg):</b>	Not applicable
<b>Vapour Density (Air = 1):</b>	0.59
<b>Evaporation Rate (nButAC = 1):</b>	Not applicable (gas at room temperature)
<b>Boiling Point (°C):</b>	-160
<b>Freezing Point (°C):</b>	Not applicable
<b>Solubility in water (20°C):</b>	Slight
<b>Percent Volatile (by volume):</b>	Not available
<b>pH:</b>	Not available
<b>Density (g/ml):</b>	Not available
<b>Partition Coefficient (water/oil):</b>	Not available
<b>Flash Point (°C):</b>	Flammable gas
<b>Flammability (solid, gas):</b>	Flammable gas
<b>Lower Explosion Limit (%):</b>	5 (by volume)
<b>Upper Explosion Limit (%):</b>	15 (by volume)
<b>Auto-ignition Temperature (°C):</b>	537

### Section 10: STABILITY AND REACTIVITY

**Chemical Stability:** Yes

## MATERIAL SAFETY DATA SHEET – NATURAL GAS (PIPELINE QUALITY - MSDS #526)

<b>Conditions to Avoid:</b>	High heat
<b>Incompatibility with Other Substances:</b>	Avoid contact with strong oxidizing agents
<b>Hazardous Decomposition Products:</b>	COx, luminous clean flame on combustion
<b>Reactivity (and Under What Conditions):</b>	Strong oxidizing agents increase risk of fire (peroxides, perchlorates, chlorine, liquid oxygen).

### Section 11: TOXICOLOGICAL INFORMATION

<b>LD50:</b>	Not applicable
<b>LC50:</b>	Not applicable
<b>Acute Effects:</b>	Simple asphyxiant: at high concentrations, natural gas can displace oxygen and cause asphyxiation. The ACGIH TLV-TWA for C <sub>1</sub> to C <sub>3</sub> Aliphatic Hydrocarbon Gases is believed to be protective against potential health effects that include CNS depression and cardiac sensitization. The TLV-TWA is based upon the abilities of these gases (methane, ethane, propane) to produce weak depressant effects on the CNS at high concentration levels approaching the lower explosive limit. It has also been reported that ethane and propane can induce cardiac arrhythmias under certain conditions leading to ventricular fibrillation which can result in death in the presence of high epinephrine levels.
<b>Chronic Effects:</b>	None
<b>Carcinogenicity:</b>	Not considered carcinogenic by IARC, NTP, ACGIH or OSHA.
<b>Reproductive Effects:</b>	Not available
<b>Teratogenicity:</b>	Not available
<b>Mutagenicity:</b>	Not available
<b>Irritant:</b>	Not available
<b>Sensitizer:</b>	Not available
<b>Synergistic Effects:</b>	Not available

### Section 12: ECOLOGICAL INFORMATION

<b>Ecotoxicity:</b>	Not available
<b>Persistence/ Degradability:</b>	Not available
<b>Bioaccumulation/ Accumulation:</b>	Not available

There is no information available on the ecotoxicological effects of natural gas. Because of the high volatility of natural gas, it is unlikely to cause ground or water pollution. Natural gas released into the environment will disperse rapidly into the atmosphere and undergo photochemical degradation.

### Section 13: DISPOSAL CONSIDERATIONS

<b>Disposal:</b>	Allow to dissipate to the atmosphere (if permitted by federal/provincial/municipal requirements). Dispose in a safe location, preferably by burning with a flare. If disposal of natural gas cannot be flared, care must be taken to ensure complete dissipation of the gas to a concentration below its flammable limits.
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### Section 14: TRANSPORT INFORMATION

<b>TDG Classification:</b>	Class 2.1 Flammable Gases
<b>UN/PIN Number:</b>	1971
<b>TDG Shipping Description:</b>	Natural gas, compressed with high methane content
<b>Special Shipping Information:</b>	Handle as extremely flammable gas. Electronically ground/bond during transfer to avoid static accumulation. Precaution should be taken to minimize inhalation of natural gas.

## MATERIAL SAFETY DATA SHEET – NATURAL GAS (PIPELINE QUALITY - MSDS #526)

### Section 15: REGULATORY INFORMATION

**DSL (Canada):** This product is on the DSL list (Canada).  
**WHMIS Class:** A – Compressed Gas;  
B1 – Flammable and Combustible Material – Division 1 Flammable Gases

### Section 16: OTHER INFORMATION

#### National Fire Protection Association (NFPA 704) Ratings:

Health	1	LEGEND	0 = minimal hazard
Flammability	4		1 = slight hazard
Instability	0		2 = moderate hazard
<i>(For natural gas from NFPA 325)</i>			3 = severe hazard
			4 = extreme hazard

#### Hazardous Materials Identification System (HMIS) Ratings:

Health	1	LEGEND	0 = minimal hazard
Flammability	4		1 = slight hazard
Physical Hazard	3		2 = moderate hazard
<i>(For methane from HMIS Chemical Ratings Guide)</i>			3 = serious hazard
			4 = severe hazard

**Prepared by:** AMEC Foster Wheeler  
Environment & Infrastructure  
Occupational Hygiene and Safety Group

**Phone Number:** (604) 294-3811  
**Preparation Date:** February 05, 2015

**Additional Information and Comments:** This MSDS has been revised and updated from the last revision date of January 26, 2012. All sections and the order that which they appear have been documented as per American National Standard – *For Hazardous Industrial Chemicals – Material Safety Data Sheets Preparation* (ANSI Z400.1-2004).

The information contained in this document applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. It is the user's responsibility to satisfy oneself as to the suitability and completeness of this information for their own particular use.

**Information Sources:** Various



# Material Safety Data Sheet

The Dow Chemical Company

Product Name: Triethylene Glycol

Issue Date: 05/10/2010  
Print Date: 11 May 2010

The Dow Chemical Company encourages and expects you to read and understand the entire (M)SDS, as there is important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

## 1. Product and Company Identification

**Product Name**  
Triethylene Glycol

### COMPANY IDENTIFICATION

The Dow Chemical Company  
2030 Willard H. Dow Center  
Midland, MI 48674  
USA

Customer Information Number: 800-258-2436

### EMERGENCY TELEPHONE NUMBER

24-Hour Emergency Contact: 989-636-4400  
Local Emergency Contact: 989-636-4400

## 2. Hazards Identification

### Emergency Overview

**Color:** Colorless  
**Physical State:** Liquid.  
**Odor:** Mild  
**Hazards of product:**

**CAUTION!** May cause skin irritation.

### OSHA Hazard Communication Standard

This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

### Potential Health Effects

**Eye Contact:** May cause slight temporary eye irritation. Mist may cause eye irritation.  
**Skin Contact:** Prolonged contact may cause skin irritation with local redness. May cause more severe response if skin is abraded (scratched or cut).  
**Skin Absorption:** Prolonged skin contact is unlikely to result in absorption of harmful amounts. Massive contact with damaged skin or of material sufficiently hot to burn skin may result in absorption of potentially lethal amounts.

®(TM)\*Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

**Inhalation:** At room temperature, exposure to vapor is minimal due to low volatility. Mist may cause irritation of upper respiratory tract (nose and throat). Vapor from heated material may cause adverse effects.

**Ingestion:** Small amounts swallowed incidentally as a result of normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury. May cause nausea and vomiting. May cause abdominal discomfort or diarrhea. May cause dizziness and drowsiness. Oral toxicity is expected to be greater in humans due to triethylene glycol even though tests in animals show a lower degree of toxicity.

**Aspiration hazard:** Based on physical properties, not likely to be an aspiration hazard.

**Effects of Repeated Exposure:** Based on available data, repeated exposures are not expected to cause significant adverse effects except at very high aerosol concentrations. Repeated excessive aerosol exposures may cause respiratory tract irritation and even death.

**Birth Defects/Developmental Effects:** Triethylene glycol did not cause birth defects in animals; reduced fetal body weight effects were seen only at very high doses.

### 3. Composition Information

Component	CAS #	Amount
Triethylene glycol	112-27-6	> 98.0 %
Diethylene glycol	111-46-6	<= 1.0 %

### 4. First-aid measures

**Eye Contact:** Flush eyes thoroughly with water for several minutes. Remove contact lenses after the initial 1-2 minutes and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.

**Skin Contact:** Immediately flush skin with water while removing contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Destroy contaminated leather items such as shoes, belts, and watchbands. Safety shower should be located in immediate work area.

**Inhalation:** Move person to fresh air; if effects occur, consult a physician.

**Ingestion:** Do not induce vomiting. Seek medical attention immediately. If person is fully conscious give 1 cup or 8 ounces (240 ml) of water. If medical advice is delayed and if an adult has swallowed several ounces of chemical, then give 3-4 ounces (1/3-1/2 Cup) (90-120 ml) of hard liquor such as 80 proof whiskey. For children, give proportionally less liquor at a dose of 0.3 ounce (1 1/2 tsp.) (8 ml) liquor for each 10 pounds of body weight, or 2 ml per kg body weight [e.g., 1.2 ounce (2 1/3 tbsp.) for a 40 pound child or 36 ml for an 18 kg child].

