CONESTOGA-ROVERS
& ASSOCIATES

6320 Rothway, Suite 100, Houston, Texas 77040
Telephone: (713) 734-3090 Fax: (713) 734-3391
www.CRAworld.com

May 19, 2015 Reference No. 082715

Mr. Jay Fedczak
Assistant Director for Permitting
Division of Air Quality
WV Department of Environmental Protection
601 57th Street, SE
Charleston, West Virginia 25304

Dear Mr. Jay Fedczak:

Re: General Permit Application G70-A
Edna Monroe Well Pad
Antero Resources Corporation

Conestoga-Rovers & Associates (CRA) would like to submit this General Permit application that we prepared on behalf of Antero Resources Corporation for an oil and gas facility identified as Edna Monroe Well Pad.

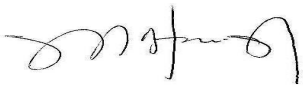
Enclosed are the following documents:

- Original copy of the G70-A General Permit Application
- Two CD copies of the G70-A General Permit Application
- The application fee with check no. 397724 in the amount of $1,500.00.

Please let us know if you have any questions or require additional information.

Sincerely,

CONESTOGA-ROVERS & ASSOCIATES



Manuel Bautista

Encl.

cc: Barry Schatz, Antero Resources Corporation

CONESTOGA-ROVERS & ASSOCIATES

www.CRAworld.com



# General Permit Application G70-A

(New Facility)

Edna Monroe Well Pad

Prepared for: Antero Resources Corporation

**Conestoga-Rovers & Associates**
6320 Rothway, Suite 100
Houston, Texas 77040

May 2015 • 082715 • Report No. 197

Partners in Sustainability

## Table of Contents

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

# APPLICATION FOR GENERAL PERMIT REGISTRATION

*CONSTRUCT, MODIFY, RELOCATE OR ADMINISTRATIVELY UPDATE*

*A STATIONARY SOURCE OF AIR POLLUTANTS*

☒ CONSTRUCTION ☐ MODIFICATION ☐ RELOCATION ☐ CLASS I ADMINISTRATIVE UPDATE
☐ CLASS II ADMINISTRATIVE UPDATE

**CHECK WHICH TYPE OF GENERAL PERMIT REGISTRATION YOU ARE APPLYING FOR:**

☐ **G10-D –** Coal Preparation and Handling
☐ **G20-B –** Hot Mix Asphalt
☐ **G30-D –** Natural Gas Compressor Stations
☐ **G33-A –** Spark Ignition Internal Combustion Engines
☐ **G35-A –** Natural Gas Compressor Stations (Flare/Glycol Dehydration Unit)
☐ **G40-C –** Nonmetallic Minerals Processing
☐ **G50-B –** Concrete Batch
☐ **G60-C –** Class II Emergency Generator
☐ **G65-C –** Class I Emergency Generator
☒ **G70-A –** Class II Oil and Natural Gas Production Facility

## SECTION I. GENERAL INFORMATION

1. Name of applicant (as registered with the WV Secretary of State's Office):
Antero Resources Corporation

2. Federal Employer ID No. **(FEIN):**
80-0162034

3. Applicant's mailing address:
1615 Wynkoop St.
Denver, CO, 80202

4. Applicant's physical address:
0.84 mile east from the intersection of Purgatory Run Rd. (WV 30/1) and (Conaway Run Rd) WV 48

5. If applicant is a subsidiary corporation, please provide the name of parent corporation:

6. **WV BUSINESS REGISTRATION.** Is the applicant a resident of the State of West Virginia? ☐ **YES** ☒ **NO**

- IF **YES,** provide a copy of the Certificate of **Incorporation/ Organization / Limited Partnership** (one page) including any name change amendments or other Business Registration Certificate as **Attachment A**.
- IF **NO,** provide a copy of the **Certificate of Authority / Authority of LLC / Registration** (one page) including any name change amendments or other Business Certificate as **Attachment A**.

## SECTION II. FACILITY INFORMATION

7. Type of plant or facility (stationary source) to be constructed, modified, relocated or administratively updated (e.g., coal preparation plant, primary crusher, etc.):
Natural Gas and Oil Production facility

8a. Standard Industrial Classification (SIC) code: 1311

AND

8b. North American Industry System (NAICS) code: 211111

9. DAQ Plant ID No. (for existing facilities only):

10. List all current 45CSR13 and other General Permit numbers associated with this process (for existing facilities only):

***A: PRIMARY OPERATING SITE INFORMATION***

| 11A. Facility name of primary operating site: | 12A. Address of primary operating site: |
|---|---|
| Edna Monroe Well Pad | Mailing: N/A Physical: 0.84 mile east from the intersection of Purgatory Run Rd. (WV 30/1) and (Conaway Run Rd) WV 48 |

13A. Does the applicant own, lease, have an option to buy, or otherwise have control of the proposed site? ☒ **YES** ☐ **NO**

– IF **YES**, please explain: Antero is leasing the mineral rights for this site

– IF **NO**, YOU ARE NOT ELIGIBLE FOR A PERMIT FOR THIS SOURCE.

14A. – For **Modifications or Administrative Updates** at an existing facility, please provide directions to the present location of the facility from the nearest state road;

– For Construction or Relocation permits, please provide directions to the proposed new site location from the nearest state road. Include a **MAP** as **Attachment F**.

From US 50W, turn right onto WV-18 N. Follow for 14.8 miles. Turn left onto Purgatory Run Rd and continue for 2.6 miles. Turn right onto Conaway Run Rd. The pad entrance will be 1.25 miles ahead on the left.

| 15A. Nearest city or town: | 16A. County: | 17A. UTM Coordinates: |
|---|---|---|
| Middlebourne | Tyler | Northing (KM): 4363.6852<br>Easting (KM): 510.916<br>Zone: 17 N |

| 18A. Briefly describe the proposed new operation or change (s) to the facility: | 19A. Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits): |
|---|---|
| New Natural Gas and Oil Production facility | Latitude: 39.422626<br>Longitude: -80.873179 |

***B: 1ST ALTERNATE OPERATING SITE INFORMATION (only available for G20, G40, & G50 General Permits)***

| 11B. Name of 1st alternate operating site: | 12B. Address of 1st alternate operating site: |
|---|---|
| | Mailing: Physical: |

13B. Does the applicant own, lease, have an option to buy, or otherwise have control of the proposed site? ☐ **YES** ☐ **NO**

– IF **YES**, please explain:

– IF **NO**, YOU ARE NOT ELIGIBLE FOR A PERMIT FOR THIS SOURCE.

14B. – For **Modifications or Administrative Updates** at an existing facility, please provide directions to the present location of the facility from the nearest state road;

– For Construction or Relocation permits, please provide directions to the proposed new site location from the nearest state road. Include a **MAP** as **Attachment F**.

| 15B. Nearest city or town: | 16B. County: | 17B. UTM Coordinates:<br>Northing (KM): _____<br>Easting (KM): _____<br>Zone: _____ |
|---|---|---|
| 18B. Briefly describe the proposed new operation or change (s) to the facility: | | 19B. Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits):<br>Latitude: _____<br>Longitude: _____ |

***C: 2ND ALTERNATE OPERATING SITE INFORMATION (only available for G20, G40, & G50 General Permits):***

| 11C. Name of 2nd alternate operating site:<br>_____<br>_____ | 12C. Address of 2nd alternate operating site:<br>Mailing:_____ Physical:_____<br>_____ |
|---|---|

13C. Does the applicant own, lease, have an option to buy, or otherwise have control of the proposed site? ☐ **YES** ☐ **NO**

- IF **YES**, please explain: _____
  _____
- IF **NO**, YOU ARE NOT ELIGIBLE FOR A PERMIT FOR THIS SOURCE.

14C.
- For **Modifications or Administrative Updates** at an existing facility, please provide directions to the present location of the facility from the nearest state road;
- For Construction or Relocation permits, please provide directions to the proposed new site location from the nearest state road. Include a **MAP** as **Attachment F**.

_____
_____
_____

| 15C. Nearest city or town: | 16C. County: | 17C. UTM Coordinates:<br>Northing (KM): _____<br>Easting (KM): _____<br>Zone: _____ |
|---|---|---|
| 18C. Briefly describe the proposed new operation or change (s) to the facility: | | 19C. Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits):<br>Latitude: _____<br>Longitude: _____ |

| 20. Provide the date of anticipated installation or change:<br>01/01/2016<br>☐ If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen: :<br>_____/_____/_____ | 21. Date of anticipated Start-up if registration is granted:<br>02/16/2016 |
|---|---|

22. Provide maximum projected **Operating Schedule** of activity/activities outlined in this application if other than 8760 hours/year. (Note: anything other than 24/7/52 may result in a restriction to the facility's operation).

Hours per day_____ Days per week _____ Weeks per year _____ Percentage of operation _____

## SECTION III. ATTACHMENTS AND SUPPORTING DOCUMENTS

23. Include a check payable to WVDEP – Division of Air Quality with the appropriate **application fee** (per 45CSR22 and 45CSR13).

24. Include a **Table of Contents** as the first page of your application package.

All of the required forms and additional information can be found under the Permitting Section (General Permits) of DAQ's website, or requested by phone.

25. Please check all attachments included with this permit application. Please refer to the appropriate reference document for an explanation of the attachments listed below.

- ☒ ATTACHMENT A : CURRENT BUSINESS CERTIFICATE
- ☒ ATTACHMENT B: PROCESS DESCRIPTION
- ☒ ATTACHMENT C: DESCRIPTION OF FUGITIVE EMISSIONS
- ☒ ATTACHMENT D: PROCESS FLOW DIAGRAM
- ☒ ATTACHMENT E: PLOT PLAN
- ☒ ATTACHMENT F: AREA MAP
- ☒ ATTACHMENT G: EQUIPMENT DATA SHEETS AND REGISTRATION SECTION APPLICABILITY FORM
- ☒ ATTACHMENT H: AIR POLLUTION CONTROL DEVICE SHEETS
- ☒ ATTACHMENT I: EMISSIONS CALCULATIONS
- ☒ ATTACHMENT J: CLASS I LEGAL ADVERTISEMENT
- ☐ ATTACHMENT K: ELECTRONIC SUBMITTAL
- ☒ ATTACHMENT L: GENERAL PERMIT REGISTRATION APPLICATION FEE
- ☐ ATTACHMENT M: SITING CRITERIA WAIVER
- ☒ ATTACHMENT N: MATERIAL SAFETY DATA SHEETS (MSDS)
- ☒ ATTACHMENT O: EMISSIONS SUMMARY SHEETS
- ☒ OTHER SUPPORTING DOCUMENTATION NOT DESCRIBED ABOVE (Equipment Drawings, Aggregation Discussion, etc.)

Please mail an original and two copies of the complete General Permit Registration Application with the signature(s) to the DAQ Permitting Section, at the address shown on the front page of this application. Please DO NOT fax permit applications. For questions regarding applications or West Virginia Air Pollution Rules and Regulations, please refer to the website shown on the front page of the application or call the phone number also provided on the front page of the application.

## SECTION IV. CERTIFICATION OF INFORMATION

This General Permit Registration Application shall be signed below by a Responsible Official. A Responsible Official is a President, Vice President, Secretary, Treasurer, General Partner, General Manager, a member of a Board of Directors, or Owner, depending on business structure. A business may certify an Authorized Representative who shall have authority to bind the Corporation, Partnership, Limited Liability Company, Association, Joint Venture or Sole Proprietorship. Required records of daily throughput, hours of operation and maintenance, general correspondence, Emission Inventory, Certified Emission Statement, compliance certifications and all required notifications must be signed by a Responsible Official or an Authorized Representative. If a business wishes to certify an Authorized Representative, the official agreement below shall be checked off and the appropriate names and signatures entered. Any administratively incomplete or improperly signed or unsigned Registration Application will be returned to the applicant.

FOR A CORPORATION (domestic or foreign)

☐ I certify that I am a President, Vice President, Secretary, Treasurer or in charge of a principal business function of the corporation

FOR A PARTNERSHIP

☐ I certify that I am a General Partner

FOR A LIMITED LIABILITY COMPANY

☐ I certify that I am a General Partner or General Manager

FOR AN ASSOCIATION

☐ I certify that I am the President or a member of the Board of Directors

FOR A JOINT VENTURE

☐ I certify that I am the President, General Partner or General Manager

FOR A SOLE PROPRIETORSHIP

☐ I certify that I am the Owner and Proprietor

☐ *I hereby certify that* (please print or type) _____

*is an Authorized Representative and in that capacity shall represent the interest of the business (e.g., Corporation, Partnership, Limited Liability Company, Association Joint Venture or Sole Proprietorship) and may obligate and legally bind the business. If the business changes its Authorized Representative, a Responsible Official shall notify the Director of the Office of Air Quality immediately, and/or,*

*I hereby certify that all information contained in this General Permit Registration Application and any supporting documents appended hereto is, to the best of my knowledge, true, accurate and complete, and that all reasonable efforts have been made to provide the most comprehensive information possible*

Signature _____
(please use blue ink) Responsible Official Date

Name & Title Barry Schatz, Senior Environmental & Regulatory Manager
(please print or type)

Signature Barry Schatz 5-19-15
(please use blue ink) Authorized Representative (if applicable) Date

Applicant's Name Antero Resources Corporation

Phone & Fax 303-357-7276 303-357-7315
Phone Fax

Email bschatz@anteroresources.com

**Attachment R**
**AUTHORITY OF CORPORATION**
**OR OTHER BUSINESS ENTITY (DOMESTIC OR FOREIGN)**

TO: The West Virginia Department of Environmental Protection, Division of Air Quality

DATE: January 23, 2015

ATTN.: Director

Corporation's / other business entity's Federal Employer I.D. Number 80-0162034

The undersigned hereby files with the West Virginia Department of Environmental Protection, Division of Air Quality, a permit application and hereby certifies that the said name is a trade name which is used in the conduct of an incorporated business or other business entity.

Further, the corporation or the business entity certifies as follows:

(1) Barry Schatz (is/are) the authorized representative(s) and in that capacity may represent the interest of the corporation or the business entity and may obligate and legally bind the corporation or the business entity.

(2) The corporation or the business entity is authorized to do business in the State of West Virginia.

(3) If the corporation or the business entity changes its authorized representative(s), the corporation or the business entity shall notify the Director of the West Virginia Department of Environmental Protection, Division of Air Quality, immediately upon such change.

President or Other Authorized Officer
(Vice President, Secretary, Treasurer or other official in charge of a principal business function of the corporation or the business entity)

(If not the President, then the corporation or the business entity must submit certified minutes or bylaws stating legal authority of other authorized officer to bind the corporation or the business entity).