**Notes to Physician:** Due to structural analogy and clinical data, this material may have a mechanism of intoxication similar to ethylene glycol. On that basis, treatment similar to ethylene glycol intoxication may be of benefit. In cases where several ounces (60 - 100 ml) have been ingested, consider the use of ethanol and hemodialysis in the treatment. Consult standard literature for details of treatment. If ethanol is used, a therapeutically effective blood concentration in the range of 100 - 150 mg/dl may be achieved by a rapid loading dose followed by a continuous intravenous infusion. Consult standard literature for details of treatment. 4-Methyl pyrazole (Antizol®) is an effective blocker of alcohol dehydrogenase and should be used in the treatment of ethylene glycol (EG), di- or triethylene glycol (DEG, TEG), ethylene glycol butyl ether (EGBE), or methanol intoxication if available. Fomepizole protocol (Brent, J. et al., New England Journal of Medicine, Feb. 8, 2001, 344:6, p. 424-9): loading dose 15 mg/kg intravenously, follow by bolus dose of 10 mg/kg every 12 hours; after 48 hours, increase bolus dose to 15 mg/kg every 12 hours. Continue fomepizole until serum methanol, EG, DEG, TEG or EGBE are undetectable. The signs and symptoms of poisoning include anion gap metabolic acidosis, CNS depression, renal tubular injury, and possible late stage cranial nerve involvement. Respiratory symptoms, including pulmonary edema, may be delayed. Persons receiving significant exposure should be observed 24-48 hours for signs of respiratory distress. In severe poisoning, respiratory support with mechanical ventilation and positive end expiratory pressure may be required. Maintain adequate ventilation and oxygenation of the patient. If lavage is performed, suggest endotracheal and/or esophageal control. Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach. If burn is present, treat as any thermal burn,

after decontamination. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

**Emergency Personnel Protection:** First Aid responders should pay attention to self-protection and use the recommended protective clothing (chemical resistant gloves, splash protection). If potential for exposure exists refer to Section 8 for specific personal protective equipment.

## 5. Fire Fighting Measures

**Extinguishing Media:** Water fog or fine spray. Dry chemical fire extinguishers. Carbon dioxide fire extinguishers. Foam. Do not use direct water stream. May spread fire. Alcohol resistant foams (ATC type) are preferred. General purpose synthetic foams (including AFFF) or protein foams may function, but will be less effective.

**Fire Fighting Procedures:** Keep people away. Isolate fire and deny unnecessary entry. Use water spray to cool fire exposed containers and fire affected zone until fire is out and danger of reignition has passed. Fight fire from protected location or safe distance. Consider the use of unmanned hose holders or monitor nozzles. Immediately withdraw all personnel from the area in case of rising sound from venting safety device or discoloration of the container. Burning liquids may be extinguished by dilution with water. Do not use direct water stream. May spread fire. Move container from fire area if this is possible without hazard. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage.

**Special Protective Equipment for Firefighters:** Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.

**Unusual Fire and Explosion Hazards:** Container may rupture from gas generation in a fire situation. Violent steam generation or eruption may occur upon application of direct water stream to hot liquids.

**Hazardous Combustion Products:** During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include and are not limited to: Carbon monoxide. Carbon dioxide.

## 6. Accidental Release Measures

**Steps to be Taken if Material is Released or Spilled:** Small spills: Absorb with materials such as: Dirt. Sand. Sawdust. Vermiculite. Perlite. Zorb-all®. Oil-Dri or equivalent filler. Large spills: Dike area to contain spill. Pump into suitable and properly labeled containers. See Section 13, Disposal Considerations, for additional information.

**Personal Precautions:** Keep unnecessary and unprotected personnel from entering the area. Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.

**Environmental Precautions:** Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

## 7. Handling and Storage

### Handling

**General Handling:** Avoid contact with skin and clothing. Wash thoroughly after handling. Spills of these organic materials on hot fibrous insulations may lead to lowering of the autoignition temperatures possibly resulting in spontaneous combustion. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

### Storage

Do not store near food, foodstuffs, drugs or potable water supplies. Additional storage and handling information on this product may be obtained by calling your sales or customer service contact. Ask for a product brochure.

## 8. Exposure Controls / Personal Protection

### Exposure Limits

Component	List	Type	Value
Triethylene glycol	Dow IHG	TWA Total	100 mg/m <sup>3</sup>

### Personal Protection

**Eye/Face Protection:** Use safety glasses (with side shields). If there is a potential for exposure to particles which could cause eye discomfort, wear chemical goggles.

**Skin Protection:** When prolonged or frequently repeated contact could occur, use protective clothing chemically resistant to this material. Selection of specific items such as faceshield, boots, apron, or full-body suit will depend on the task. When handling hot material, protect skin from thermal burns as well as from skin absorption.

**Hand protection:** Use gloves chemically resistant to this material when prolonged or frequently repeated contact could occur. If hands are cut or scratched, use gloves chemically resistant to this material even for brief exposures. Use gloves with insulation for thermal protection, when needed. Examples of preferred glove barrier materials include: Butyl rubber. Natural rubber ("latex"). Neoprene. Nitrile/butadiene rubber ("nitrile" or "NBR"). Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Polyvinyl alcohol ("PVA"). Polyvinyl chloride ("PVC" or "vinyl"). **NOTICE:** The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

**Respiratory Protection:** Respiratory protection should be worn when there is a potential to exceed the exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, wear respiratory protection when adverse effects, such as respiratory irritation or discomfort have been experienced, or where indicated by your risk assessment process. In misty atmospheres, use an approved particulate respirator. The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

**Ingestion:** Use good personal hygiene. Do not consume or store food in the work area. Wash hands before smoking or eating.

### Engineering Controls

**Ventilation:** Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

## 9. Physical and Chemical Properties

<b>Physical State</b>	Liquid.
<b>Color</b>	Colorless
<b>Odor</b>	Mild
<b>Odor Threshold</b>	No test data available
<b>Flash Point - Closed Cup</b>	177 °C (351 °F) <i>ASTM D93</i>
<b>Flammability (solid, gas)</b>	Not applicable to liquids
<b>Flammable Limits in Air</b>	<b>Lower:</b> 0.9 %(V) <i>Calculated</i> <b>Upper:</b> 9.2 %(V) <i>Estimated.</i>
<b>Autoignition Temperature</b>	349 °C (660 °F) <i>Literature</i>
<b>Vapor Pressure</b>	< 0.01 mmHg @ 20 °C <i>Literature</i>
<b>Boiling Point (760 mmHg)</b>	288 °C (550 °F) <i>Literature</i> <i>Decomposes.</i>
<b>Vapor Density (air = 1)</b>	5.2 <i>Literature</i>
<b>Specific Gravity (H<sub>2</sub>O = 1)</b>	1.1255 20 °C/20 °C <i>Literature</i>
<b>Freezing Point</b>	-4.3 °C (24.3 °F) <i>Literature</i>
<b>Melting Point</b>	No test data available

<b>Solubility in water (by weight)</b>	100 % <i>Literature</i>
<b>pH</b>	8 <i>Literature</i>
<b>Molecular Weight</b>	150.18 g/mol <i>Literature</i>
<b>Molecular Formula</b>	HO(C <sub>2</sub> H <sub>4</sub> O) <sub>3</sub> H
<b>Decomposition</b>	No test data available
<b>Temperature</b>	
<b>Evaporation Rate (Butyl Acetate = 1)</b>	<0.01 <i>Literature</i>

## 10. Stability and Reactivity

### Stability/Instability

Stable under recommended storage conditions. See Storage, Section 7.

**Conditions to Avoid:** Exposure to elevated temperatures can cause product to decompose. Generation of gas during decomposition can cause pressure in closed systems.

**Incompatible Materials:** Avoid contact with: Strong acids. Strong bases. Strong oxidizers.

### Hazardous Polymerization

Will not occur.

### Thermal Decomposition

Decomposition products depend upon temperature, air supply and the presence of other materials. Decomposition products can include and are not limited to: Aldehydes. Ketones. Organic acids.

## 11. Toxicological Information

### Acute Toxicity

#### Ingestion

LD<sub>50</sub>, Rat 16,800 - 22,060 mg/kg

#### Dermal

LD<sub>50</sub>, Rabbit > 18,016 mg/kg

#### Inhalation

Maximum attainable concentration. LC<sub>50</sub>, 4 h, Aerosol, Rat > 4.5 mg/l

### Eye damage/eye irritation

May cause slight temporary eye irritation. Mist may cause eye irritation.

### Skin corrosion/irritation

Prolonged contact may cause skin irritation with local redness. May cause more severe response if skin is abraded (scratched or cut).

### Sensitization

#### Skin

No relevant information found.

#### Respiratory

No relevant information found.

### Repeated Dose Toxicity

Based on available data, repeated exposures are not expected to cause significant adverse effects except at very high aerosol concentrations. Repeated excessive aerosol exposures may cause respiratory tract irritation and even death.

### Chronic Toxicity and Carcinogenicity

Did not cause cancer in laboratory animals.

### Developmental Toxicity

Triethylene glycol did not cause birth defects in animals; reduced fetal body weight effects were seen only at very high doses.

### Reproductive Toxicity

In animal studies, did not interfere with reproduction.

### Genetic Toxicology

In vitro genetic toxicity studies were negative.

## 12. Ecological Information

### ENVIRONMENTAL FATE

#### Data for Component: Triethylene glycol

##### Movement & Partitioning

Bioconcentration potential is low (BCF less than 100 or log Pow less than 3). Potential for mobility in soil is very high (Koc between 0 and 50).

Henry's Law Constant (H): 4.37E-10 atm\*m3/mole; 25 °C Estimated.

Partition coefficient, n-octanol/water (log Pow): -1.75 Estimated.

Partition coefficient, soil organic carbon/water (Koc): 10 Estimated.

##### Persistence and Degradability

Material is ultimately biodegradable (reaches > 70% mineralization in OECD test(s) for inherent biodegradability). Material is readily biodegradable. Passes OECD test(s) for ready biodegradability.

##### Indirect Photodegradation with OH Radicals

Rate Constant	Atmospheric Half-life	Method
3.64E-11 cm3/s	3.5 h	Estimated.

##### OECD Biodegradation Tests:

Biodegradation	Exposure Time	Method
25 - 92 %	28 d	OECD 301C Test
> 70 - 95 %	2 - 14 d	OECD 302B Test

##### Biological oxygen demand (BOD):

BOD 5	BOD 10	BOD 20	BOD 28
12 - 32 %	15 - 64 %	17 - 86 %	

Theoretical Oxygen Demand: 1.60 mg/mg

#### Data for Component: Diethylene glycol

##### Movement & Partitioning

Bioconcentration potential is low (BCF less than 100 or log Pow less than 3). Potential for mobility in soil is very high (Koc between 0 and 50). Given its very low Henry's constant, volatilization from natural bodies of water or moist soil is not expected to be an important fate process.

Henry's Law Constant (H): 7.96E-10 atm\*m3/mole; 25 °C Estimated.

Partition coefficient, n-octanol/water (log Pow): -1.47 Estimated.

Partition coefficient, soil organic carbon/water (Koc): < 1 Estimated.

##### Persistence and Degradability

Material is readily biodegradable. Passes OECD test(s) for ready biodegradability. Material is ultimately biodegradable (reaches > 70% mineralization in OECD test(s) for inherent biodegradability).

##### Indirect Photodegradation with OH Radicals

Rate Constant	Atmospheric Half-life	Method
2.23E-11 cm3/s	5.7 h	Estimated.

##### OECD Biodegradation Tests:

Biodegradation	Exposure Time	Method
92 %	28 d	OECD 301C Test
82 - 98 %	28 d	OECD 302C Test

Theoretical Oxygen Demand: 1.51 mg/mg

### ECOTOXICITY

#### Data for Component: Triethylene glycol

Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).

**Fish Acute & Prolonged Toxicity**

LC50, bluegill (*Lepomis macrochirus*), 96 h: 61,000 mg/l

**Aquatic Invertebrate Acute Toxicity**

EC50, water flea *Daphnia magna*, 48 h: 49,000 mg/l

**Toxicity to Micro-organisms**

EC50; bacteria, Growth inhibition (cell density reduction), 16 h: > 10,000 mg/l

**Aquatic Invertebrates Chronic Toxicity Value:**

ChV Value mg/l	Species	Test Type	Endpoint	Exposure Time
10607 mg/l	water flea <i>Daphnia magna</i>	static renewal	growth	21 d

**Data for Component: Diethylene glycol**

Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).

**Fish Acute & Prolonged Toxicity**

LC50, rainbow trout (*Oncorhynchus mykiss*), 96 h: > 1,000 mg/l

**Aquatic Invertebrate Acute Toxicity**

EC50, water flea *Daphnia magna*, 48 h, immobilization: 48,900 mg/l

**Aquatic Plant Toxicity**

EC50, green alga *Pseudokirchneriella subcapitata* (formerly known as *Selenastrum capricornutum*), biomass growth inhibition, 7 d: > 100 mg/l

**Toxicity to Micro-organisms**

IC50, OECD 209 Test; activated sludge, respiration inhibition, 3 h: > 1,000 mg/l

### 13. Disposal Considerations

DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. WE HAVE NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION: Composition Information. FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: Reclaimer. As a service to our customers, we can provide names of information resources to help identify waste management companies and other facilities which recycle, reprocess or manage chemicals or plastics, and that manage used drums. Please contact our Customer Information Group (telephone number in Section 1 of this document) for further details.

### 14. Transport Information

**DOT Non-Bulk**  
NOT REGULATED

**DOT Bulk**  
NOT REGULATED

**IMDG**  
NOT REGULATED

**ICAO/IATA  
NOT REGULATED**

*This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.*

**15. Regulatory Information****OSHA Hazard Communication Standard**

This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

**Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312**

<b>Immediate (Acute) Health Hazard</b>	No
<b>Delayed (Chronic) Health Hazard</b>	No
<b>Fire Hazard</b>	No
<b>Reactive Hazard</b>	No
<b>Sudden Release of Pressure Hazard</b>	No

**Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313**

To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

**Pennsylvania (Worker and Community Right-To-Know Act): Pennsylvania Hazardous Substances List and/or Pennsylvania Environmental Hazardous Substance List:**

The following product components are cited in the Pennsylvania Hazardous Substance List and/or the Pennsylvania Environmental Substance List, and are present at levels which require reporting.

<b>Component</b>	<b>CAS #</b>	<b>Amount</b>
Triethylene glycol	112-27-6	> 98.0 %
Diethylene glycol	111-46-6	<= 1.0 %

**Pennsylvania (Worker and Community Right-To-Know Act): Pennsylvania Special Hazardous Substances List:**

To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

**California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)**

**WARNING:** This product contains a chemical(s) known to the State of California to cause cancer.

<b>Component</b>	<b>CAS #</b>	<b>Amount</b>
Formaldehyde	50-00-0	0.0047 %
Acetaldehyde	75-07-0	15.6 PPM

**US. Toxic Substances Control Act**

All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30

**CEPA - Domestic Substances List (DSL)**

All substances contained in this product are listed on the Canadian Domestic Substances List (DSL) or are not required to be listed.

**16. Other Information****Product Literature**

Additional information on this and other products we offer may be obtained by contacting our Customer Information Group. Ask for a product information brochure or data on how to access our website.

**Recommended Uses and Restrictions**

For industrial use only. Gas treating. It is recommended that you use this product in a manner consistent with the recommended use. If your intended use is not consistent with the recommended use, please contact our Customer Information Group (telephone number in Section 1 of this document).

**Revision**

Identification Number: 2150 / 0000 / Issue Date 05/10/2010 / Version: 4.0

Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

**Legend**

N/A	Not available
W/W	Weight/Weight
OEL	Occupational Exposure Limit
STEL	Short Term Exposure Limit
TWA	Time Weighted Average
ACGIH	American Conference of Governmental Industrial Hygienists, Inc.
DOW IHG	Dow Industrial Hygiene Guideline
WEEL	Workplace Environmental Exposure Level
HAZ DES	Hazard Designation
Action Level	A value set by OSHA that is lower than the PEL which will trigger the need for activities such as exposure monitoring and medical surveillance if exceeded.