Secretary

Name of Corporation or business entity

# Attachment A

## Current Business Certificate

# State of West Virginia

# Certificate

***I, Natalie E. Tennant, Secretary of State of the State of West Virginia, hereby certify that***

**ANTERO RESOURCES CORPORATION**

a corporation formed under the laws of Delaware, which is authorized to transact business in West Virginia by a Certificate of Authority has filed in my office as required by the provisions of the West Virginia Code, a copy of an amendment to its Articles of Incorporation authenticated by the proper office of the state or country of its incorporation and was found to conform to law.

Therefore, I issue this

## CERTIFICATE OF AMENDMENT TO CERTIFICATE OF AUTHORITY

***Given under my hand and the Great Seal of the State of West Virginia on this day of June 10, 2013***

*Natalie E Tennant*

***Secretary of State***

FILED

JUN 10 2013

IN THE OFFICE OF SECRETARY OF STATE

Natalie E. Tennant
Secretary of State
1900 Kanawha Blvd E
Bldg 1, Suite 157-K
Charleston, WV 25305

Penney Barker, Manager
Corporations Division
Tel: (304)558-8000
Fax: (304)558-8381
Website: www.wvsos.com
E-mail: business@wvsos.com

Office Hours: Monday – Friday
8:30 a.m. – 5:00 p.m. ET

**FILE ONE ORIGINAL**
**(Two if you want a filed stamped copy returned to you)**
**FEE: $25.00**

# APPLICATION FOR AMENDED CERTIFICATE OF AUTHORITY

****** In accordance with the provisions of the West Virginia Code, the undersigned corporation hereby **** applies for an Amended Certificate of Authority and submits the following statement:**

1. Name under which the corporation was authorized to transact business in WV: Antero Resources Appalachian Corporation

2. Date Certificate of Authority was issued in West Virginia: 6/25/2008

3. Corporate name has been changed to: Antero Resources Corporation
**(Attach one Certified Copy of Name Change as filed in home State of incorporation.)**

4. Name the corporation elects to use in WV: Antero Resources Corporation
(due to home state name not being available)

5. Other amendments:
(attach additional pages if necessary)

6. **Name and phone number of contact person.** (This is optional, however, if there is a problem with the filing, listing a contact person and phone number may avoid having to return or reject the document.)

Alvyn A. Schopp — Contact Name
(303) 357-7310 — Phone Number

7. **Signature information** (See below ******Important Legal Notice Regarding Signature*): 

Print Name of Signer: Alvyn A. Schopp Title/Capacity: Authorized Person

**Signature:** Alvyn A. Schopp **Date:** June 10, 2013

******Important Legal Notice Regarding Signature*: **Per West Virginia Code §31D-1-129. Penalty for signing false document. Any person who signs a document he or she knows is false in any material respect and knows that the document is to be delivered to the secretary of state for filing is guilty of a misdemeanor and, upon conviction thereof, shall be fined not more than one thousand dollars or confined in the county or regional jail not more than one year, or both.**

# Delaware



*The First State*

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY THE ATTACHED IS A TRUE AND CORRECT COPY OF THE CERTIFICATE OF AMENDMENT OF "ANTERO RESOURCES APPALACHIAN CORPORATION", CHANGING ITS NAME FROM "ANTERO RESOURCES APPALACHIAN CORPORATION" TO "ANTERO RESOURCES CORPORATION", FILED IN THIS OFFICE ON THE TENTH DAY OF JUNE, A.D. 2013, AT 9:37 O'CLOCK A.M.

A FILED COPY OF THIS CERTIFICATE HAS BEEN FORWARDED TO THE NEW CASTLE COUNTY RECORDER OF DEEDS.

Jeffrey W. Bullock, Secretary of State

4520810 8100

130754186

AUTHENTICATION: 0496546

DATE: 06-10-13

You may verify this certificate online at corp.delaware.gov/authver.shtml

State of Delaware
Secretary of State
Division of Corporations
Delivered 09:37 AM 06/10/2013
FILED 09:37 AM 06/10/2013
SRV 130754186 - 4520810 FILE

# AMENDMENT TO THE AMENDED AND RESTATED CERTIFICATE OF INCORPORATION OF ANTERO RESOURCES APPALACHIAN CORPORATION

Antero Resources Appalachian Corporation (the "Corporation"), a corporation organized and existing under the laws of the State of Delaware, hereby certifies as follows:

1. The original Certificate of Incorporation of the Corporation was filed under the name Antero Resources Barnett Corporation with the filing of the original Certificate of Incorporation of the Corporation with the Secretary of State of the State of Delaware on March 18, 2008.

2. This Amendment to the Amended and Restated Certificate of Incorporation has been duly adopted and approved in accordance with Sections 242 of the General Corporation Law of the State of Delaware.

3. Article FIRST of the Amended and Restated Certificate of Incorporation is hereby amended to read in its entirety as follows:

FIRST. The name of the Corporation is Antero Resources Corporation.

IN WITNESS WHEREOF, the Corporation has caused this Certificate of Amendment to be executed by its duly authorized officer on the 10th day of June, 2013.

ANTERO RESOURCES APPALACHIAN CORPORATION

By: _____
Name: Alvyn A. Schopp
Title: Vice President of Accounting & Administration / Treasurer

# Attachment B

## Process Description

**Attachment B**

**Process Description**
**Edna Monroe Well Pad**
**Antero Resources Corporation**
**Tyler County, West Virginia**

A mixture of condensate and entrained gas from the wells enters the facility through a number of three phase low pressure separators where the gas phase is separated from the condensate and produced water. Gas Processing Units (GPU) heaters (H001-H010) are used in conjunction with the separators to help separate the gas from the liquid phases. These heaters are fueled by a slip stream of the separated gas. The separated gas from the three phase low pressure separators is sent to a compressor (ENG001). The compressed gas is then metered and sent to the sales gas pipeline. The separated water flow to the produced water storage tanks (TANKPW001-002). The separated condensate is then sent to two phase low pressure separators where gas is further separated from the condensate. The separated gas is routed to the compressor (ENG001), compressed, sent to the sales gas line. The condensate from the two phase separators flow to the condensate storage tanks (TANKCOND001-010).

The facility has ten (10) tanks (TANKCOND001-010) on site to store condensate and two (2) tanks (TANKPW001-002) to store produced water prior to removal from the site. The flashing, working and breathing losses from the tanks are routed to the enclosed combustor to control emissions. The enclosed combustor that will be used to control emissions is designed to achieve a VOC destruction efficiency of 98 percent.

Condensate and produced water are transported off site on an as needed basis via tanker truck. Truck loading connections are in place to pump condensate (L001) and produced water (L002) from the storage tanks into tanker trucks. Emissions from the loading operations are vented to the atmosphere.

Emissions from the facility's emission sources were calculated using the extended analysis of the condensate and produced water from Sweeney No. 2H, one of the wells in Forest pad. Gas analysis from Sweeney No. 2H, one of the wells in Forest pad, is used for emission calculation. These extended analyses are considered representative of the materials from Edna Monroe, being in the same Marcellus rock formation.

Edna Monroe Pad calculation of potential to emit included all of the emission sources that belong to the same industrial grouping, are located on contiguous or adjacent properties, and are under the control of the same person. The nearest emission source that belongs to the same industrial grouping and under the control of the same person but not located on contiguous or adjacent property is the Estlack Pad. This is approximately 0.65 miles southwest of the facility.

# Attachment C

## Description of Fugitive Emissions

**Attachment C**

**Description of Fugitive Emissions**
**Edna Monroe Well Pad**
**Antero Resources Corporation**
**Tyler County, West Virginia**

Sources of fugitive emissions include loading operations, haul road emissions, equipment leaks, and pneumatic control valves. Fugitive emissions were calculated using AP-42 factors. Routine equipment leaks are assumed to be occurring continuously throughout the year. Loading operations and haul road emissions only occur when tanker trucks are onsite. The fugitives emissions summary is also located in Attachment O.

**Equipment Leaks**

Equipment include valves, flanges, and connectors installed in various process equipment such as gas production unit heaters, compressor, pipelines, and separators. Emissions are assumed to be occurring throughout the year. Detailed calculations are shown on Table 4.

**Pneumatic Control Valves**

Pneumatic control valves are part of the gas production unit heaters. These are intermittent low bleed valves and their emissions are assumed to be occurring throughout the year. Detailed calculations are shown on Table 5.

**Loading Operations**

Loading emissions occur when condensate and produced water are transferred out of the well site via tanker trucks. Fugitive emissions were estimated using AP-42 loading loss formula, L= 12.46*SPM/T, and Bryan & Engineering (BR&E) software known as Promax. Detailed calculations are shown in Table 8.

**Haul Road Emissions**

Haul road emissions are emitted when tanker trucks or service vehicles enter the Facility. The Facility is flat and unpaved. Detailed calculations are shown on Table 12.

# Attachment C/O: G70-A Emissions Summary Sheet

## Fugitive Emissions Data Summary Sheet

| FUGITIVE EMISSIONS SUMMARY | All Regulated Pollutants Chemical Name/CAS [1] | Maximum Potential Uncontrolled Emissions [2] | | Maximum Potential Controlled Emissions [3] | | Est. Method Used [4] |
|---|---|---|---|---|---|---|
| | | lb/hr | ton/yr | lb/hr | ton/yr | |
| Haul Road/Road Dust Emissions<br>Paved Haul Roads | n/a | | | | | |
| Unpaved Haul Roads | PM, PM10, PM2.5 | 1.3291 | 8.3718 | 0.6645 | 4.1859 | MB |
| Loading/Unloading Operations | VOCs | 6.2848 | 5.5080 | 6.2848 | 5.5080 | MB |
| | toluene (108883) | 0.0009 | 0.0008 | 0.0009 | 0.0008 | |
| | ethyl benzene (100414) | 0.0010 | 0.0009 | 0.0010 | 0.0009 | |
| | hexane (110543) | 0.0086 | 0.0075 | 0.0086 | 0.0075 | |
| | o,m,p-xylenes (95476,108383,106423) | 0.0022 | 0.0019 | 0.0022 | 0.0019 | |
| | CO2 Equivalent<br>CO2 (124389), CH4 | 3.2288 | 12.3613 | 3.2288 | 12.3613 | |
| | benzene (71432) | 0.0002 | 0.0002 | 0.0002 | 0.0002 | |
| | TAPs (benzene) | 0.0002 | 0.0002 | 0.0002 | 0.0002 | |
| Equipment Leaks (Components) | Benzene (71432) | Does not apply | 0.0103 | Does not apply | 0.0103 | MB |
| | Toluene (108883) | | 0.0788 | | 0.0788 | |
| | Ethyl benzene (100414) | | 0.1384 | | 0.1384 | |
| | Hexane (110543) | | 0.8741 | | 0.8741 | |
| | o,m,p-xylenes (95476,108383,106423) | | 0.3209 | | 0.3209 | |
| | CO2 Equivalent<br>CO2 (124389)), CH4 | | 354.4988 | | 354.4988 | |
| | VOCs | | 16.5870 | | 16.5870 | |
| | TAPs (benzene) | | 0.0103 | | 0.0103 | |
| Equipment Leaks (PCVs) | toluene (108883) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MB |
| | ethyl benzene (100414) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| | hexane (110543) | 0.0136 | 0.0596 | 0.0136 | 0.0596 | |
| | o,m,p-xylenes (95476,108383,106423) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| | CO2 Equivalent<br>CO2 (124389)), CH4 | 9.0327 | 39.5633 | 9.0327 | 39.5633 | |
| | VOCs | 0.1145 | 0.5015 | 0.1145 | 0.5015 | |
| | TAPs (benzene) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |

[1] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. LIST Acids, CO, $CS_2$, VOCs, $H_2S$, Inorganics, Lead, Organics, $O_3$, NO, $NO_2$, $SO_2$, $SO_3$, all applicable Greenhouse Gases (including $CO_2$ and methane), etc. DO NOT LIST $H_2$, $H_2O$, $N_2$, $O_2$, and Noble Gases.

[2] Give rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[3] Give rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

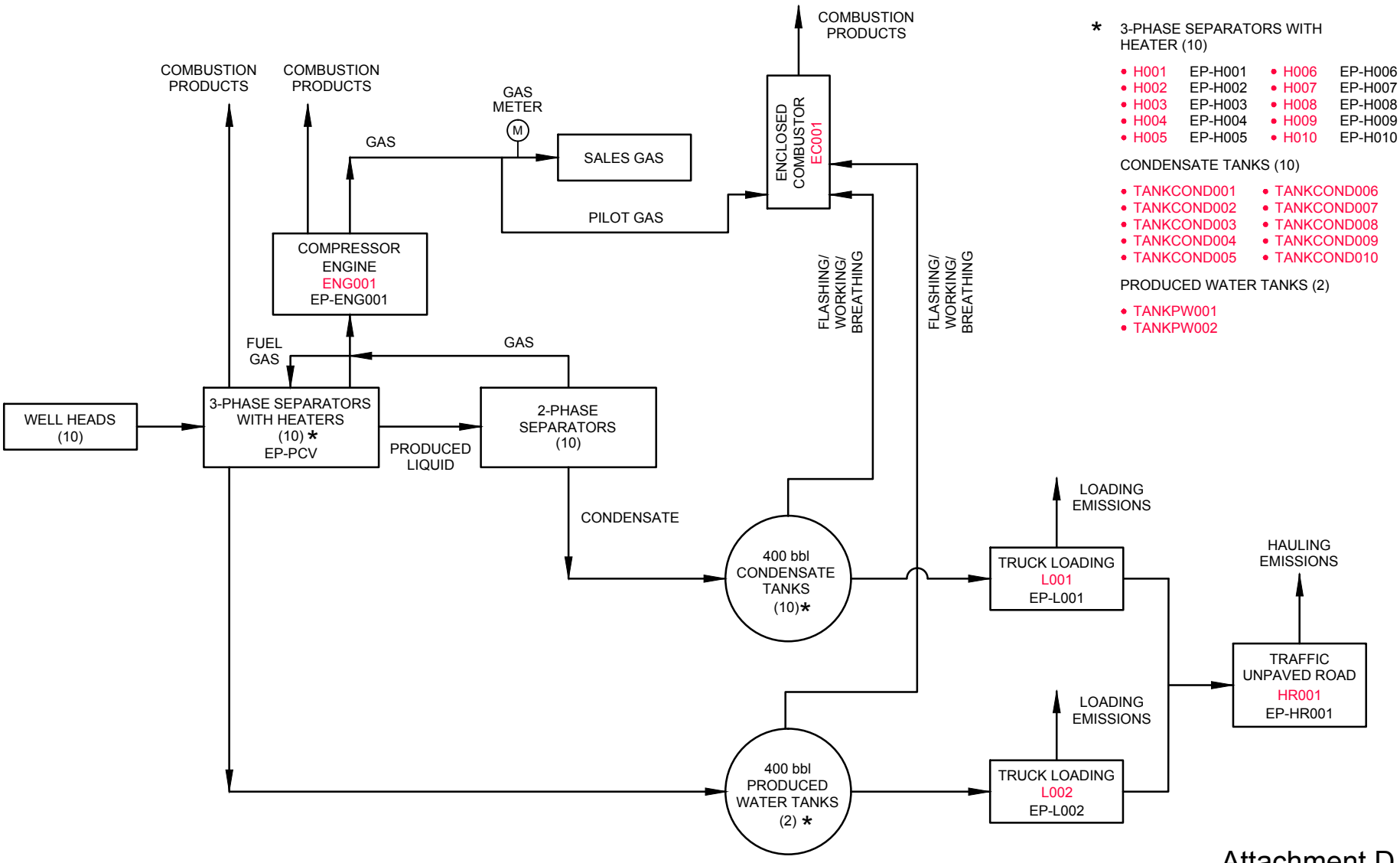
[4] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