*The Dow Chemical Company urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.*

**ATTACHMENT E**  
**EMISSIONS CALCULATIONS**

By: PEW  
Date: 10/19/2015

Checked By: JJD  
Date: 10/19/2015

**Potential to Emit**

Pollutant	Emissions			
	Uncontrolled		Controlled	
	lb/hr	ton/year	lb/hr	ton/year
PM	0.0015	0.0066	0.0015	0.0066
PM10	0.0015	0.0066	0.0015	0.0066
PM2.5	0.0015	0.0066	0.0015	0.0066
SO <sub>2</sub>	0.0001	0.0004	0.0001	0.0004
NO <sub>x</sub>	0.0200	0.0876	0.0200	0.0876
CO	0.0168	0.0736	0.0168	0.0736
VOC	1.2511	5.4806	1.2511	5.4806
Formaldehyde	9.19E-06	4.03E-05	9.19E-06	4.03E-05
Ethylbenzene	2.02E-02	8.87E-02	2.02E-02	8.87E-02
Hexane	1.49E-02	6.53E-02	1.49E-02	6.53E-02
Benzene	1.77E-02	7.74E-02	1.77E-02	7.74E-02
Toluene	6.94E-02	3.04E-01	6.94E-02	3.04E-01
Xylene	2.23E-01	9.75E-01	2.23E-01	9.75E-01
Total Other HAPS	9.14E-07	4.00E-06	9.14E-07	4.00E-06
Total HAPS	0.3448	1.5101	0.3448	1.5101

By: PEW  
Date: 10/19/2015

Checked By: JJD  
Date: 10/19/2015

**Regenerator Emissions from GRI-GlyCalc Version 4.0**

Pollutant	Emissions			
	Uncontrolled		Controlled	
	lb/hr	ton/year	lb/hr	ton/year
VOC	1.0434	4.5702	1.0434	4.5702
n-Hexane	0.0143	0.0627	0.0143	0.0627
Benzene	0.0177	0.0773	0.0177	0.0773
Toluene	0.0694	0.3038	0.0694	0.3038
Ethylbenzene	0.0202	0.0887	0.0202	0.0887
Xylene	0.2225	0.9747	0.2225	0.9747
Total HAPS	0.3441	1.5072	0.3441	1.5072

**Reboiler for Dehydration Unit**

Maximum Burner Rating =	125,000	Btu/hr - From Weldfab Quote
Heat Content of Fuel =	1,042	Btu/scf - From N.G. Analysis
Fuel Use =	120	scf/hr
Hours of Operation =	8,760	hrs/year
Fuel Usage =	0.0002	10 <sup>6</sup> scf per hour
	1.75	10 <sup>6</sup> scf/year

**Criteria Emissions**

Emission Type	EF <sup>(2)</sup> lb/10 <sup>6</sup> scf	Emissions		EF
		lb/hr	ton/year	Reference
PM	7.6	0.0015	0.0066	Table 1.4-2
PM10 <sup>(1)</sup>	7.6	0.0015	0.0066	See Note 1
PM2.5 <sup>(1)</sup>	7.6	0.0015	0.0066	See Note 1
SO <sub>2</sub>	0.6	0.0001	0.0004	Table 1.4-2
NO <sub>x</sub>	100	0.0200	0.0876	Table 1.4-2
CO	84	0.0168	0.0736	Table 1.4-2
VOC	5.5	0.0011	0.0048	Table 1.4-2

Rounding to = 4

**Notes:**

- 1 - It is assumed that PM10 and PM2.5 are equal to TSP (PM).
- 2 - Emission factors from AP-42, Section 1.4 dated 7/98.

By: PEW  
Date: 10/19/2015

Checked By: JJD  
Date: 10/19/2015

**Reboiler Natural Gas Combustion HAPS**

Burner Rating =	125,000	Btu/hr
Operating Hours =	8,760	hrs/yr
Conversion from lb/10 <sup>6</sup> scf to lb/MMBtu (divide by) <sup>(1)</sup> =	1,020	Btu/cf

CAS No.	Hazardous Air Pollutants	EF (1)		Emissions	
		lb/10 <sup>6</sup> scf	lb/MMBtu	lb/hr	ton/year
91-57-6	2-Methylnaphthalene	2.40E-05	2.35E-08	2.94E-09	1.29E-08
56-49-5	3-Methylchloranthrene	1.80E-06	1.76E-09	2.21E-10	9.66E-10
57-97-6	7,12-Dimethylbenz(a)anthracene	1.60E-05	1.57E-08	1.96E-09	8.59E-09
83-32-9	Acenaphthene	1.80E-06	1.76E-09	2.21E-10	9.66E-10
203-96-8	Acenaphthylene	1.80E-06	1.76E-09	2.21E-10	9.66E-10
120-12-7	Anthracene	2.40E-06	2.35E-09	2.94E-10	1.29E-09
56-55-3	Benz(a)anthracene	1.80E-06	1.76E-09	2.21E-10	9.66E-10
71-43-2	Benzene	2.10E-03	2.06E-06	2.57E-07	1.01E-06
50-32-8	Benzo(a)pyrene	1.20E-06	1.18E-09	1.47E-10	6.44E-10
205-99-2	Benzo(b)fluoranthene	1.80E-06	1.76E-09	2.21E-10	9.66E-10
191-24-2	Benzo(g,h,i)perylene	1.20E-06	1.18E-09	1.47E-10	6.44E-10
205-82-3	Benzo(k)fluoranthene	1.80E-06	1.76E-09	2.21E-10	9.66E-10
218-01-9	Chrysene	1.80E-06	1.76E-09	2.21E-10	9.66E-10
53-70-3	Dibenzo(a,h)anthracene	1.20E-06	1.18E-09	1.47E-10	6.44E-10
25321-22-6	Dichlorobenzene	1.20E-03	1.18E-06	1.47E-07	6.44E-07
206-44-0	Fluoranthene	3.00E-06	2.94E-09	3.68E-10	1.61E-09
86-73-7	Fluorene	2.80E-06	2.75E-09	3.43E-10	1.50E-09
50-00-0	Formaldehyde	7.50E-02	7.35E-05	9.19E-06	4.03E-05
110-54-3	Hexane	1.80E+00	1.76E-03	2.21E-04	9.66E-04
193-39-5	Indeno(1,2,3-cd)pyrene	1.80E-06	1.76E-09	2.21E-10	9.66E-10
91-20-3	Naphthalene	6.10E-04	5.98E-07	7.48E-08	3.27E-07
85-01-8	Phenanthrene	1.70E-05	1.67E-08	2.08E-09	9.13E-09
129-00-0	Pyrene	5.00E-06	4.90E-09	6.13E-10	2.68E-09
108-88-3	Toluene	3.40E-03	3.33E-06	4.17E-07	1.83E-06
7440-38-2	Arsenic	2.00E-04	1.96E-07	2.45E-08	1.07E-07
7440-41-7	Beryllium	1.20E-05	1.18E-08	1.47E-09	6.44E-09
7440-43-9	Cadmium	1.10E-03	1.08E-06	1.35E-07	5.90E-07
7440-47-3	Chromium	1.40E-03	1.37E-06	1.72E-07	7.51E-07
7440-48-4	Cobalt	8.40E-05	8.24E-08	1.03E-08	4.51E-08
7439-96-5	Manganese	3.80E-04	3.73E-07	4.66E-08	2.04E-07
7439-97-6	Mercury	2.60E-04	2.55E-07	3.19E-08	1.40E-07
7440-02-0	Nickel	2.10E-03	2.06E-06	2.57E-07	1.13E-06
7782-49-2	Selenium	2.40E-05	2.35E-08	2.94E-09	1.29E-08
VOC HAPS Subtotal =				2.31E-04	1.01E-03
Metal HAPS Subtotal =				6.81E-07	2.98E-06
Total HAPS =				2.31E-04	1.01E-03
Total Other HAPS (2) =				9.14E-07	4.00E-06

References:

1. AP42 Table 1.4-3 and Table 1.4-4.
2. Total Other HAPS is the total of the hazardous air pollutants without the HAPS that are highlighted in blue which are included individually on the totals page of this calculation set.

By: PEW  
Date: 10/19/2015

Checked By: JJD  
Date: 10/19/2015

**Estimation of Fugitive Equipment Leaks**

Source Type	Number of Sources	Emission Factor <sup>(1)</sup> (kg/hr/source)	TOC Emissions (lb/hr)	TOC Emissions (ton/yr)	VOC Emissions (lb/hr)	VOC Emissions (ton/yr)
Valves	14	4.50E-03	0.1389	0.6088	0.1389	0.6088
Pump Seals	0	2.40E-03	0.0000	0.0000	0.0000	0.0000
Others	1	8.80E-03	0.0194	0.0850	0.0194	0.0850
Connectors	55	2.00E-04	0.0243	0.1063	0.0243	0.1063
Flanges	28	3.90E-04	0.0241	0.1055	0.0241	0.1055
Open Ended Lines	0	2.00E-03	0.0000	0.0000	0.0000	0.0000
		Total TOC	0.2066	Total VOC	0.2066	0.9056

Total HAP from Gas Service Leaks			
HAP	HAP Concentration (wt %)	HAPS (lb/hr)	HAPS (ton/yr)
n-Hexane	0.1759	0.000363	0.00159
Benzene	0.0055	0.000011	0.00005
Toluene	0.0122	0.000025	0.00011
Ethylbenzene	0.0019	0.000004	0.00002
o-Xylene	0.0180	0.000037	0.00016
	Total HAP	0.000500	0.00200

1. AP42, Chapter 5, Protocol for Equipment Leak Emission Estimates, Table 2-4.

lb/kg = 2.2046

2. HAP emissions based on weight percent of the HAP contained in the gas from the analysis and the total organic emissions from the emissions factors.

## GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: 15-343

File Name: V:\RJAmmirato\15-343 Reserve Spencer\Lane Dehy (15-343).ddf

Date: September 30, 2015

## DESCRIPTION:

Description: Lane Station

Annual Hours of Operation: 8760.0 hours/yr

## EMISSIONS REPORTS:

## UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.0502	1.204	0.2198
Ethane	0.0524	1.258	0.2297
Propane	0.0747	1.793	0.3272
Isobutane	0.0146	0.350	0.0638
n-Butane	0.0545	1.308	0.2388
Isopentane	0.0172	0.412	0.0753
n-Pentane	0.0218	0.524	0.0956
n-Hexane	0.0143	0.343	0.0627
Cyclohexane	0.0147	0.353	0.0644
Other Hexanes	0.0148	0.355	0.0648
Heptanes	0.0657	1.577	0.2879
Methylcyclohexane	0.0010	0.023	0.0042
Benzene	0.0177	0.424	0.0773
Toluene	0.0694	1.665	0.3038
Ethylbenzene	0.0202	0.486	0.0887
Xylenes	0.2225	5.341	0.9747
C8+ Heavies	0.4204	10.088	1.8411
<b>Total Emissions</b>	<b>1.1460</b>	<b>27.505</b>	<b>5.0196</b>
<b>Total Hydrocarbon Emissions</b>	<b>1.1460</b>	<b>27.505</b>	<b>5.0196</b>
<b>Total VOC Emissions</b>	<b>1.0434</b>	<b>25.042</b>	<b>4.5702</b>
<b>Total HAP Emissions</b>	<b>0.3441</b>	<b>8.259</b>	<b>1.5072</b>
<b>Total BTEX Emissions</b>	<b>0.3298</b>	<b>7.915</b>	<b>1.4445</b>

## EQUIPMENT REPORTS:

## ABSORBER

Calculated Absorber Stages:	1.51
Specified Dry Gas Dew Point:	7.00 lbs. H2O/MMSCF
Temperature:	65.0 deg. F
Pressure:	90.0 psig
Dry Gas Flow Rate:	1.0000 MMSCF/day

Glycol Losses with Dry Gas: 0.0010 lb/hr  
 Wet Gas Water Content: Saturated  
 Calculated Wet Gas Water Content: 143.04 lbs. H2O/MMSCF  
 Specified Lean Glycol Recirc. Ratio: 3.00 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	4.88%	95.12%
Carbon Dioxide	99.93%	0.07%
Nitrogen	100.00%	0.00%
Methane	100.00%	0.00%
Ethane	99.98%	0.02%
Propane	99.96%	0.04%
Isobutane	99.93%	0.07%
n-Butane	99.90%	0.10%
Isopentane	99.87%	0.13%
n-Pentane	99.83%	0.17%
n-Hexane	99.63%	0.37%
Cyclohexane	98.48%	1.52%
Other Hexanes	99.74%	0.26%
Heptanes	99.10%	0.90%
Methylcyclohexane	97.79%	2.21%
Benzene	85.30%	14.70%
Toluene	74.61%	25.39%
Ethylbenzene	56.59%	43.41%
Xylenes	43.86%	56.14%
C8+ Heavies	95.31%	4.69%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
Water	29.61%	70.39%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
Isopentane	0.50%	99.50%
n-Pentane	0.50%	99.50%
n-Hexane	0.50%	99.50%
Cyclohexane	3.20%	96.80%
Other Hexanes	1.00%	99.00%
Heptanes	0.50%	99.50%
Methylcyclohexane	4.00%	96.00%
Benzene	5.00%	95.00%
Toluene	7.90%	92.10%
Ethylbenzene	10.40%	89.60%
Xylenes	12.90%	87.10%
C8+ Heavies	12.00%	88.00%

## STREAM REPORTS:

## WET GAS STREAM

Temperature: 65.00 deg. F  
 Pressure: 104.70 psia  
 Flow Rate: 4.18e+004 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	3.01e-001	5.98e+000
Carbon Dioxide	3.19e-002	1.55e+000
Nitrogen	2.85e+000	8.79e+001
Methane	8.11e+001	1.43e+003
Ethane	1.01e+001	3.35e+002
Propane	3.91e+000	1.90e+002
Isobutane	3.25e-001	2.08e+001
n-Butane	8.59e-001	5.50e+001
Isopentane	1.69e-001	1.35e+001
n-Pentane	1.60e-001	1.28e+001
n-Hexane	4.10e-002	3.89e+000
Cyclohexane	1.05e-002	9.70e-001
Other Hexanes	5.96e-002	5.66e+000
Heptanes	6.60e-002	7.28e+000
Methylcyclohexane	3.99e-004	4.31e-002
Benzene	1.40e-003	1.20e-001
Toluene	2.69e-003	2.73e-001
Ethylbenzene	3.99e-004	4.66e-002
Xylenes	3.39e-003	3.96e-001
C8+ Heavies	4.77e-002	8.96e+000
Total Components	100.00	2.18e+003

## DRY GAS STREAM

Temperature: 65.00 deg. F  
 Pressure: 104.70 psia  
 Flow Rate: 4.17e+004 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.47e-002	2.92e-001
Carbon Dioxide	3.20e-002	1.55e+000
Nitrogen	2.86e+000	8.79e+001
Methane	8.13e+001	1.43e+003
Ethane	1.01e+001	3.35e+002
Propane	3.92e+000	1.90e+002
Isobutane	3.26e-001	2.08e+001
n-Butane	8.61e-001	5.50e+001
Isopentane	1.70e-001	1.35e+001
n-Pentane	1.61e-001	1.27e+001
n-Hexane	4.09e-002	3.88e+000
Cyclohexane	1.03e-002	9.56e-001

Other Hexanes	5.96e-002	5.64e+000
Heptanes	6.56e-002	7.22e+000
Methylcyclohexane	3.91e-004	4.22e-002
Benzene	1.19e-003	1.02e-001
Toluene	2.01e-003	2.04e-001
Ethylbenzene	2.26e-004	2.64e-002
Xylenes	1.49e-003	1.74e-001
C8+ Heavies	4.56e-002	8.54e+000
-----		
Total Components	100.00	2.18e+003

## LEAN, GLYCOL STREAM

-----  
 Temperature: 65.00 deg. F  
 Flow Rate: 2.83e-001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.84e+001	1.57e+002
Water	1.50e+000	2.39e+000
Carbon Dioxide	6.76e-014	1.08e-013
Nitrogen	1.87e-013	2.99e-013
Methane	1.06e-018	1.69e-018
Ethane	1.55e-008	2.47e-008
Propane	1.91e-009	3.04e-009
Isobutane	2.74e-010	4.37e-010
n-Butane	8.48e-010	1.35e-009
Isopentane	5.41e-005	8.63e-005
n-Pentane	6.88e-005	1.10e-004
n-Hexane	4.51e-005	7.19e-005
Cyclohexane	3.05e-004	4.86e-004
Other Hexanes	9.37e-005	1.49e-004
Heptanes	2.07e-004	3.30e-004
Methylcyclohexane	2.49e-005	3.97e-005
Benzene	5.83e-004	9.29e-004
Toluene	3.73e-003	5.95e-003
Ethylbenzene	1.47e-003	2.35e-003
Xylenes	2.07e-002	3.30e-002
C8+ Heavies	3.59e-002	5.73e-002
-----		
Total Components	100.00	1.59e+002

## RICH GLYCOL STREAM

-----  
 Temperature: 65.00 deg. F  
 Pressure: 104.70 psia  
 Flow Rate: 2.97e-001 gpm  
 NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.44e+001	1.57e+002
Water	4.86e+000	8.08e+000
Carbon Dioxide	6.49e-004	1.08e-003
Nitrogen	1.79e-003	2.98e-003
Methane	3.02e-002	5.02e-002

Ethane	3.16e-002	5.24e-002
Propane	4.50e-002	7.47e-002
Isobutane	8.77e-003	1.46e-002
n-Butane	3.28e-002	5.45e-002
Isopentane	1.04e-002	1.73e-002
n-Pentane	1.32e-002	2.19e-002
n-Hexane	8.65e-003	1.44e-002
Cyclohexane	9.14e-003	1.52e-002
Other Hexanes	8.99e-003	1.49e-002
Heptanes	3.98e-002	6.61e-002
Methylcyclohexane	5.97e-004	9.93e-004
Benzene	1.12e-002	1.86e-002
Toluene	4.53e-002	7.53e-002
Ethylbenzene	1.36e-002	2.26e-002
Xylenes	1.54e-001	2.56e-001
C8+ Heavies	2.87e-001	4.78e-001
-----		
Total Components	100.00	1.66e+002