## Attachment C: Leak Source Data Sheet

| Source Category | Pollutant | Number of Source Components (1) | Number of Components Monitored by Frequency2 | Average Time to Repair (days) (3) | Estimated Annual Emission Rate (lb/yr) (4) |
|---|---|---|---|---|---|
| Pumps (5) | light liquid VOC [6,7] | | | | |
| | heavy liquid VOC[8] | | | | |
| | Non-VOC[9] | | | | |
| Valves (10) | Gas VOC | 500 | | First attempt within 5 days of detection and final repair within 15 days | 8,280.76 |
| | Light Liquid VOC | 520 | | First attempt within 5 days of detection and final repair within 15 days | 24,272.31 |
| | Heavy Liquid VOC | -- | | | -- |
| | Non-VOC | -- | | | -- |
| Safety Relief Valves (11) | Gas VOC | See Valves | | First attempt within 5 days of detection and final repair within 15 days | see Valves |
| | Non VOC | See Valves | | First attempt within 5 days of detection and final repair within 15 days | see Valves |
| Open-ended Lines (12) | VOC | | | | |
| | Non-VOC | | | | |
| Sampling Connections (13) | VOC | | | | |
| | Non-VOC | | | | |
| Compressors | VOC | | | | |
| | Non-VOC | | | | |
| Flanges | VOC | 130 | | First attempt within 5 days of detection and final repair within 15 days | 186.59 |
| | Non-VOC | | | First attempt within 5 days of detection and final repair within 15 days | 790.50 |
| Other | VOC | 590 | | First attempt within 5 days of detection and final repair within 15 days | 434.28 |
| | Non-VOC | | | | 1,839.82 |

# Attachment D

## Process Flow Diagram

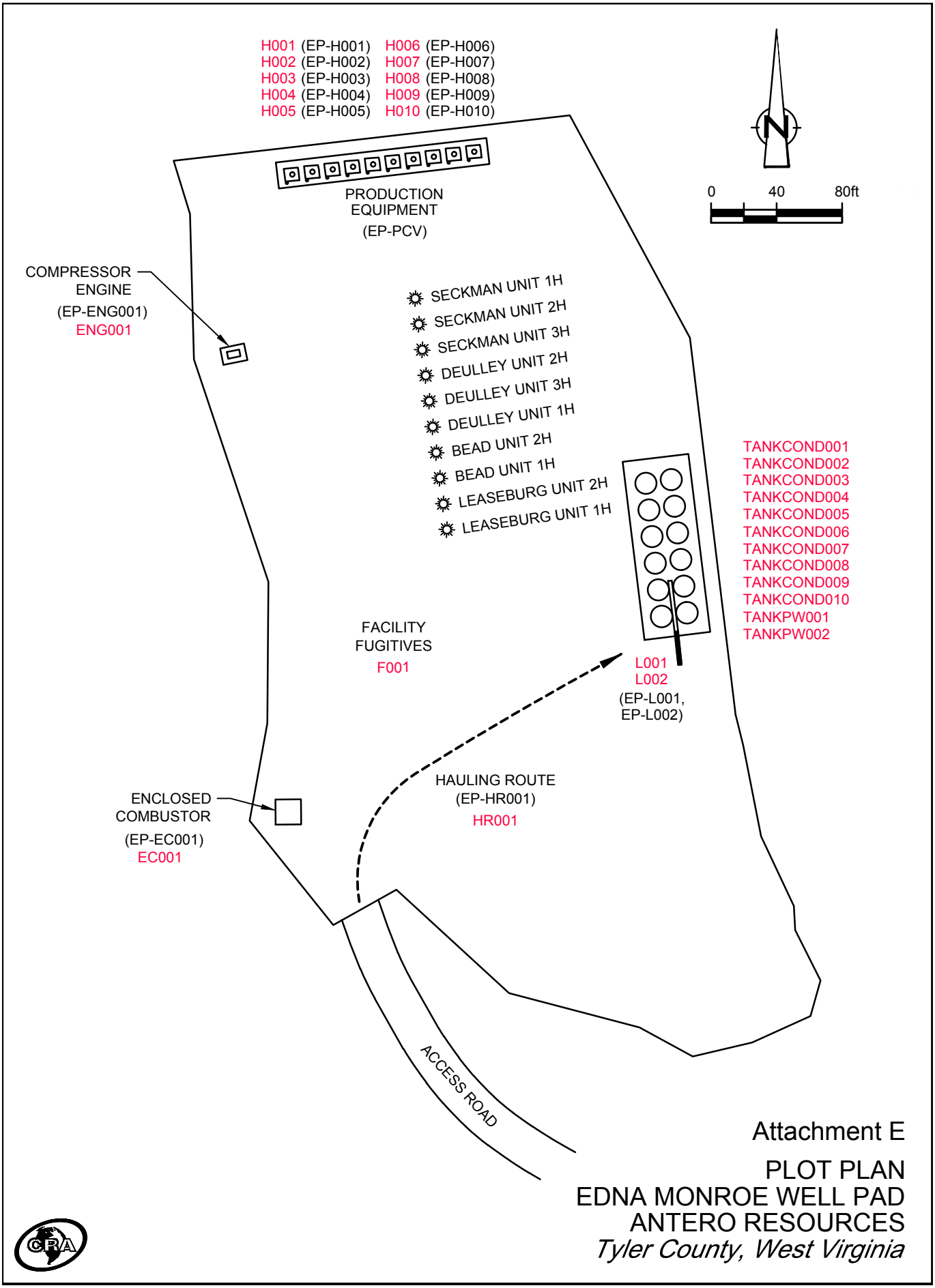



Attachment D

# PROCESS FLOW DIAGRAM - ANTERO RESOURCES
# EDNA MONROE WELL PAD
*Tyler County, West Virginia*

# Attachment E

## Plot Plan



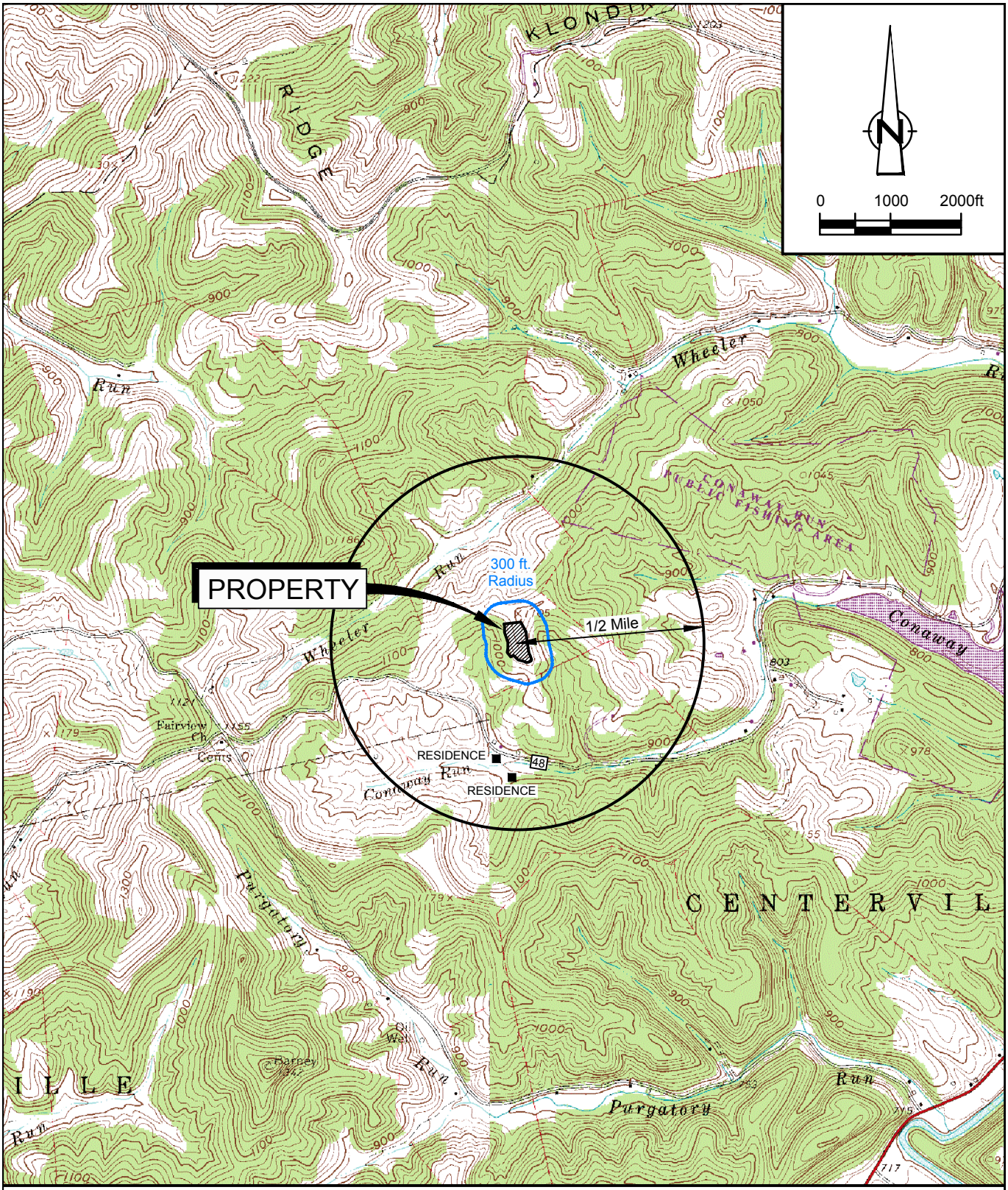

# Attachment E

## PLOT PLAN
## EDNA MONROE WELL PAD
## ANTERO RESOURCES
*Tyler County, West Virginia*

82715-00(197)GN-WA002 APR 27/2015

# Attachment F

## Area Map




SOURCE: USGS QUADRANGLE MAPS;
MIDDLEBOURNE AND SHIRLEY, WEST VIRGINIA

SITE COORDINATES: LAT. 39.422626, LONG. -80.873179
SITE ELEVATION: 1063 ft AMSL

Attachment F

AREA MAP
EDNA MONROE WELL PAD
ANTERO RESOURCES
*Tyler County, West Virginia*

82715-00(197)GN-WA003 APR 27/2015

# Attachment G

## Emission Unit Data Sheets/G70-A Section Applicability Form

## General Permit G70-A Registration
## Section Applicability Form

General Permit G70-A was developed to allow qualified applicants to seek registration for a variety of sources. These sources include natural gas well affected facilities, storage tanks, natural gas-fired compressor engines (RICE), natural gas producing units, natural gas-fired in-line heaters, pneumatic controllers, heater treaters, tank truck loading, glycol dehydration units, completion combustion devices, flares, enclosed combustion devices, and vapor recovery systems. All registered facilities will be subject to Sections 1.0, 2.0, 3.0, and 4.0.

General Permit G70-A allows the registrant to choose which sections of the permit they are seeking registration under. Therefore, please mark which additional sections that you are applying for registration under. If the applicant is seeking registration under multiple sections, please select all that apply. Please keep in mind, that if this registration is approved, the issued registration will state which sections will apply to your affected facility.

| | | |
|---|---|---|
| Section 5 | Natural Gas Well Affected Facility | ☑ |
| Section 6 | Storage Vessels* | ☑ |
| Section 7 | Gas Producing Units, In-Line Heaters, Heater Treaters, and Glycol Dehydration Reboilers | ☑ |
| Section 8 | Pneumatic Controllers Affected Facility (NSPS, Subpart OOOO) | ☐ |
| Section 9 | *Reserved* | ☐ |
| Section 10 | Natural gas-fired Compressor Engine(s) (RICE) ** | ☑ |
| Section 11 | Tank Truck Loading Facility *** | ☑ |
| Section 12 | Standards of Performance for Storage Vessel Affected Facilities (NSPS, Subpart OOOO) | ☐ |
| Section 13 | Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (NSPS, Subpart JJJJ) | ☑ |
| Section 14 | Control Devices not subject to NSPS, Subpart OOOO | ☑ |
| Section 15 | National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (40CFR63, Subpart ZZZZ) | ☑ |
| Section 16 | Glycol Dehydration Units | ☐ |
| Section 17 | Dehydration Units With Exemption from NESHAP Standard, Subpart HH § 63.764(d) (40CFR63, Subpart HH) | ☐ |
| Section 18 | Dehydration Units Subject to NESHAP Standard, Subpart HH and Not Located Within an UA/UC (40CFR63, Subpart HH) | ☐ |
| Section 19 | Dehydration Units Subject to NESHAP Standard, Subpart HH and Located Within an UA/UC (40CFR63, Subpart HH) | ☐ |

***** *Applicants that are subject to Section 6 may also be subject to Section 12 if the applicant is subject to the NSPS, Subpart OOOO control requirements or the applicable control device requirements of Section 14.*

****** *Applicants that are subject to Section 10 may also be subject to the applicable RICE requirements of Section 13 and/or Section 15.*

******* *Applicants that are subject to Section 11 may also be subject to control device requirements of Section 14.*

# NATURAL GAS WELL AFFECTED FACILITY DATA SHEET

*Complete this data sheet if you are the owner or operator of a gas well affected facility for which construction, modification, or reconstruction commenced after August 23, 2011. This form must be completed for natural gas well affected facilities regardless of when flowback operations occur (or have occurred).*

| Please provide the API number(s) for each NG well at this facility: | |
|---|---|
| 10 wells unpermitted | |
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*Note: This is the same API well number(s) provided in the well completion notification and as provided to the WVDEP, Office of Oil and Gas for the well permit. The API number may be provided on the application without the state code (047).*

*Every oil and gas well permitted in West Virginia since 1929 has been issued an API (American Petroleum Institute) number. This API is used by agencies to identify and track oil and gas wells.*

*The API number has the following format: 047-001-00001*

*Where,*
*047 = State code. The state code for WV is 047.*
*001 = County Code. County codes are odd numbers, beginning with 001 (Barbour) and continuing to 109 (Wyoming).*
*00001= Well number. Each well will have a unique well number.*

## Attachment G: Emission Units Data Sheet

**(includes all emission units and air pollution control devices that will be part of this permit application review, regardless of permitting status)**

| Emission Unit ID1 | Emission Point ID2 | Emission Unit Description | Year Installed/ Modified | Design Capacity | Type3 and Date of Change | Control Device 4 |
|---|---|---|---|---|---|---|
| H001, H002, H003, H004, H005, H006, H007, H008, H009, H010 | EP-H001, EP-H002, EP-H003, EP-H004, EP-H005, EP-H006, EP-H007, EP-H008, EP-H009, EP-H010 | Gas Production Unit Heater | 2016 | 1.5 MMBtu/hr (each) | New | N/A |
| F001 | F001 | Fugitives | 2016 | | New | N/A |
| TANKCOND001-010 | EP-EC001 | Condensate Tanks | 2016 | 400 bbl each | New | EP-EC001 |
| TANKPW001-002 | EP-EC001 | PW Tanks | 2016 | 400 bbl each | New | EP-EC001 |
| L001 | EP-L001 | Loading (Condensate) | 2016 | 200BBL capacity (each) | New | N/A |
| L002 | EP-L002 | Loading (Water) | 2016 | 200BBL capacity (each) | New | N/A |
| HR001 | EP-HR001 | Haul Truck | 2016 | 40 ton capacity | New | N/A |
| EC001 | EP-EC001 | Enclosed Combustor | 2016 | 90 scf/min | New | N/A |
| PCV | EP-PCV | Pneumatic CV | 2016 | 6.6 scf/day/PCV | New | N/A |
| ENG001 | EP-ENG001 | Compressor Engine | 2016 | 24HP | New | N/A |
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1 For Emission Units (or Sources) use the following numbering system:1S, 2S, 3S,... or other appropriate designation.
2 For Emission Points use the following numbering system:1E, 2E, 3E, ... or other appropriate designation.
3 New, modification, removal.
4 For Control Devices use the following numbering system: 1C, 2C, 3C,... or other appropriate designation.

# Attachment G: Storage Vessel Emission Unit Data Sheet (Condensate)

*Provide the following information for each new or modified bulk liquid storage tank.*

**I. GENERAL INFORMATION (required)**

| | |
|---|---|
| 1. Bulk Storage Area Name CONDTANK | 2. Tank Name TANKCOND001-010 |
| 3. Emission Unit ID number TANKCOND001-010 | 4. Emission Point ID number EP-EC001 |
| 5. Date Installed or Modified *(for existing tanks):* New | 6. Type of change: NA |
| 7A. Description of Tank Modification *(if applicable)* NA | |
| 7B. Will more than one material be stored in this tank? *If so, a separate form must be completed for each material.* No | |
| 7C. Provide any limitations on source operation affecting emissions. (production variation, etc.) | |

**II. TANK INFORMATION (required)**

| | |
|---|---|
| 8. Design Capacity *(specify barrels or gallons).* Use the internal cross-sectional area multiplied by internal height. 400bbls | |
| 9A. Tank Internal Diameter (ft.) 12 | 9B. Tank Internal Height (ft.) 20 |
| 10A. Maximum Liquid Height (ft.) 18 | 10B. Average Liquid Height (ft.) 10 |
| 11A. Maximum Vapor Space Height (ft.) 18 | 11B. Average Vapor Space Height (ft.) 10 |
| 12. Nominal Capacity *(specify barrels or gallons)* . This is also known as "working volume." 400bbls | |
| 13A. Maximum annual throughput (gal/yr) 17,629,500 | 13B. Maximum daily throughput (gal/day) 48,300 |
| 14. Number of tank turnovers per year 105 | 15. Maximum tank fill rate (gal/min) 168 |
| 16. Tank fill method: Splash Fill | |
| 17. Is the tank system a variable vapor space system? No<br>If yes, (A) What is the volume expansion capacity of the system (gal)?<br>(B) What are the number of transfers into the system per year? | |
| 18. Type of tank (check all that apply):<br>X Fixed Roof X vertical horizontal X flat roof cone roof dome roof other (describe)<br>External Floating Roof pontoon roof double deck roof Domed External (or Covered) Floating Roof<br>Internal Floating Roof vertical column support self-supporting Variable Vapor Space lifter roof diaphragm<br>Pressurized spherical cylindrical Underground<br>Other (describe) | |

**III. TANK CONSTRUCTION AND OPERATION INFORMATION** *(check which one applies)*

Refer to enclosed TANKS Summary Sheets

X Refer to the responses to items 19 – 26 in section VII

**IV. SITE INFORMATION** *(check which one applies)*

Refer to enclosed TANKS Summary Sheets

X Refer to the responses to items 27 – 33 in section VII

**V. LIQUID INFORMATION** *(check which one applies)*

Refer to enclosed TANKS Summary Sheets

X Refer to the responses to items 34 – 39 in section VII

# Attachment G: Storage Vessel Emission Unit Data Sheet (Condensate)

*Provide the following information for each new or modified bulk liquid storage tank.*

**VI. EMISSIONS AND CONTROL DEVICE DATA (required)**

40. Emission Control Devices (check as many as apply):

Does Not Apply — Rupture Disc (psig)

Carbon Adsorption[1] — Inert Gas Blanket of _____

X Vent to Vapor Combustion Device[1] (vapor combustors, flares, thermal oxidizers) Condenser[1]

Conservation Vent (psig

Other[1] (describe) — Vacuum Setting — Pressure Setting Emergency Relief Valve (psig)

[1] Complete appropriate Air Pollution Control Device Sheet

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

| Material Name and CAS No. | Flashing Loss | | Breathing Loss | | Working Loss | | Total Emissions Loss | | |
|---|---|---|---|---|---|---|---|---|---|
| | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | |
| | ***Please see Tables 6 and 7*** | | | | | | | | |
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1 EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

*Remember to attach emissions calculations, including TANKS Summary Sheets and other modeling summary sheets if applicable.*

**SECTION VII (required if did not provide TANKS Summary Sheets)**

| **TANK CONSTRUCTION AND OPERATION INFORMATION** | | |
|---|---|---|
| 19. Tank Shell Construction: Steel | | |
| 20A. Shell Color: Green | 20B. Roof Color: Green | 20C. Year Last Painted: 2016 |
| 21. Shell Condition (if metal and unlined): No Rust | | |
| 22A. Is the tank heated? No | 22B. If yes, operating temperature: | 22C. If yes, how is heat provided to tank? |
| 23. Operating Pressure Range (psig): 0 | | |
| 24. Is the tank a **Vertical Fixed Roof Tank**? Yes | 24A. If yes, for dome roof provide radius (ft): | 24B. If yes, for cone roof, provide slop (ft/ft): |
| 25. Complete item 25 for **Floating Roof Tanks** Does not apply | | |
| 25A. Year Internal Floaters Installed: | | |
| 25B. Primary Seal Type *(check one):* Metallic (mechanical) shoe seal Liquid mounted resilient seal | | |
| 25C. Is the Floating Roof equipped with a secondary seal? Yes No | | |
| 25D. If yes, how is the secondary seal mounted? *(check one)* Shoe Rim Other (describe): | | |
| 25E. Is the floating roof equipped with a weather shield? Yes No | | |
| 25F. Describe deck fittings: | | |
| 26. Complete the following section for **Internal Floating Roof Tanks** Does not apply | | |
| 26A. Deck Type: Bolted Welded | 26B. For bolted decks, provide deck construction: | |
| 26C. Deck seam. Continuous sheet construction: | | |
| 26D. Deck seam length (ft.): | 26E. Area of deck (ft2): | 26F. For column supported | 26G. For column supported |

# Attachment G: Storage Vessel Emission Unit Data Sheet (Condensate)

*Provide the following information for each new or modified bulk liquid storage tank.*

| | | | |
|---|---|---|---|
| **SITE INFORMATION:** | | | |
| 27. Provide the city and state on which the data in this section are based: Charleston, WV | | | |
| 28. Daily Avg. Ambient Temperature (°F): 55.3 | | 29. Annual Avg. Maximum Temperature (°F): 75.94 | |
| 30. Annual Avg. Minimum Temperature (°F): 65.9 | | 31. Avg. Wind Speed (mph): 5.9 | |
| 32. Annual Avg. Solar Insulation Factor (BTU/ft2-day): 1030.235999 | | 33. Atmospheric Pressure (psia): 14.8 | |
| **LIQUID INFORMATION:** | | | |
| 34. Avg. daily temperature range of bulk liquid (°F): 51.7 | 34A. Minimum (°F): 39.5 | 34B. Maximum (°F): 63.8 | |
| 35. Avg. operating pressure range of tank (psig): 0 | 35A. Minimum (psig): 0 | 35B. Maximum (psig): 0 | |
| 36A. Minimum liquid surface temperature (°F): 39.5 | | 36B. Corresponding vapor pressure (psia): | 0.7429 |
| 37A. Avg. liquid surface temperature (°F): 51.7 | | 37B. Corresponding vapor pressure (psia): | 0.9934 |
| 38A. Maximum liquid surface temperature (°F): 63.8 | | 38B. Corresponding vapor pressure (psia): | 1.3075 |
| 39. Provide the following for each liquid or gas to be stored in the tank. Add additional pages if necessary. | | | |
| 39A. Material name and composition: | Condensate | | |
| 39B. CAS number: | mix of HC | | |
| 39C. Liquid density (lb/gal): | 5.77 | | |
| 39D. Liquid molecular weight (lb/lb-mole): | 97.4 | | |
| 39E. Vapor molecular weight (lb/lb-mole): | 41.94 | | |
| 39F. Maximum true vapor pressure (psia): | 1.5672 | | |
| 39G. Max Reid vapor pressure (psi): | 2.65000 | | |
| 39H. Months Storage per year. From: To: | year round | | |

# Attachment G: Storage Vessel Emission Unit Data Sheet (Produced Water)

*Provide the following information for each new or modified bulk liquid storage tank.*

**I. GENERAL INFORMATION (required)**

| | |
|---|---|
| 1. Bulk Storage Area Name PWTANK | 2. Tank Name TANKPW001-002 |
| 3. Emission Unit ID number TANKPW001-002 | 4. Emission Point ID number EP-EC001 |
| 5. Date Installed or Modified *(for existing tanks):* New | 6. Type of change: NA |
| 7A. Description of Tank Modification *(if applicable)* NA | |
| 7B. Will more than one material be stored in this tank? *If so, a separate form must be completed for each material.* No | |
| 7C. Provide any limitations on source operation affecting emissions. (production variation, etc.) | |

**II. TANK INFORMATION (required)**

| | |
|---|---|
| 8. Design Capacity *(specify barrels or gallons).* Use the internal cross-sectional area multiplied by internal height. 400bbls | |
| 9A. Tank Internal Diameter (ft.) 12 | 9B. Tank Internal Height (ft.) 20 |
| 10A. Maximum Liquid Height (ft.) 18 | 10B. Average Liquid Height (ft.) 10 |
| 11A. Maximum Vapor Space Height (ft.) 18 | 11B. Average Vapor Space Height (ft.) 10 |
| 12. Nominal Capacity *(specify barrels or gallons)* . This is also known as "working volume." 400bbls | |
| 13A. Maximum annual throughput (gal/yr) 211,554,000 | 13B. Maximum daily throughput (gal/day) 579,600 |
| 14. Number of tank turnovers per year 6297 | 15. Maximum tank fill rate (gal/min) 168 |
| 16. Tank fill method Splash Fill | |
| 17. Is the tank system a variable vapor space system? No<br>If yes, (A) What is the volume expansion capacity of the system (gal)?<br>(B) What are the number of transfers into the system per year? | |
| 18. Type of tank (check all that apply):<br>X Fixed Roof X vertical horizontal X flat roof cone roof dome roof other (describe)<br>External Floating Roof pontoon roof double deck roof Domed External (or Covered) Floating Roof<br>Internal Floating Roof vertical column support self-supporting Variable Vapor Space lifter roof diaphragm<br>Pressurized spherical cylindrical Underground<br>Other (describe) | |

**III. TANK CONSTRUCTION AND OPERATION INFORMATION** *(check which one applies)*

Refer to enclosed TANKS Summary Sheets

X Refer to the responses to items 19 – 26 in section VII

**IV. SITE INFORMATION** *(check which one applies)*

Refer to enclosed TANKS Summary Sheets

X Refer to the responses to items 27 – 33 in section VII

**V. LIQUID INFORMATION** *(check which one applies)*

Refer to enclosed TANKS Summary Sheets

X Refer to the responses to items 34 – 39 in section VII

## Attachment G: Storage Vessel Emission Unit Data Sheet (Produced Water)

*Provide the following information for each new or modified bulk liquid storage tank.*

**VI. EMISSIONS AND CONTROL DEVICE DATA (required)**

40. Emission Control Devices (check as many as apply):

Does Not Apply — Rupture Disc (psig)

Carbon Adsorption[1] — Inert Gas Blanket of _____

X Vent to Vapor Combustion Device1 (vapor combustors, flares, thermal oxidizers) Condenser[1]

Conservation Vent (psig

Other[1] (describe) — Vacuum Setting — Pressure Setting Emergency Relief Valve (psig)

[1] Complete appropriate Air Pollution Control Device Sheet

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

| Material Name and CAS No. | Flashing Loss | | Breathing Loss | | Working Loss | | Total Emissions Loss | | |
|---|---|---|---|---|---|---|---|---|---|
| | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | |
| | ***Please see Tables 6 and 7*** | | | | | | | | |
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1 EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

*Remember to attach emissions calculations, including TANKS Summary Sheets and other modeling summary sheets if applicable.*