## REGENERATOR OVERHEADS STREAM

-----

Temperature: 212.00 deg. F  
 Pressure: 14.70 psia  
 Flow Rate: 1.26e+002 scfh

Component	Conc. (vol%)	Loading (lb/hr)
-----		
Water	9.54e+001	5.69e+000
Carbon Dioxide	7.39e-003	1.08e-003
Nitrogen	3.21e-002	2.98e-003
Methane	9.45e-001	5.02e-002
Ethane	5.27e-001	5.24e-002
Propane	5.12e-001	7.47e-002
Isobutane	7.57e-002	1.46e-002
n-Butane	2.83e-001	5.45e-002
Isopentane	7.19e-002	1.72e-002
n-Pentane	9.13e-002	2.18e-002
n-Hexane	5.01e-002	1.43e-002
Cyclohexane	5.28e-002	1.47e-002
Other Hexanes	5.18e-002	1.48e-002
Heptanes	1.98e-001	6.57e-002
Methylcyclohexane	2.93e-003	9.53e-004
Benzene	6.83e-002	1.77e-002
Toluene	2.27e-001	6.94e-002
Ethylbenzene	5.76e-002	2.02e-002
Xylenes	6.33e-001	2.23e-001
C8+ Heavies	7.45e-001	4.20e-001
-----		
Total Components	100.00	6.84e+000



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Gas Analysis Report No: 225268

225268-1-42

Reported Date: 9/9/2015

For: SOUTHERN HYDROCARBONS CORP

Attn: TODD SHREWSBURY  
 934 LITTLE COAL RIVER ROAD  
 ALUM CREEK, WV 25003

Sample Identification:

Company: SOUTHERN HYDROCARBONS CORP  
 Field: NP  
 Lease: UGP  
 STA #: NP

Sample Data: Date Collected: 08/17/2015  
 PSIG: 50

Date Received: 09/02/2015

By: S. H.

Temp: N/P DEG. F.

Remarks:

CYL # SH-1

Sample Type: SPOT

Analyst: MP

Hydrocarbon Analysis - GPA 2261-13

Component Name	Mol Percent	GPM @ 14.730 PSIA
Carbon Dioxide (CO2)	0.032	
Nitrogen (N2)	2.858	
Methane (C1)	81.321	
Ethane (C2)	10.133	2.717
Propane (C3)	3.922	1.083
Iso-Butane (IC4)	0.326	0.107
N-Butane (NC4)	0.862	0.273
Iso-Pentane (IC5)	0.170	0.062
N-Pentane (NC5)	0.161	0.059
Hexanes Plus (C6+)	0.215	0.095
Total	100.000	

Mol Weight: 19.77

BTU/LB: 22314.42

Ethane + GPM: 4.396

Propane + GPM: 1.679

Iso-Pentane + GPM: 0.216

Compressibility Factor: 0.9970

Specific Gravity @ 60 Deg. F. (Air = 1): 0.684

BTU/Cuft. (Real) 60 Deg. F. - PSIA:	14.650	14.696	14.730	15.025
Dry:	1162.3	1165.9	1168.6	1192.1
Sat:	1142.4	1148.0	1148.7	1171.8

Reviewed By:

*Jana Venable*

Data Reviewer

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Gas Analysis Report No: 225268

225268-1 -

Date: 9/9/2015

For: SOUTHERN HYDROCARBONS CORP  
Attn: TODD SHREWSBURY  
934 LITTLE COAL RIVER ROAD  
ALUM CREEK, WV 25003

Sample Identification:  
Company: SOUTHERN HYDROCARBONS CORP  
Field:  
Lease: UGP  
STA # :

225268-1

CAPILLARY ANALYSIS - METHOD GPA 2286-95  
COMPONENT AS % OF TOTAL SAMPLE

COMPONENT NAME	MOL %	WEIGHT %
METHANE	0.0000	0.0000
ETHANE	0.0000	0.0000
PROPANE	0.0000	0.0000
ISO-BUTANE	0.0000	0.0000
N-BUTANE	0.0000	0.0000
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0000	0.0000
ISOPENTANE	0.0000	0.0000
N-PENTANE	0.0000	0.0000
2,2-DIMETHYLBUTANE (NEOHEXANE)	0.0021	0.0090
2,3-DIMETHYLBUTANE	0.0099	0.0383
CYCLOPENTANE		
2-METHYLPENTANE	0.0311	0.1329
3-METHYLPENTANE	0.0167	0.0714
N-HEXANE	0.0411	0.1759
2,2-DIMETHYLPENTANE	0.0008	0.0037
METHYLCYCLOPENTANE	0.0135	0.0565
2,4-DIMETHYLPENTANE	0.0001	0.0004
2,2,3-TRIMETHYLBUTANE	0.0002	0.0009
BENZENE	0.0014	0.0055
3,3-DIMETHYLPENTANE	0.0003	0.0017
CYCLOHEXANE	0.0105	0.0438
2-METHYLHEXANE	0.0077	0.0384
2,3-DIMETHYLPENTANE	0.0018	0.0090
1,1-DIMETHYLCYCLOPENTANE	0.0087	0.0434
3-METHYLHEXANE		

225268-1

CAPILLARY ANALYSIS - METHOD GPA 2286-95  
COMPONENT AS % OF TOTAL SAMPLE

COMPONENT NAME	MOL %	WEIGHT %
1,13-DIMETHYLCYCLOPENTANE	0.0017	0.0081
1,c3-DIMETHYLCYCLOPENTANE 3-ETHYLPENTANE	0.0019	0.0094
1,12-DIMETHYLCYCLOPENTANE 2,2,4-TRIMETHYLPENTANE	0.0021	0.0102
N-HEPTANE	0.0155	0.0770
METHYLCYCLOHEXANE 1,1,1,3-TRIMETHYLCYCLOPENTANE 2,2-DIMETHYLHEXANE	0.0004	0.0019
1,C2-DIMETHYLCYCLOPENTANE	0.0000	0.0000
2,5-DIMETHYLHEXANE	0.0007	0.0037
2,4-DIMETHYLHEXANE 2,2,3-TRIMETHYLPENTANE ETHYLCYCLOPENTANE	0.0015	0.0077
1,12,c4-TRIMETHYLCYCLOPENTANE 3,3-DIMETHYLHEXANE	0.0007	0.0041
1,12,C3-TRIMETHYLCYCLOPENTANE	0.0004	0.0021
2,3,4-TRIMETHYLPENTANE	0.0001	0.0005
TOLUENE	0.0027	0.0122
2,3-DIMETHYLHEXANE	0.0006	0.0034
1,1,2-TRIMETHYLCYCLOPENTANE	0.0035	0.0193
2-METHYLHEPTANE	0.0012	0.0070
4-METHYLHEPTANE	0.0002	0.0012
3,4-DIMETHYLHEXANE	0.0033	0.0185
3-METHYLHEPTANE 3-ETHYLHEXANE	0.0022	0.0123
1,c3-DIMETHYLCYCLOHEXANE 1,c2,13-TRIMETHYLCYCLOPENTANE 1,c2,14-TRIMETHYLCYCLOPENTANE	0.0011	0.0060
1,14-DIMETHYLCYCLOHEXANE	0.0001	0.0003
2,2,5-TRIMETHYLHEXANE	0.0004	0.0027
1,1-DIMETHYLCYCLOHEXANE 1,methyl-13-ETHYLCYCLOPENTANE	0.0001	0.0005
1-methyl-C3-ETHYLCYCLOPENTANE	0.0002	0.0009
1-methyl-12-ETHYLCYCLOPENTANE 2,2,4-TRIMETHYLHEXANE	0.0001	0.0004
1-methyl-1-ETHYLCYCLOPENTANE CYCLOHEPTANE N-OCTANE	0.0006	0.0035
1,12-DIMETHYLCYCLOHEXANE	0.0000	0.0000
UNKNOWN	0.0001	0.0004
1,13-DIMETHYLCYCLOHEXANE 1,c4-DIMETHYLCYCLOHEXANE 1,c2,c3-TRIMETHYLCYCLOPENTANE	0.0007	0.0037
2,4,4-TRIMETHYLHEXANE	0.0000	0.0003
ISOPROPYLCYCLOPENTANE	0.0001	0.0004