**SECTION VII (required if did not provide TANKS Summary Sheets)**

| **TANK CONSTRUCTION AND OPERATION INFORMATION** | | |
|---|---|---|
| 19. Tank Shell Construction: Steel | | |
| 20A. Shell Color: Green | 20B. Roof Color: Green | 20C. Year Last Painted: 2016 |
| 21. Shell Condition (if metal and unlined): No Rust | | |
| 22A. Is the tank heated? No | 22B. If yes, operating temperature: | 22C. If yes, how is heat provided to tank? |
| 23. Operating Pressure Range (psig): 0 | | |
| 24. Is the tank a **Vertical Fixed Roof Tank**? Yes | 24A. If yes, for dome roof provide radius (ft): | 24B. If yes, for cone roof, provide slop (ft/ft): |
| 25. Complete item 25 for **Floating Roof Tanks** Does not apply | | |
| 25A. Year Internal Floaters Installed: | | |
| 25B. Primary Seal Type *(check one):* Metallic (mechanical) shoe seal Liquid mounted resilient seal | | |
| 25C. Is the Floating Roof equipped with a secondary seal? Yes No | | |
| 25D. If yes, how is the secondary seal mounted? *(check one)* Shoe Rim Other (describe): | | |
| 25E. Is the floating roof equipped with a weather shield? Yes No | | |
| 25F. Describe deck fittings: | | |
| 26. Complete the following section for **Internal Floating Roof Tanks** Does not apply | | |
| 26A. Deck Type: Bolted Welded | 26B. For bolted decks, provide deck construction: | |
| 26C. Deck seam. Continuous sheet construction: | | |
| 26D. Deck seam length (ft.): | 26E. Area of deck (ft2): | 26F. For column supported 26G. For column supported |

# Attachment G: Storage Vessel Emission Unit Data Sheet (Produced Water)

*Provide the following information for each new or modified bulk liquid storage tank.*

| | | | |
|---|---|---|---|
| **SITE INFORMATION:** | | | |
| 27. Provide the city and state on which the data in this section are based: Charleston, WV | | | |
| 28. Daily Avg. Ambient Temperature (°F): 55.3 | | 29. Annual Avg. Maximum Temperature (°F): 75.94 | |
| 30. Annual Avg. Minimum Temperature (°F): 65.9 | | 31. Avg. Wind Speed (mph): 5.9 | |
| 32. Annual Avg. Solar Insulation Factor (BTU/ft2-day): 1030.235999 | | 33. Atmospheric Pressure (psia): 14.8 | |
| **LIQUID INFORMATION:** | | | |
| 34. Avg. daily temperature range of bulk liquid (°F): 51.7 | 34A. Minimum (°F): 39.5 | 34B. Maximum (°F): 63.8 | |
| 35. Avg. operating pressure range of tank (psig): 0 | 35A. Minimum (psig): 0 | 35B. Maximum (psig): 0 | |
| 36A. Minimum liquid surface temperature (°F): 39.5 | | 36B. Corresponding vapor pressure (psia): | 0.1837 |
| 37A. Avg. liquid surface temperature (°F): 51.7 | | 37B. Corresponding vapor pressure (psia): | 0.2596 |
| 38A. Maximum liquid surface temperature (°F): 63.8 | | 38B. Corresponding vapor pressure (psia): | 0.3600 |
| 39. Provide the following for each liquid or gas to be stored in the tank. Add additional pages if necessary. | | | |
| 39A. Material name and composition: | Produced Water | | |
| 39B. CAS number: | mix of HC and water | | |
| 39C. Liquid density (lb/gal): | 8.33 | | |
| 39D. Liquid molecular weight (lb/lb-mole): | 18.0156 | | |
| 39E. Vapor molecular weight (lb/lb-mole): | 18.3250 | | |
| 39F. Maximum true vapor pressure (psia): | 0.4467 | | |
| 39G. Max Reid vapor pressure (psi): | 1.02325 | | |
| 39H. Months Storage per year. From: To: | year round | | |

## Attachment G: Natural Gas Fired Fuel Burning Units

## Emission Data Sheet

*Complete the information on this data for each Gas Producing Unit(s), Heater Treater(s), and in-line heater(s) at the production pad. Reboiler information should be entered on the Glycol Dehydration Emission Unit Data Sheet.*

| Emission Unit ID #[1] | Emission Point ID#[2] | Emission Unit Description (Manufacturer / Model #) | Year Installed/ Modified | Type[3] and Date of Change | Control Device[4] | Design Heat Input (mmBtu/hr)[5] | Fuel Heating Value (Btu/scf)[6] |
|---|---|---|---|---|---|---|---|
| H001 | EP-H001 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| H002 | EP-H002 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| H003 | EP-H003 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| H004 | EP-H004 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| H005 | EP-H005 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| H006 | EP-H006 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| H007 | EP-H007 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| H008 | EP-H008 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| H009 | EP-H009 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| H010 | EP-H010 | Gas Production Unit Heater | 2016 | New | -- | 1.50 | 1,247.06 |
| ENG001 | EP-ENG001 | Engine (Kubota DG972-E2) | 2016 | New | -- | -- | 1,247.06 |
| EC001 | EP-EC001 | Enclosed Combustor (Cimarron) | 2016 | New | EP-EC001 | 6.6 | 1,247.06 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

1 Enter the appropriate Emission Unit (or Sources) identification numbers for each fuel burning unit located at the production pad. Gas Producing Unit Burners should be designated GPU-1, GPU-2, etc. Heater Treaters should be designated HT-1, HT-2, etc. Heaters or Line Heaters should be designated LH-1, LH-2, etc. For sources, use 1S, 2S, 3S…or other appropriate designation. Enter glycol dehydration unit Reboiler Vent data on the Glycol Dehydration Unit Data Sheet.

2 Enter the appropriate Emission Point identification numbers for each fuel burning unit located at the production pad. Gas Producing Unit Burners should be designated GPU-1, GPU-2, etc. Heater Treaters should be designated HT-1, HT-2, etc. Heaters or Line Heaters should be designated LH-1, LH-2, etc. For emission points, use 1E, 2E, 3E…or other appropriate designation.

3 New, modification, removal.

4 Complete appropriate air pollution control device sheet for any control device.

5 Enter design heat input capacity in mmBtu/hr.

6 Enter the fuel heating value in Btu/standard cubic foot.

## Attachment G: Natural Gas-Fired Compressor Engine (RICE)

## Emission Unit Data Sheet

*Complete this section for any natural gas-fired reciprocating internal combustion engine.*

| | | | |
|---|---|---|---|
| Emission Unit (Source) ID No. | | ENG001 | |
| Emission Point ID No. | | EP-ENG001 | |
| Engine Manufacturer and Model | | Engine (Kubota DG972-E2) | |
| Manufacturer's Rated bhp/rpm | | 24 HP @ 3600 rpm | |
| Source Status | | NS | |
| Date Installed/Modified/Removed | | January 2016 | |
| Engine Manufactured/Reconstruction Date | | 2013 | |
| Is this engine subject to 40CFR60, Subpart JJJJ? | | Yes | |
| Is this a Certified Stationary Spark Ignition Engine according to 40CFR60, Subpart JJJJ? (Yes or No) | | Yes | |
| Is this engine subject to 40CFR63, Subpart ZZZZ? (yes or no) | | Yes | |
| Engine, Fuel and Combustion Data | Engine Type | RB4S | |
| | APCD Type | - | |
| | Fuel Type | RG | |
| | H2S (gr/100 scf) | 0 | |
| | Operating bhp/rpm | 16.5 HP @ 2400 rpm | |
| | BSFC (Btu/bhp-hr) | 9773 | |
| | Fuel throughput ($ft^3$/hr) | 193 | |
| | Fuel throughput ($MMft^3$/yr) | 1.6907 | |
| | Operation (hrs/yr) | 8760 | |
| Reference | Potential Emissions | lbs/hr | tons/yr |
| MD | $NO_X$ | 0.3158 | 1.3831 |
| MD | CO | 5.6445 | 24.7228 |
| AP | VOC | 0.0071 | 0.0311 |
| AP | $SO_2$ | 0.0001 | 0.0006 |
| AP | $PM_{10}$ | 0.0024 | 0.0104 |
| AP | Formaldehyde | 0.0049 | 0.0215 |
| MRR | Proposed Monitoring: | Monitor engine setting adjustments to ensure these are consistent with manufacturer's instructions. | |
| | Proposed Recordkeeping: | 1) Maintain records of maintenance performed on engines.<br>2) Documentation from manufacturer that engine is certified to meet emission standards | |
| | Proposed Reporting: | N/A | |

## Attachment G: Tank Truck Loading
## Emissions Unit Data Sheet

*Furnish the following information for each new or modified bulk liquid transfer area or loading rack at the natural gas production pad.*
*This form is to be used for bulk liquid transfer operations to tank trucks.*

| 1. Emission Unit ID: L001, L002 | 2. Emission Point ID: EP-L001, EP-L002 | 3. Year Installed/ Modified: 2016 |
|---|---|---|

4. Emission Unit Description: CONDENSATE AND PRODUCED WATER

5. Loading Area Data

| 5A. Number of pumps: 4 | 5B. Number of liquids loaded: 2 | 5C. Maximum number of tank trucks loading at one time: 4 |
|---|---|---|

6. Describe cleaning location, compounds and procedure for tank trucks: For hire tank trucks are used and are cleaned at the operator's dispatch terminal. These trucks are in dedicated service and cleaned only prior to repair or leak tests. Cleaning materials include water, steam, detergent, and solvents which are applied using hand held pressurized spray nozzles.

7. Are tank trucks pressure tested for leaks at this or any other location?
X Yes No
If YES, describe: Tank trucks are pressure tested for leaks at the location of the leak testing company. Trucks are tested using EPA Method 27-internal vapor valve test and issued certification that DOT requirements are met.

8. Projected Maximum Operating Schedule (for rack or transfer point as a whole):

| Maximum | Jan. - Mar. | Apr. - June | July - Sept. | Oct. - Dec. |
|---|---|---|---|---|
| hours/day | 16 | 16 | 16 | 16 |
| days/week | 7 | 7 | 7 | 7 |

9. Bulk Liquid Data *(add pages as necessary)*

| Liquid Name | | Condensate | Produced Water | |
|---|---|---|---|---|
| Max. daily throughput (1000 gal/day) | | 48.3 | 579.6 | |
| Max. annual throughput (1000 gal/yr) | | 17,629.50 | 211,554.00 | |
| Loading Method [1] | | BF | BF | |
| Max. Fill Rate (gal/min) | | 168 | 168 | |
| Average Fill Time (min/loading) | | 50 | 50 | |
| Max. Bulk Liquid Temperature ($^{o}$F) | | 72.1 | 72.1 | |
| True Vapor Pressure [2] | | 1.57 | 0.45 | |
| Cargo Vessel Condition [3] | | U | U | |
| Control Equipment or Method [4] | | None | None | |
| Minimum collection efficiency (%) | | 0 | 0 | |
| Minimum control efficiency (%) | | 0 | 0 | |
| Maximum Emission Rate | Loading (lb/hr) | 9.31 | 1.16 | |
| | Annual (ton/yr) | 8.15 | 12.17 | |
| Estimation Method [5] | | Promax | Promax | |

Notes:

1 BF = Bottom Fill SP = Splash Fill SUB = Submerged Fill

2 At maximum bulk liquid temperature

3 B = Ballasted Vessel, C = Cleaned, U = Uncleaned (dedicated service), O = other (describe)

4 List as many as apply (complete and submit appropriate *Air Pollution Control Device Sheets as Attachment "H"* ):
CA = Carbon Adsorption
VB = Dedicated Vapor Balance (closed system) ECD = Enclosed Combustion Device
F = Flare
TO = Thermal Oxidation or Incineration

5 EPA = EPA Emission Factor as stated in AP-42

10. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**

| MONITORING | RECORDKEEPING |
|---|---|
| 1) Visual inspection to ensure that loading connections from storage tanks to trucks are leak-free. | 1) Maintain records of condensate transferred from storage tanks.<br>2) Maintain records of produced water transferred from storage tanks. |
| REPORTING<br>N/A | TESTING<br>N/A |

11. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty: N/A

# Attachment H

## Air Pollution Control Device Data Sheet

# Attachment H: Air Pollution Control Device

## Vapor Combustion Control Device Sheet

*Complete this vapor combustion control device sheet for each enclosed combustion device, flare, thermal oxidizer, or completion combustion device that is located at the natural gas production pad for the purpose of thermally destructing waste gas to control emissions of regulated pollutants to the atmosphere.*

**IMPORTANT: READ THE INSTRUCTIONS ACCOMPANYING THIS FORM BEFORE COMPLETING.**

**General Information**

| 1. Control Device ID#: | 2. Installation Date: New |
|---|---|
| EC001 | |

| 3. Maximum Rated Total Flow Capacity: | 4. Maximum Design Heat Input: | 5. Design Heat Content: |
|---|---|---|
| 131,000 scfd | 6.6 MMBtu/hr | 2300 BTU/scf |

**Control Device Information**

6. Select the type of vapor combustion control device being used: Enclosed Combustor

| 7. Manufacturer: Model No. Cimarron Model No. 48" HV ECD | 8. Hours of operation per year: 8760 |
|---|---|

9. List the emission units whose emissions are controlled by this vapor combustion control device: (Emission Point ID#:)

| 10. Emission Unit ID# | Emission Source Description: | Emission Unit ID# | Emission Source Description: |
|---|---|---|---|
| TANKCOND001-010 | Condensate Tank | | |
| TANKPW001-002 | PW Tanks | | |
| | | | |

*If this vapor combustor controls emissions from more than six emission units, please attach additional pages.*

| 11. Assist Type | 12. Flare Height (ft) | 13. Tip Diameter (ft) | 14. Was the design per §60.18? |
|---|---|---|---|
| Steam - Air - Pressure - X Non - | 25 | 3.33 | Yes |

**Waste Gas Information**

| 15. Maximum waste gas flow rate (scfm): | 16. Heat value of waste gas stream (BTU/ft3) | 17. Temperature of the emissions stream (°F) | 18. Exit Velocity of the emissions stream (ft/s) |
|---|---|---|---|
| 87.78 | 1,792.39 | 900 | 1.68E-01 |

19. Provide an attachment with the characteristics of the waste gas stream to be burned.

**Pilot Information**

| 20. Type/Grade of pilot fuel: | 21. Number of pilot lights: | 22. Fuel flow rate to pilot flame per pilot (scf/hr): | 23. Heat input per pilot (BTU/hr): | 24. Will automatic re-ignition be used? |
|---|---|---|---|---|
| Natural Gas | 1 | 12.6 | 12800 | Yes |

25. If automatic re-ignition will be used, describe the method: Based on a monitoring system

26. Describe the method of controlling flame: Flame Rectification, a thermocouple equivalent

| 27. Is pilot flame equipped with a monitor to detect the presence of the flame? Yes | 28. If yes, what type? Thermocouple |
|---|---|

| 29. Pollutant(s) Controlled | 30. % Capture Efficiency | 31. Manufacturer's Guaranteed Control Efficiency (%) |
|---|---|---|
| F/W/B Emissions from TANKCOND | 98 | 98 |
| F/W/B Emissions from TANKPW | 98 | 98 |
| | | |
| | | |

# Attachment H: Air Pollution Control Device

## Vapor Combustion Control Device Sheet

*Complete this vapor combustion control device sheet for each enclosed combustion device, flare, thermal oxidizer, or completion combustion device that is located at the natural gas production pad for the purpose of thermally destructing waste gas to control emissions of regulated pollutants to the atmosphere.*

32. Has the control device been tested by the manufacturer and certified? Yes, see spec sheet.

33. Describe all operating ranges and maintenance procedures required by the manufacturer to maintain warranty: See spec sheet for operating ranges.

MONITORING

1) Report any period when visible emissions exceeded 5 minutes during any two-hour period.
2) Monitor the presence of pilot flame at all times with the Flame rectification system, a thermocouple equivalent.
3) Monitor visible emissions from the vapor combustor.
4) Monitor throughput to the vapor combustor.

RECORDKEEPING

1) Record the times and duration of periods when the pilot flame was not present.
2) Records of throughput to the vapor combustor.
3) Records of vapor combustor malfunction or shutdown which resulted in excess emissions.
4) Records of vapor combustor inspection and maintenance activities conducted.

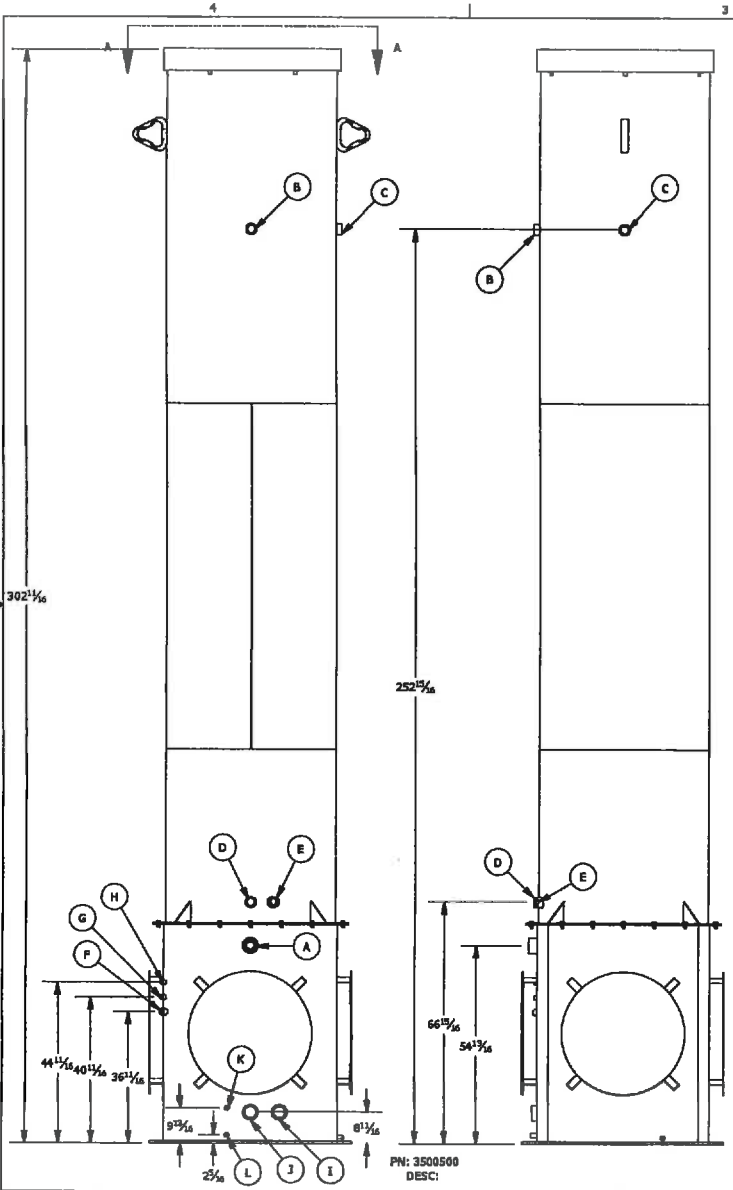
REPORTING

1) Report any period when visible emissions exceeded 5 minutes during any two-hour period.

34. Additional Information Attached? **YES**

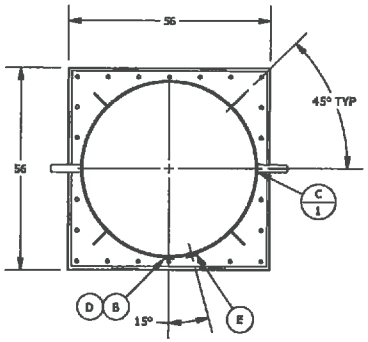
*Please attach a copy of manufacturer's data sheet. Please attach a copy of manufacturer's drawing.*
*Please attach a copy of the manufacturer's performance testing.*

**If any of the requested information is not available, please contact the manufacturer.**




48" DIA x 302 5/8" HEIGHT, 88 ORIFICES EMISSION CONTROL DEVICE

* >98% TVOC DRE, CERTIFIED USEPA 40 CFR 60, APPENDIX A, SOURCE EMMISIONS TEST METHODS REFERENCED. MEETS ALL EPA & CDPHE REGULATIONS.
* DESTROYS OIL/CONDENSATE PRODUCTION TANK VAPORS W/ NO VISIBLE FLAME.
* EXCELLENT OPACITY AND SMOKELESS OPERATION.
* RELIABLE AND CUSTOMIZABLE IGNITION.
* VERY LOW CAPITAL AND OPERATING COST.
* EASY TO OPERATE AND MAINTAIN.
* FIELD TESTED TO DESTROY UP TO 119.5 MDSCFD (131 MCFD) @ 10 oz/in$^2$; 2300 BTU/CF WASTE GAS (SG 1.45)
* STRUCTURE CERTIFIED FOR 90 MPH 3-SEC WIND GUST PER ASCE 7-05 & IBC 2006 STANDARDS. HIGHER WIND LOAD RATED STRUCTURES AVAILABLE.




VIEW A-A

PN: 3500500
DESC:

| SCHEDULE OF NOZZLES | | | | |
|---|---|---|---|---|
| MARK | QTY | DESCRIPTION | SERIES | SERVICE |
| A | 1 | 3" HALF COUPLING | 2000# | BURNER WASTE GAS IN |
| B | 1 | 2" FULL COUPLING | 3000# | FLOW TEST/AUTOMATION |
| C | 1 | 2" FULL COUPLING | 3000# | FLOW TEST/AUTOMATION |
| D | 1 | 2" FULL COUPLING | 3000# | SIGHT GLASS |
| E | 1 | 2" FULL COUPLING | 3000# | MANUAL LIGHTING |
| F | 1 | 1" FULL COUPLING | 3000# | PILOT GAS IN |
| G | 1 | 1/2" FULL COUPLING | 3000# | IGNITOR CABLE |
| H | 1 | 1/2" FULL COUPLING | 3000# | AUTOMATION |
| I | 1 | 3" HALF COUPLING | 3000# | DRIP TANK WASTE GAS IN |
| J | 1 | 3" HALF COUPLING | 3000# | DRIP TANK WASTE GAS OUT |
| K | 1 | 1/2" FULL COUPLING | 3000# | AUTOMATION |
| L | 1 | 1/2" FULL COUPLING | 3000# | LIQUID DRAIN |

UNLESS OTHERWISE SPECIFIED

1. REMOVE ALL BURRS AND SHARP CORNERS.
2. COR. RAD .03
3. DO NOT SCALE DRAWING.
4. ALL DIMENSIONS ARE IN INCHES.
5. MACHINE FIN.
6. FABRICATION
   .X = ± 0.25
   .XX = ± 0.125
   .XXX = ± 0.06
   ANGLES ± 3°
7. MACHINE
   .X = ±0.030
   .XX = ±0.015
   .XXX = ±0.005
   ANGLES ±1/2°
   CONTRICITY WITHIN 0.010 TIR

APPROVED FOR A.S.M.E CODE, SECTION VIII DIV 1
_____ED,_____ ADDENDA BY_____ DATE_____

CIMARRON
Energy Inc.

TITLE:
48" HIGH VOLUME ECD

| DATE: | WO No.: | SHEET: 1 OF 1 |
|---|---|---|

DRAWN BY: TDS | REV. | DRAW NO.: 3500500

# Attachment I

## Emission Calculations

**Table 1**

**Facility Information**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| Oil and Gas Site General Information |
|---|

| Administrative Information | |
|---|---|
| Company Name | Antero Resources Corporation |
| Facility/Well Name | Edna Monroe Well Pad |
| Nearest City/Town | Middlebourne |
| API Number/SIC Code | 1311 |
| Latitude/Longitude | 39.422626, -80.873179 |
| County | Tyler County |

| Technical Information | |
|---|---|
| Max Condensate Site Throughput (bbl/day): | 1,150 |
| Max Produced Water Site Throughput (bbl/day): | 13,800 |
| Are there any sour gas streams at this site? | No |
| Is this site currently operational/producing? | No |

| Equipment/Processes at Site | |
|---|---|
| **Equipment/Process Types** | **How many for this site?** |
| Fugitives | 10 |
| IC Engines | 1 |
| Turbines | 0 |
| Diesel Engines | 0 |
| Gas Production Unit Heaters | 10 |
| Condensate Tanks | 10 |
| Produced Water Tanks | 2 |
| Miscellaneous Tanks | 0 |
| Loading Jobs | 2 |
| Glycol Units | 0 |
| Amine Units | 0 |
| Enclosed Combustors-Vapor Combustors | 1 |

**Table 2**

**Uncontrolled/Controlled Emissions Summary**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| Emission Source | VOC | | $NO_x$ | | $CO_{2e}$ | | CO | | $SO_2$ | | $PM_{2.5}$ | | $PM_{10}$ | | Lead | | Total HAPs | | Benzene | | Xylenes | | Formaldehyde | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) | (lbs/hr) | (ton/yr) |
| **UNCONTROLLED (Fugitives, Storage Tanks, Gas Production Unit Heaters)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Fugitive Emissions (Component Count, PCV and Hauling)[1] | 3.9015 | 17.0884 | | | 89.969 | 394.06 | | | | | | | 0.5981 | 3.7673 | | | 0.3384 | 1.4821 | 0.0023 | 0.0103 | 7.33E-02 | 3.21E-01 | | |
| Flashing, Working and Breathing (F/W/B) Losses[2] | 280.21 | 1,227.3 | | | 1,761.4 | 7,715.1 | | | | | | | | | | | 7.001 | 30.666 | 0.2081 | 0.9114 | 0.4858 | 2.1276 | | |
| Engine Emissions[3] | 0.0071 | 0.0311 | 0.3158 | 1.3831 | 27.78 | 121.66 | 5.6445 | 24.7228 | 0.0001 | 0.0006 | 0.0024 | 0.0104 | 0.0023 | 0.0100 | | | 0.0055 | 0.0241 | 0.0004 | 0.0017 | 0.0000 | 0.0002 | 0.0049 | 0.0215 |
| Gas Production Unit Heater Emissions[4] | 0.0662 | 0.2898 | 1.2028 | 5.2684 | 1,451.97 | 6,359.64 | 1.0104 | 4.4254 | 0.0072 | 0.0316 | 0.0914 | 0.4004 | 0.0914 | 0.4004 | 6.01E-06 | 2.63E-05 | 2.26E-02 | 9.92E-02 | 2.53E-05 | 1.11E-04 | | | 0.0009 | 0.0040 |
| **TOTALS:** | **284.1815** | **1244.7148** | **1.5186** | **6.6515** | **3331.1620** | **14590.4895** | **6.6549** | **29.1482** | **0.0074** | **0.0322** | **0.0938** | **0.4108** | **0.6918** | **4.1777** | **6.01E-06** | **2.63E-05** | **7.3680** | **32.2717** | **0.2108** | **0.9235** | **0.5591** | **2.4487** | **0.0058** | **0.0255** |
| **UNCONTROLLED (Truck Loading Emissions)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Truck Loading Emissions[5] | 6.285 | 5.508 | | | 3.229 | 12.361 | | | | | | | | | | | 0.0129 | 0.0113 | 1.98E-04 | 1.83E-04 | 0.0022 | 0.0019 | | |
| **CONTROLLED EMISSIONS** | | | | | | | | | | | | | | | | | | | | | | | | |
| Enclosed Combustor Emissions (from F/W/B losses)[6] | 5.6042 | 24.5464 | 0.5279 | 2.3124 | 2679.5754 | 11736.5401 | 0.4435 | 1.9424 | 7.56E-06 | 3.31E-05 | 0.0301 | 0.1318 | 0.0401 | 0.1757 | 2.64E-06 | 1.16E-05 | 0.1401 | 0.6134 | 4.16E-03 | 1.82E-02 | 0.0097 | 0.0426 | 9.45E-07 | 4.14E-06 |
| Controlled Fugitive Emissions from Hauling | | | | | | | | | | | | | 0.2990 | 1.8837 | | | | | | | | | | |
| **TOTALS:** | **5.6042** | **24.5464** | **0.5279** | **2.3124** | **2679.5754** | **11736.5401** | **0.4435** | **1.9424** | **7.56E-06** | **3.31E-05** | **0.0301** | **0.1318** | **0.3392** | **2.0594** | **2.64E-06** | **1.16E-05** | **0.1401** | **0.6134** | **0.0042** | **0.0182** | **0.0097** | **0.0426** | **9.45E-07** | **4.14E-06** |
| **POTENTIAL TO EMIT[7]** | **9.5789** | **47.4637** | **2.0465** | **8.9639** | **4249.2926** | **18624.2631** | **7.0983** | **31.0906** | **0.0074** | **0.0323** | **0.1239** | **0.5426** | **0.4329** | **2.4698** | **8.65E-06** | **3.79E-05** | **0.5066** | **2.2301** | **0.0069** | **0.0305** | **0.0830** | **0.3655** | **0.0058** | **0.0255** |

| | |
|---|---|
| **Enter any notes here:** | 1 - See Tables 4 and 5 for fugitive emission calculations; Table 12 for PM emissions from hauling.<br>2 - See Tables 6 and 7 for tanks emission calculations.<br>3 - See Table 13 for engine emissions.<br>4 - See Table 9 for gas production unit heater emission calculations.<br>5 - The maximum emission was calculated based on tank truck capacity of 200 barrels and actual fill rate of 50 minutes per tank truck. At a production rate of 1150 barrels per day, VOC emissions would be 6.2848 pounds per hour when there is truck loading activity. Average hourly VOC emissions from truck loading per year is 1.2575 pound per hour.<br>6 - See Table 10 and 11 for enclosed combustor emission calculations.<br>7 - The hourly potential to emit is the sum of emissions from gas production unit heaters, engine, storage tanks, fugitives and flare. Does not include emissions from loading (see footnote 5). The total TPY PTE is the sum of all emissions.<br>PM 10 TPY is the sum of uncontrolled hauling and other PM10 sources. |