225268-1

CAPILLARY ANALYSIS - METHOD GPA 2286-95  
COMPONENT AS % OF TOTAL SAMPLE

COMPONENT NAME	MOL %	WEIGHT %
UNKNOWN	0.0002	0.0010
2,2-DIMETHYLHEPTANE	0.0003	0.0022
2,4-DIMETHYLHEPTANE	0.0000	0.0003
1-methyl-c2-ETHYLCYCLOPENTANE		
2,2,3-TRIMETHYLHEXANE	0.0005	0.0030
1,c2-DIMETHYLCYCLOHEXANE	0.0002	0.0013
2,6-DIMETHYLHEPTANE		
N-PROPYLCYCLOPENTANE	0.0001	0.0009
1,c3,c5-TRIMETHYLCYCLOHEXANE		
2,5-DIMETHYLHEPTANE	0.0019	0.0106
3,5-DIMETHYLHEPTANE		
ETHYLCYCLOHEXANE		
1,1,3-TRIMETHYLCYCLOHEXANE	0.0005	0.0031
2,3,3-TRIMETHYLHEXANE		
3,3-DIMETHYLHEPTANE		
1,1,4-TRIMETHYLCYCLOHEXANE	0.0002	0.0010
UNKNOWN	0.0000	0.0002
2,3,4-TRIMETHYLHEXANE	0.0001	0.0004
ETHYLBENZENE	0.0004	0.0019
1,1,14-TRIMETHYLCYCLOHEXANE		
1,c3,t5-TRIMETHYLCYCLOHEXANE	0.0005	0.0032
2,3-DIMETHYLHEPTANE		
M-XYLENE	0.0026	0.0139
P-XYLENE		
3,4-DIMETHYLHEPTANE		
2-METHYLOCTANE	0.0018	0.0117
4-METHYLOCTANE		
UNKNOWN	0.0000	0.0001
3-METHYLOCTANE	0.0013	0.0085
UNKNOWN	0.0000	0.0002
1,t2,c3-TRIMETHYLCYCLOHEXANE	0.0002	0.0010
1,t2,c4-TRIMETHYLCYCLOHEXANE		
O-XYLENE	0.0008	0.0041
1,1,2-TRIMETHYLCYCLOHEXANE	0.0003	0.0016
UNKNOWN	0.0004	0.0031
ISOBUTYLCYCLOPENTANE	0.0003	0.0016
N-NONANE	0.0037	0.0237
UNKNOWN	0.0000	0.0003
1,c2,c3-TRIMETHYLCYCLOHEXANE	0.0000	0.0002
1,c2,t3-TRIMETHYLCYCLOHEXANE		
UNKNOWN	0.0003	0.0019
ISOPROPYLBENZENE	0.0001	0.0008
2,2-DIMETHYLOCTANE	0.0001	0.0004
ISOPROPYLCYCLOHEXANE	0.0004	0.0021
CYCLOOCTANE		
UNKNOWN	0.0000	0.0003

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CAPILLARY ANALYSIS - METHOD GPA 2286-95  
COMPONENT AS % OF TOTAL SAMPLE

COMPONENT NAME	MOL %	WEIGHT %
N-BUTYLCYCLOPENTANE	0.0005	0.0034
N-PROPYLCYCLOHEXANE		
3,3-DIMETHYLOCTANE	0.0001	0.0005
UNKNOWN	0.0001	0.0006
N-PROPYLBENZENE	0.0009	0.0052
UNKNOWN	0.0001	0.0006
M-ETHYLTOLUENE	0.0001	0.0007
P-ETHYLTOLUENE	0.0002	0.0010
2,3-DIMETHYLOCTANE		
4-METHYLNONANE	0.0007	0.0046
5-METHYLNONANE		
1,3,5-TRIMETHYLBENZENE		
2-METHYLNONANE	0.0008	0.0057
3-ETHYLOCTANE	0.0005	0.0038
O-ETHYLTOLUENE	0.0004	0.0025
3-METHYLNONANE		
UNKNOWN	0.0001	0.0004
1,2,4-TRIMETHYLBENZENE	0.0002	0.0010
i-BUTYLBENZENE		
METHYLCYCLOOCTANE		
tert-BUTYLCYCLOHEXANE	0.0006	0.0043
ISO-BUTYLCYCLOHEXANE	0.0000	0.0002
N-DECANE	0.0017	0.0118
ISOBUTYLBENZENE	0.0001	0.0007
sec-BUTYLBENZENE	0.0002	0.0011
UNKNOWN	0.0001	0.0011
1-METHYL-3-ISOPROPYLBENZENE	0.0001	0.0008
1,2,3-TRIMETHYLBENZENE	0.0002	0.0013
1-METHYL-4-ISOPROPYLBENZENE		
UNKNOWN	0.0001	0.0008
1-METHYL-2-ISOPROPYLBENZENE	0.0000	0.0003
UNKNOWN	0.0001	0.0005
N-BUTYLCYCLOHEXANE	0.0002	0.0012
UNKNOWN	0.0001	0.0006
1,3-DIETHYLBENZENE	0.0001	0.0004
1-METHYL-3-PROPYLBENZENE		
1,2-DIETHYLBENZENE	0.0001	0.0009
N-BUTYLBENZENE		
1-METHYL-4-PROPYLBENZENE		
1,4-DIETHYLBENZENE	0.0000	0.0002
1-METHYL-2-PROPYLBENZENE	0.0002	0.0010
1,4-DIMETHYL-2-ETHYLBENZENE	0.0001	0.0009
UNKNOWN	0.0001	0.0011

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**CAPILLARY ANALYSIS - METHOD GPA 2286-95  
COMPONENT AS % OF TOTAL SAMPLE**

COMPONENT NAME	MOL %	WEIGHT %
1,2-DIMETHYL-4-ETHYLBENZENE	0.0001	0.0006
1,3-DIMETHYL-2-ETHYLBENZENE	0.0002	0.0011
UNKNOWN	0.0000	0.0001
1,2-DIMETHYL-3-ETHYLBENZENE	0.0000	0.0003
UNKNOWN	0.0000	0.0002
N-UNDECANE	0.0006	0.0046
UNKNOWN	0.0000	0.0004
1,2,4,5-TETRAMETHYLBENZENE	0.0001	0.0004
1,2,3,5-TETRAMETHYLBENZENE	0.0000	0.0001
UNKNOWN	0.0000	0.0001
1,2,3,4-TETRAMETHYLBENZENE	0.0000	0.0001
CYCLODECANE		
UNKNOWN	0.0000	0.0002
NAPHTHALENE	0.0001	0.0003
N-DODECANE	0.0000	0.0002
ISOTRIDECANES PLUS	0.0001	0.0013
<b>Total:</b>	0.2150	1.0224

TOTAL HEXANES	0.1009	0.4275
TOTAL HEPTANES	0.0662	0.3082
TOTAL OCTANES	0.0198	0.1082
TOTAL NONANES	0.0171	0.1031
TOTAL DECANES PLUS	0.0110	0.0753

**BTEX COMPONENTS**

N-HEXANE	0.0411	0.1759
BENZENE	0.0014	0.0055
TOLUENE	0.0027	0.0122
ETHYLBENZENE	0.0004	0.0019
XYLENE	0.0034	0.0180



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CAPILLARY ANALYSIS - METHOD GPA 2286-95  
HEAVY END FRACTION

COMPONENT NAME	MOL %	WEIGHT %
METHANE	0.000	0.000
ETHANE	0.000	0.000
PROPANE	0.000	0.000
ISO-BUTANE	0.000	0.000
N-BUTANE	0.000	0.000
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.000	0.000
ISOPENTANE	0.000	0.000
N-PENTANE	0.000	0.000
2,2-DIMETHYLBUTANE (NEOHEXANE)	0.974	0.877
2,3-DIMETHYLBUTANE CYCLOPENTANE	4.587	3.744
2-METHYLPENTANE	14.447	13.004
3-METHYLPENTANE	7.757	6.982
N-HEXANE	19.116	17.206
2,2-DIMETHYLPENTANE	0.350	0.367
METHYLCYCLOPENTANE	6.282	5.522
2,4-DIMETHYLPENTANE	0.042	0.044
2,2,3-TRIMETHYLBUTANE	0.088	0.092
BENZENE	0.661	0.539
3,3-DIMETHYLPENTANE	0.155	0.163
CYCLOHEXANE	4.878	4.288
2-METHYLHEXANE	3.590	3.758
2,3-DIMETHYLPENTANE	0.845	0.885
1,1-DIMETHYLCYCLOPENTANE 3-METHYLHEXANE	4.065	4.246
1,13-DIMETHYLCYCLOPENTANE	0.771	0.791
1,3-DIMETHYLCYCLOPENTANE 3-ETHYLPENTANE	0.895	0.920
1,12-DIMETHYLCYCLOPENTANE 2,2,4-TRIMETHYLPENTANE	0.961	1.001
N-HEPTANE	7.200	7.538
METHYLCYCLOHEXANE	0.183	0.191