**Table 3**

**Permit Summary**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| Pollutant | | Emissions | | | Threshold Exceeded? | |
|---|---|---|---|---|---|---|
| | | Uncontrolled | Controlled | Threshold | Uncontrolled | Controlled |
| VOC | lbs/hr | 284.1815 | 9.5789 | 6 | **Yes** | **Yes** |
| | tons/yr | 1250.2228 | 47.4637 | 10 | **Yes** | **Yes** |
| $NO_X$ | lbs/hr | 1.5186 | 2.0465 | 6 | | |
| | tons/yr | 6.6515 | 8.9639 | 10 | | |
| CO | lbs/hr | 6.6549 | 7.0983 | 6 | **Yes** | **Yes** |
| | tons/yr | 29.1482 | 31.0906 | 10 | **Yes** | **Yes** |
| $SO_2$ | lbs/hr | 0.0074 | 0.0074 | 6 | | |
| | tons/yr | 0.0322 | 0.0323 | 10 | | |
| $PM_{2.5}$ | lbs/hr | 9.38E-02 | 1.24E-01 | 6 | | |
| | tons/yr | 4.11E-01 | 5.43E-01 | 10 | | |
| $PM_{10}$ | lbs/hr | 0.6918 | 0.4329 | 6 | | |
| | tons/yr | 4.1777 | 2.4698 | 10 | | |
| Lead | lbs/hr | 6.01E-06 | 8.65E-06 | 6 | | |
| | tons/yr | 2.63E-05 | 3.79E-05 | 10 | | |
| Total HAPs | lbs/hr | 7.3680 | 0.5066 | 2 | **Yes** | |
| | tons/yr | 32.2830 | 2.2301 | 5 | **Yes** | |
| Total TAPs | lbs/hr | 0.2167 | 0.0127 | 1.14 | | |
| n-Hexane | lbs/hr | 5.8168 | 0.3465 | | | |
| | tons/yr | 25.4850 | 1.5252 | | | |
| Toluene | lbs/hr | 0.4753 | 0.0273 | | | |
| | tons/yr | 2.0826 | 0.1204 | | | |
| Ethylbenzene | lbs/hr | 0.3001 | 0.0370 | | | |
| | tons/yr | 1.3155 | 0.1628 | | | |
| Xylenes | lbs/hr | 0.5591 | 0.0830 | | | |
| | tons/yr | 2.4506 | 0.3655 | | | |
| Benzene | lbs/hr | 0.2108 | 0.0069 | | | |
| | tons/yr | 0.9236 | 0.0305 | | | |

| | |
|---|---|
| **Enter any notes here:** | 1. Emissions are based on 98% Enclosed combustor DRE operating 100% of the time.<br>2. Please see Attachment C/O- Fugitive Emissions Data Summary Sheet and Attachment O – Emission Points Data Summary Sheet for sitewide sources and breakdown of emission quantities. |

**Table 4**

**Fugitive Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| | |
|---|---|
| VOC Type: | Condensate VOC |
| Emission Type: | Steady State (continuous) |

| | | |
|---|---|---|
| Gas Weight Fraction From Analysis: | VOC frac | 0.191 |
| | Benzene frac | 0.000 |
| | Toluene | 0.000 |
| | Ethylbenzene | 0.000 |
| | Xylenes | 0.000 |
| | n-Hexane | 0.023 |
| | Methane | 0.603 |

| Gas | | | | | |
|---|---|---|---|---|---|
| Number | Component | Pollutant | Emission Factor (kg/hr of THC per component) | kg/hr | lb/yr |
| 500 | Valves | Gas VOC | 0.004500 | 0.43 | 8,280.76 |
| | | Non VOC | 0.004500 | 1.82 | 35,081.24 |
| 590 | Connectors | VOC | 0.000200 | 0.02 | 434.28 |
| | | Non-VOC | 0.000200 | 0.10 | 1,839.82 |
| 130 | Flanges | VOC | 0.000390 | 0.01 | 186.59 |
| | | Non-VOC | 0.000390 | 0.04 | 790.50 |
| | | | **Total VOCs:** | 0.46 | 8,901.63 |
| | | | **Total THC:** | 2.42 | 46,613.19 |

| | | |
|---|---|---|
| Light Liquid Weight Fraction From Analysis: | VOC frac | 0.969 |
| | Benzene frac | 0.001 |
| | Toluene | 0.006 |
| | Ethylbenzene | 0.011 |
| | Xylenes | 0.026 |
| | n-hexane | 0.028 |
| | Methane | 0.011 |

| Light Liquid | | | | | |
|---|---|---|---|---|---|
| Number | Component | Pollutant | Emission Factor (kg/hr of THC per component) | kg/hr | lb/yr |
| 520 | Valves | Light Liquid VOC | 0.002500 | 1.26 | 24,272.31 |
| | | Light Liquid Non-VOC | | 0.04 | 781.29 |
| | | | **Total VOC:** | 1.26 | 24,272.31 |
| | | | **Total THC:** | 1.30 | 25,053.60 |

| Fugitive Total Emissions | | | |
|---|---|---|---|
| | Annual Emissions (lb/yr) | Annual Emissions (lb/hr) | Annual Emissions (tpy) |
| VOC | 33,173.94 | 3.79 | 16.59 |
| Ethylbenzene | | 0.03 | 0.14 |
| Toluene | | 0.02 | 0.08 |
| Xylenes | | 0.07 | 0.32 |
| n-Hexane | | 0.20 | 0.87 |
| TAPs (Benzene) | | 0.00 | 0.01 |
| HAPs | | 0.32 | 1.42 |
| $CO_{2e}$ | 708,997.62 | 80.94 | 354.50 |

| | |
|---|---|
| **Enter Notes Here:** | Fugitive emissions based on an estimated component count<br>Global Warming Potentials from EPA site<br>Reference to Emission factors used:<br>1. Emission factors are for oil and gas production facilities (not refineries) come from the EPA's "Protocol for Equipment Leak Emission Estimates" November 1995, EPA 4531, R-95-017, Table 2-4.<br>2. Percent of speciated VOCs used in fugitive calculations are based on the total hydrocarbons, not of the total sample. |

**Table 5**

**Pneumatic Control Valve Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| | |
|---|---|
| Number of PCVs | 40 |
| Bleed Rate (scf/day/PCV) | 6.6 |
| Total Bleed Rate (scf/day) | 264 |

| Component | Mol% | Molecular Weight (lb/lb-mole) | Component Flow (scf/day) | Component Moles (lb-moles) | Component Emissions (lbs/day) | (lbs/hr) | (tons/year) |
|---|---|---|---|---|---|---|---|
| H2S | 0 | 34.08 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nitrogen | 0.4946 | 14.01 | 1.305744 | 0.00 | 0.05 | 0.00 | 0.01 |
| Carbon Dioxide | 0.1467 | 44.01 | 0.387288 | 0.00 | 0.04 | 0.00 | 0.01 |
| Methane | 77.6927 | 16.04 | 205.108728 | 0.54 | 8.67 | 0.36 | 1.58 |
| Ethane | 14.1987 | 30.07 | 37.484568 | 0.10 | 2.97 | 0.12 | 0.54 |
| Propane | 4.4938 | 44.1 | 11.863632 | 0.03 | 1.38 | 0.06 | 0.25 |
| Isobutane | 0.5666 | 58.12 | 1.495824 | 0.00 | 0.23 | 0.01 | 0.04 |
| n-Butane | 1.1838 | 58.12 | 3.125232 | 0.01 | 0.48 | 0.02 | 0.09 |
| Isopentane | 0.3749 | 72.15 | 0.989736 | 0.00 | 0.19 | 0.01 | 0.03 |
| n-Pentane | 0.2914 | 72.15 | 0.769296 | 0.00 | 0.15 | 0.01 | 0.03 |
| 2-Methylpentane | 0 | 86.18 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3-Methylpentane | 0 | 86.18 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| n-Hexane | 0.5451 | 86.18 | 1.439064 | 0.00 | 0.33 | 0.01 | 0.06 |
| Methylcyclopentane | 0 | 84.16 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Benzene | 0 | 78.11 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2-Methylhexane | 0 | 100.2 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3-Methylhexane | 0 | 100.2 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Heptane | 0 | 100.21 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Methylcyclohexane | 0 | 98.186 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Toluene | 0 | 92.14 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Octane | 0 | 114.23 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ethylbenzene | 0 | 106.17 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| m & p-Xylene | 0 | 106.16 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| o-Xylene | 0 | 106.16 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nonane | 0 | 128.2 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| C10+ | 0 | 174.28 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |

| | lb/hr | tpy |
|---|---|---|
| VOC Emissions | 0.1145 | 0.5015 |
| Benzene Emissions | 0.0000 | 0.0000 |
| Toluene Emissions | 0.0000 | 0.0000 |
| Ethylbenzene Emissions | 0.0000 | 0.0000 |
| Xylene Emissions | 0.0000 | 0.0000 |
| n-Hexane Emissions | 0.0136 | 0.0596 |
| HAPs Emissions | 0.0136 | 0.0596 |
| TAPs Emissions | 0.0000 | 0.0000 |
| $CO_{2e}$ emissions | 9.0327 | 39.5633 |

| | |
|---|---|
| **Enter any notes here:** | 1. PCV bleed rate obtained from the user manual for PCV<br>http://issuu.com/rmcprocesscontrols/docs/mizer-pilot-operation--parts---installation-manual<br>2. Emissions per hour= Mol % x no. of PCV x bleed rate x MW / 379.48 / 24 |

**Table 6**

**Uncontrolled Flashing Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| # Hours Operational | 8760 |
|---|---|

| | Condensate Tank Flashing Losses | | | Produced Water Tank Flashing Losses | | |
|---|---|---|---|---|---|---|
| | Vapor Mass Fraction | Flashing Losses | | Vapor Mass Fraction | Flashing Losses | |
| | wt% | lbs/hr | tpy | wt% | lbs/hr | tpy |
| Water | 0.0995 | 0.3603 | 1.5782 | 2.7258 | 0.0000 | 0.0000 |
| H2S | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Nitrogen | 0.0061 | 0.0223 | 0.0975 | 0.3893 | 0.3427 | 1.5011 |
| Carbon Dioxide | 0.1298 | 0.4700 | 2.0587 | 2.0777 | 1.8290 | 8.0109 |
| Methane | 4.4478 | 16.1015 | 70.5245 | 61.3719 | 54.0258 | 236.6332 |
| Ethane | 25.1005 | 90.8670 | 397.9975 | 21.2881 | 18.7400 | 82.0811 |
| Propane | 30.7698 | 111.3906 | 487.8908 | 8.4858 | 7.4700 | 32.7188 |
| Isobutane | 7.4451 | 26.9522 | 118.0504 | 0.4697 | 0.4135 | 1.8109 |
| n-Butane | 13.9455 | 50.4844 | 221.1218 | 1.6811 | 1.4799 | 6.4819 |
| Isopentane | 5.1452 | 18.6263 | 81.5834 | 0.3736 | 0.3289 | 1.4405 |
| n-Pentane | 4.1372 | 14.9771 | 65.5995 | 0.2862 | 0.2520 | 1.1036 |
| 2-Methylpentane | 1.8226 | 6.5979 | 28.8987 | 0.0570 | 0.0502 | 0.2198 |
| 3-Methylpentane | 0.8846 | 3.2025 | 14.0270 | 0.0737 | 0.0649 | 0.2843 |
| n-Hexane | 1.5270 | 5.5278 | 24.2117 | 0.0377 | 0.0332 | 0.1455 |
| Methylcyclopentane | 0.3096 | 1.1207 | 4.9086 | 0.0751 | 0.0661 | 0.2895 |
| Benzene | 0.0414 | 0.1499 | 0.6566 | 0.0655 | 0.0577 | 0.2527 |
| 2-Methylhexane | 0.6707 | 2.4281 | 10.6350 | 0.0184 | 0.0162 | 0.0711 |
| 3-Methylhexane | 0.5226 | 1.8917 | 8.2857 | 0.0150 | 0.0132 | 0.0578 |
| Heptane | 0.9976 | 3.6115 | 15.8186 | 0.0300 | 0.0264 | 0.1157 |
| Methylcyclohexane | 0.5784 | 2.0937 | 9.1704 | 0.0922 | 0.0811 | 0.3553 |
| Toluene | 0.0922 | 0.3339 | 1.4627 | 0.1374 | 0.1209 | 0.5297 |
| Octane | 0.8869 | 3.2108 | 14.0631 | 0.0158 | 0.0139 | 0.0611 |
| Ethylbenzene | 0.0541 | 0.1960 | 0.8585 | 0.0795 | 0.0700 | 0.3067 |
| m & p-Xylene | 0.0324 | 0.1172 | 0.5134 | 0.0471 | 0.0415 | 0.1817 |
| o-Xylene | 0.0650 | 0.2355 | 1.0313 | 0.0980 | 0.0863 | 0.3780 |
| Nonane | 0.2258 | 0.8176 | 3.5809 | 0.0062 | 0.0055 | 0.0240 |
| C10+ | 0.0624 | 0.2260 | 0.9900 | 0.0019 | 0.0017 | 0.0075 |
| Total VOCs | 70.216 | 254.19 | 1,113.4 | 12.147 | 10.6932 | 46.8362 |
| Total $CO_{2e}$ | | 403.01 | 1,765.2 | | 1,352.47 | 5,923.8 |
| Total TAPs (Benzene) | | 0.1499 | 0.6566 | | 0.0577 | 0.2527 |
| Toluene | | 0.3339 | 1.4627 | | 0.1209 | 0.5297 |
| Ethylbenzene | | 0.1960 | 0.8585 | | 0.0700 | 0.3067 |
| Xylenes | | 0.3527 | 1.5448 | | 0.1278 | 0.5597 |
| n-Hexane | | 5.528 | 24.212 | | 0.0332 | 0.1455 |
| Total HAPs | | 6.560 | 28.734 | | 0.4096 | 1.7942 |
| Total | 100.00 | 362.01 | 1,585.6 | 100.00 | 85.631 | 375.06 |

| **Enter any notes here:** | Vapor mass fractions and Flashing losses from Promax output |
|---|---|