**CAPILLARY ANALYSIS - METHOD GPA 2286-95**  
**HEAVY END FRACTION**

COMPONENT NAME	MOL %	WEIGHT %
1,1,3-TRIMETHYLCYCLOPENTANE		
2,2-DIMETHYLHEXANE		
1,C2-DIMETHYLCYCLOPENTANE	0.000	0.000
2,5-DIMETHYLHEXANE	0.305	0.364
2,4-DIMETHYLHEXANE	0.696	0.749
2,2,3-TRIMETHYLPENTANE		
ETHYLCYCLOPENTANE		
1,t2,c4-TRIMETHYLCYCLOPENTANE	0.344	0.404
3,3-DIMETHYLHEXANE		
1,t2,C3-TRIMETHYLCYCLOPENTANE	0.173	0.203
2,3,4-TRIMETHYLPENTANE	0.039	0.047
TOLUENE	1.242	1.196
2,3-DIMETHYLHEXANE	0.280	0.334
1,1,2-TRIMETHYLCYCLOPENTANE	1.610	1.887
2-METHYLHEPTANE	0.576	0.687
4-METHYLHEPTANE	0.102	0.121
3,4-DIMETHYLHEXANE	1.515	1.808
3-METHYLHEPTANE	1.010	1.206
3-ETHYLHEXANE		
1,c3-DIMETHYLCYCLOHEXANE	0.498	0.583
1,c2,t3-TRIMETHYLCYCLOPENTANE		
1,c2,t4-TRIMETHYLCYCLOPENTANE		
1,t4-DIMETHYLCYCLOHEXANE	0.027	0.031
2,2,5-TRIMETHYLHEXANE	0.198	0.266
1,1-DIMETHYLCYCLOHEXANE	0.038	0.045
1,methyl-t3-ETHYLCYCLOPENTANE		
1-methyl-C3-ETHYLCYCLOPENTANE	0.073	0.085
1-methyl-t2-ETHYLCYCLOPENTANE	0.034	0.043
2,2,4-TRIMETHYLHEXANE		
1-methyl-1-ETHYLCYCLOPENTANE	0.283	0.338
CYCLOHEPTANE		
N-OCTANE		
1,t2-DIMETHYLCYCLOHEXANE	0.000	0.000
UNKNOWN	0.026	0.035
1,t3-DIMETHYLCYCLOHEXANE	0.311	0.364
1,c4-DIMETHYLCYCLOHEXANE		
1,c2,c3-TRIMETHYLCYCLOPENTANE		
2,4,4-TRIMETHYLHEXANE	0.023	0.030
ISOPROPYLCYCLOPENTANE	0.031	0.036
UNKNOWN	0.072	0.096
2,2-DIMETHYLHEPTANE	0.162	0.216
2,4-DIMETHYLHEPTANE	0.023	0.029
1-methyl-c2-ETHYLCYCLOPENTANE		

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CAPILLARY ANALYSIS - METHOD GPA 2286-95  
HEAVY END FRACTION

COMPONENT NAME	MOL %	WEIGHT %
2,2,3-TRIMETHYLHEXANE	0.222	0.297
1,c2-DIMETHYLCYCLOHEXANE	0.102	0.123
2,6-DIMETHYLHEPTANE		
N-PROPYLCYCLOPENTANE	0.069	0.086
1,c3,c5-TRIMETHYLCYCLOHEXANE		
2,5-DIMETHYLHEPTANE	0.874	1.040
3,5-DIMETHYLHEPTANE		
ETHYLCYCLOHEXANE		
1,1,3-TRIMETHYLCYCLOHEXANE	0.231	0.307
2,3,3-TRIMETHYLHEXANE		
3,3-DIMETHYLHEPTANE		
1,1,4-TRIMETHYLCYCLOHEXANE	0.071	0.094
UNKNOWN	0.015	0.020
2,3,4-TRIMETHYLHEXANE	0.027	0.036
ETHYLBENZENE	0.166	0.184
1,12,14-TRIMETHYLCYCLOHEXANE	0.235	0.310
1,c3,t5-TRIMETHYLCYCLOHEXANE		
2,3-DIMETHYLHEPTANE		
M-XYLENE	1.224	1.362
P-XYLENE		
3,4-DIMETHYLHEPTANE		
2-METHYLOCTANE	0.852	1.142
4-METHYLOCTANE		
UNKNOWN	0.005	0.007
3-METHYLOCTANE	0.618	0.828
UNKNOWN	0.012	0.018
1,12,c3-TRIMETHYLCYCLOHEXANE	0.077	0.101
1,12,c4-TRIMETHYLCYCLOHEXANE		
O-XYLENE	0.359	0.398
1,1,2-TRIMETHYLCYCLOHEXANE	0.117	0.154
UNKNOWN	0.203	0.302
ISOBUTYLCYCLOPENTANE	0.117	0.155
N-NONANE	1.728	2.315
UNKNOWN	0.017	0.025
1,c2,c3-TRIMETHYLCYCLOHEXANE	0.012	0.016
1,c2,t3-TRIMETHYLCYCLOHEXANE		
UNKNOWN	0.132	0.185
ISOPROPYLBENZENE	0.063	0.080
2,2-DIMETHYLOCTANE	0.023	0.035
ISOPROPYLCYCLOHEXANE	0.168	0.210
CYCLOOCTANE		
UNKNOWN	0.022	0.031
N-BUTYLCYCLOPENTANE	0.253	0.334
N-PROPYLCYCLOHEXANE		

**CAPILLARY ANALYSIS - METHOD GPA 2286-95  
HEAVY END FRACTION**

COMPONENT NAME	MOL %	WEIGHT %
3,3-DIMETHYLOCTANE	0.035	0.052
UNKNOWN	0.041	0.057
N-PROPYLBENZENE	0.403	0.506
UNKNOWN	0.042	0.059
M-ETHYLTOLUENE	0.055	0.070
P-ETHYLTOLUENE	0.078	0.098
2,3-DIMETHYLOCTANE		
4-METHYLNONANE	0.335	0.452
5-METHYLNONANE		
1,3,5-TRIMETHYLBENZENE		
2-METHYLNONANE	0.372	0.553
3-ETHYLOCTANE	0.251	0.372
O-ETHYLTOLUENE	0.180	0.247
3-METHYLNONANE		
UNKNOWN	0.026	0.037
1,2,4-TRIMETHYLBENZENE	0.076	0.100
t-BUTYLBENZENE		
METHYLCYCLOOCTANE		
tert-BUTYLCYCLOHEXANE	0.289	0.424
ISO-BUTYLCYCLOHEXANE	0.013	0.019
N-DECANE	0.779	1.158
ISOBUTYLBENZENE	0.046	0.065
sec-BUTYLBENZENE	0.074	0.103
UNKNOWN	0.069	0.112
1-METHYL-3-ISOPROPYLBENZENE	0.055	0.077
1,2,3-TRIMETHYLBENZENE	0.099	0.129
1-METHYL-4-ISOPROPYLBENZENE		
UNKNOWN	0.048	0.078
1-METHYL-2-ISOPROPYLBENZENE	0.022	0.030
UNKNOWN	0.031	0.050
N-BUTYLCYCLOHEXANE	0.083	0.122
UNKNOWN	0.033	0.054
1,3-DIETHYLBENZENE	0.026	0.037
1-METHYL-3-PROPYLBENZENE		
1,2-DIETHYLBENZENE	0.065	0.091
N-BUTYLBENZENE		
1-METHYL-4-PROPYLBENZENE		
1,4-DIETHYLBENZENE	0.017	0.024
1-METHYL-2-PROPYLBENZENE	0.072	0.101
1,4-DIMETHYL-2-ETHYLBENZENE	0.061	0.085
UNKNOWN	0.065	0.107

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**CAPILLARY ANALYSIS - METHOD GPA 2286-95  
HEAVY END FRACTION**

<b>COMPONENT NAME</b>	<b>MOL %</b>	<b>WEIGHT %</b>
1,2-DIMETHYL-4-ETHYLBENZENE	0.039	0.055
1,3-DIMETHYL-2-ETHYLBENZENE	0.076	0.107
UNKNOWN	0.004	0.007
1,2-DIMETHYL-3-ETHYLBENZENE	0.022	0.031
UNKNOWN	0.010	0.017
N-UNDECANE	0.277	0.452
UNKNOWN	0.023	0.040
1,2,4,5-TETRAMETHYLBENZENE	0.025	0.035
1,2,3,5-TETRAMETHYLBENZENE	0.008	0.011
UNKNOWN	0.008	0.015
1,2,3,4-TETRAMETHYLBENZENE	0.006	0.009
CYCLODECANE		
UNKNOWN	0.013	0.022
NAPHTHALENE	0.024	0.033
N-DODECANE	0.013	0.024
ISOTRIDECANES PLUS	0.057	0.126
<b>Total:</b>	<b>100.000</b>	<b>100.000</b>

<b>Specific Gravity @ 60 Deg. F. (Air = 1)</b>	3.2924
<b>Molecular Weight</b>	95.81
<b>Compressibility Factor</b>	0.8655
<b>Summation Factor</b>	0.0957
<b>Cu. Ft. Vapor/Gal @ 14.696 &amp; 60 Deg. F.</b>	23.906
<b>Cu. Ft. Vapor/Gal @ 14.730 &amp; 60 Deg. F.</b>	23.851
<b>Cu. Ft. Vapor/Gal @ 14.650 &amp; 60 Deg. F.</b>	23.981
<b>Btu/cu. Ft. @ 14.696 PSIA, Dry</b>	5192.88
<b>Btu/cu. Ft. @ 14.730 PSIA, Dry</b>	5204.89
<b>BTU/LB</b>	20614