**Table 7**

**Uncontrolled Working and Breathing Losses**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| Condensate Tank Information | |
|---|---|
| Number of Tanks | 10 |
| Maximum Working Losses (lbs/hr) | 10.5760 |
| Maximum Breathing Losses (lbs/hr) | 12.1351 |

| | Condensate Tank W/B Losses | | | | | | |
|---|---|---|---|---|---|---|---|
| | Vapor Mass Fraction | Working Losses | | Breathing Losses | | Max W/B Losses | |
| | wt% | lbs/hr | tpy | lbs/hr | tpy | lbs/hr | tpy |
| H2S | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Nitrogen | 0.0002 | 0.0000 | 0.0001 | 0.0000 | 0.0001 | 0.0001 | 0.0002 |
| Carbon Dioxide | 0.1372 | 0.0145 | 0.0636 | 0.0167 | 0.0730 | 0.0312 | 0.1365 |
| Methane | 0.9553 | 0.1010 | 0.4425 | 0.1159 | 0.5078 | 0.2170 | 0.9503 |
| Ethane | 31.4443 | 3.3256 | 14.5659 | 3.8158 | 16.7132 | 7.1414 | 31.2791 |
| Propane | 32.7228 | 3.4608 | 15.1582 | 3.9709 | 17.3927 | 7.4317 | 32.5509 |
| Isobutane | 7.3520 | 0.7776 | 3.4057 | 0.8922 | 3.9077 | 1.6697 | 7.3134 |
| n-Butane | 13.5387 | 1.4319 | 6.2715 | 1.6429 | 7.1960 | 3.0748 | 13.4676 |
| Isopentane | 4.7333 | 0.5006 | 2.1926 | 0.5744 | 2.5158 | 1.0750 | 4.7085 |
| n-Pentane | 3.7605 | 0.3977 | 1.7420 | 0.4563 | 1.9988 | 0.8541 | 3.7408 |
| 2-Methylpentane | 1.6221 | 0.1716 | 0.7514 | 0.1968 | 0.8622 | 0.3684 | 1.6136 |
| 3-Methylpentane | 0.7852 | 0.0830 | 0.3637 | 0.0953 | 0.4174 | 0.1783 | 0.7811 |
| n-Hexane | 0.0922 | 0.0097 | 0.0427 | 0.0112 | 0.0490 | 0.0209 | 0.0917 |
| Methylcyclopentane | 0.2545 | 0.0269 | 0.1179 | 0.0309 | 0.1353 | 0.0578 | 0.2531 |
| Benzene | 0.0021 | 0.0002 | 0.0010 | 0.0003 | 0.0011 | 0.0005 | 0.0021 |
| 2-Methylhexane | 0.0378 | 0.0040 | 0.0175 | 0.0046 | 0.0201 | 0.0086 | 0.0376 |
| 3-Methylhexane | 0.4437 | 0.0469 | 0.2055 | 0.0538 | 0.2358 | 0.1008 | 0.4413 |
| Heptane | 0.7799 | 0.0825 | 0.3613 | 0.0946 | 0.4145 | 0.1771 | 0.7758 |
| Methylcyclohexane | 0.4564 | 0.0483 | 0.2114 | 0.0554 | 0.2426 | 0.1037 | 0.4540 |
| Toluene | 0.0100 | 0.0011 | 0.0046 | 0.0012 | 0.0053 | 0.0023 | 0.0099 |
| Octane | 0.6523 | 0.0690 | 0.3022 | 0.0792 | 0.3467 | 0.1481 | 0.6489 |
| Ethylbenzene | 0.0110 | 0.0012 | 0.0051 | 0.0013 | 0.0059 | 0.0025 | 0.0110 |
| m & p-Xylene | 0.0085 | 0.0009 | 0.0039 | 0.0010 | 0.0045 | 0.0019 | 0.0084 |
| o-Xylene | 0.0148 | 0.0016 | 0.0068 | 0.0018 | 0.0078 | 0.0034 | 0.0147 |
| Nonane | 0.1503 | 0.0159 | 0.0696 | 0.0182 | 0.0799 | 0.0341 | 0.1495 |
| C10+ | 0.0348 | 0.0037 | 0.0161 | 0.0042 | 0.0185 | 0.0079 | 0.0347 |
| Total VOCs | 67.463 | 7.1349 | 31.251 | 8.1867 | 35.8576 | 15.3216 | 67.108 |
| Total $CO_{2e}$ | | 2.5404 | 11.1267 | 2.9148 | 12.7670 | 5.4552 | 23.894 |
| Total TAPs (Benzene) | | 0.0002 | 0.0010 | 0.0003 | 0.0011 | 0.0005 | 0.0021 |
| Toluene | | 0.0011 | 0.0046 | 0.0012 | 0.0053 | 0.0023 | 0.0099 |
| Ethylbenzene | | 0.0012 | 0.0051 | 0.0013 | 0.0059 | 0.0025 | 0.0110 |
| Xylenes | | 0.0025 | 0.0108 | 0.0028 | 0.0124 | 0.0053 | 0.0231 |
| n-Hexane | | 0.0097 | 0.0427 | 0.0112 | 0.0490 | 0.0209 | 0.0917 |
| Total HAPs | | 0.0147 | 0.0642 | 0.0168 | 0.0736 | 0.0315 | 0.1378 |
| Total | 100.00 | 10.5760 | 46.3230 | 12.1351 | 53.1516 | 22.7111 | 99.475 |

**Table 7**

**Uncontrolled Working and Breathing Losses**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| Produced Water Tank Information | |
|---|---|
| Number of Tanks | 2 |
| Maximum Working Losses (lbs/hr) | 0.5856 |
| Maximum Breathing Losses (lbs/hr) | 0.0082 |

| | Produced Water Tank W/B Losses | | | | | | |
|---|---|---|---|---|---|---|---|
| | Vapor Mass Fraction | Working Losses | | Breathing Losses | | Max W/B Losses | |
| | wt% | lbs/hr | tpy | lbs/hr | tpy | lbs/hr | tpy |
| H2S | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Nitrogen | 0.0076 | 0.0000 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0002 |
| Carbon Dioxide | 2.7173 | 0.0159 | 0.0697 | 0.0002 | 0.0010 | 0.0161 | 0.0707 |
| Methane | 3.3104 | 0.0194 | 0.0849 | 0.0003 | 0.0012 | 0.0197 | 0.0861 |
| Ethane | 1.0597 | 0.0062 | 0.0272 | 0.0001 | 0.0004 | 0.0063 | 0.0276 |
| Propane | 0.1030 | 0.0006 | 0.0026 | 0.0000 | 0.0000 | 0.0006 | 0.0027 |
| Isobutane | 0.0007 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| n-Butane | 0.0038 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0001 |
| Isopentane | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| n-Pentane | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2-Methylpentane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3-Methylpentane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| n-Hexane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Methylcyclopentane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Benzene | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2-Methylhexane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3-Methylhexane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Heptane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Methylcyclohexane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Toluene | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Octane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Ethylbenzene | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| m & p-Xylene | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| o-Xylene | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Nonane | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| C10+ | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Total VOCs | 0.1082 | 0.0006 | 0.0028 | 0.0000 | 0.0000 | 0.0006 | 0.0028 |
| Total $CO_{2e}$ | | 0.5005 | 2.1923 | 0.0070 | 0.0307 | 0.5075 | 2.2230 |
| Total TAPs (Benzene) | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Toluene | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Ethylbenzene | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Xylenes | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| n-Hexane | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Total HAPs | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Total | 100.00 | 0.5856 | 2.5648 | 0.0082 | 0.0360 | 0.5938 | 2.6008 |

| **Enter any notes here:** | Vapor mass fractions, working losses and breathing losses from Promax output |
|---|---|

**Table 8**

**Loading Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| Annual Loading | Oil Truck Loading | Water Truck Loading |
|---|---|---|
| RVP | 2.65 | 1.0233 |
| Annual Average Temp (F) | 72.1 | 72.1 |
| S (saturation factor) | 0.6 | 0.6 |
| P (true vapor pressure) | 1.57 | 0.45 |
| M (MW of vapor) | 41.94 | 18.32 |
| Collection Efficiency (%) | 0 | 0 |
| Loading Loss (lb/10^3 gal)* | 0.92 | 0.12 |
| Maximum Throughput (gallons/hr) | 10,080 | 10,080 |
| Average Throughput (gallons/yr) | 17,629,500 | 211,554,000 |
| Loading Emissions (lbs/hr) | 9.31 | 1.16 |
| Loading Emissions (tpy) | 8.15 | 12.17 |

| | Condensate Tank Loading Losses | | | Produced Water Tank Loading Losses | | |
|---|---|---|---|---|---|---|
| | Vapor Mass Fraction | Loading Losses | | Vapor Mass Fraction | Loading Losses | |
| | wt% | lbs/hr | tpy | wt% | lbs/hr | tpy |
| H2S | 0.0000 | 0.00 | 0.00 | 0.0000 | 0.00E+00 | 0.00E+00 |
| Nitrogen | 0.0002 | 0.00 | 0.00 | 0.0076 | 8.77E-05 | 9.20E-04 |
| Carbon Dioxide | 0.1372 | 0.01 | 0.01 | 2.7173 | 3.15E-02 | 3.31E-01 |
| Methane | 0.9553 | 0.09 | 0.08 | 3.3104 | 3.84E-02 | 4.03E-01 |
| Ethane | 31.4443 | 2.93 | 2.56 | 1.0597 | 1.23E-02 | 1.29E-01 |
| Propane | 32.7228 | 3.05 | 2.67 | 0.1030 | 1.19E-03 | 1.25E-02 |
| Isobutane | 7.3520 | 0.68 | 0.60 | 0.0007 | 8.28E-06 | 8.69E-05 |
| n-Butane | 13.5387 | 1.26 | 1.10 | 0.0038 | 4.46E-05 | 4.68E-04 |
| Isopentane | 4.7333 | 0.44 | 0.39 | 0.0002 | 2.48E-06 | 2.61E-05 |
| n-Pentane | 3.7605 | 0.35 | 0.31 | 0.0001 | 1.39E-06 | 1.46E-05 |
| 2-Methylpentane | 1.6221 | 0.15 | 0.13 | 0.0000 | 5.28E-08 | 5.54E-07 |
| 3-Methylpentane | 0.7852 | 0.07 | 0.06 | 0.0000 | 1.65E-07 | 1.74E-06 |
| n-Hexane | 0.0922 | 0.01 | 0.01 | 0.0000 | 1.35E-09 | 1.42E-08 |
| Methylcyclopentane | 0.2545 | 0.02 | 0.02 | 0.0000 | 3.62E-07 | 3.80E-06 |
| Benzene | 0.0021 | 0.00 | 0.00 | 0.0001 | 9.72E-07 | 1.02E-05 |
| 2-Methylhexane | 0.0378 | 0.00 | 0.00 | 0.0000 | 2.80E-10 | 2.94E-09 |
| 3-Methylhexane | 0.4437 | 0.04 | 0.04 | 0.0000 | 3.41E-09 | 3.58E-08 |
| Heptane | 0.7799 | 0.07 | 0.06 | 0.0000 | 5.01E-09 | 5.25E-08 |
| Methylcyclohexane | 0.4564 | 0.04 | 0.04 | 0.0000 | 9.50E-08 | 9.97E-07 |
| Toluene | 0.0100 | 0.00 | 0.00 | 0.0001 | 9.80E-07 | 1.03E-05 |
| Octane | 0.6523 | 0.06 | 0.05 | 0.0000 | 5.15E-10 | 5.41E-09 |
| Ethylbenzene | 0.0110 | 0.00 | 0.00 | 0.0000 | 3.19E-07 | 3.35E-06 |
| m & p-Xylene | 0.0085 | 0.00 | 0.00 | 0.0000 | 2.11E-07 | 2.22E-06 |
| o-Xylene | 0.0148 | 0.00 | 0.00 | 0.0000 | 4.59E-07 | 4.82E-06 |
| Nonane | 0.1503 | 0.01 | 0.01 | 0.0000 | 9.55E-11 | 1.00E-09 |
| C10+ | 0.0348 | 0.00 | 0.00 | 0.0000 | 2.71E-12 | 2.85E-11 |
| Total VOCs | 67.4629 | 6.284 | 5.495 | 0.1082 | 1.25E-03 | 1.32E-02 |
| Total $CO_{2e}$ | | 2.237 | 1.9564 | | 0.9915 | 10.4049 |
| Total TAPs (Benzene) | | 0.0002 | 0.0002 | | 0.0000 | 0.0000 |
| Toluene | | 0.0009 | 0.0008 | | 0.0000 | 0.0000 |
| Ethylbenzene | | 0.0010 | 0.0009 | | 0.0000 | 0.0000 |
| Xylenes | | 0.0022 | 0.0019 | | 0.0000 | 0.0000 |
| n-Hexane | | 0.0086 | 0.0075 | | 0.0000 | 0.0000 |
| Total HAPs | | 0.0129 | 0.0113 | | 0.0000 | 0.0000 |
| Total | 100.0000 | 9.3141 | 8.1450 | 100.0000 | 1.1600 | 12.1728 |

**Enter any notes here**

Vapor mass fractions and loading losses from Promax output

*Using equation $L_L$ = 12.46* SPM/T from AP-42, Chapter 5, Section 5.2-4

MW was obtained by Promax; RVP was taken from laboratory reports

Annual Average Temp (F) obtained from Charleston, WV (preset in Promax)

S (saturation factor) is based on submerged loading, dedicated service as it was most representative

True vapor pressure (TVP) equation from AP-42, Chapter 7, Figure 7.1-13b

Loading emissions are vented to the atmosphere.

**Table 9**

**Gas Production Unit Heater Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| | |
|---|---|
| Number of Units | 10 |
| GPU Heater Rating (MMBtu/hr) | 1.50 |
| Operating hours/year | 8760 |
| Fuel Heat Value (Btu/scf) | 1,247 |

| Pollutant | Emission Factors (lb/MMscf) | lb/hr | tpy |
|---|---|---|---|
| NOx | 100 | 1.203 | 5.268 |
| CO | 84 | 1.010 | 4.425 |
| $CO_2$ | 120,000 | 1443.395 | 6322.070 |
| Lead | 0.0005 | 6.01E-06 | 2.63E-05 |
| $N_2O$ | 2.2 | 0.026 | 0.116 |
| PM (Total) | 7.6 | 0.091 | 0.400 |
| $SO_2$ | 0.6 | 0.007 | 0.032 |
| TOC | 11 | 0.132 | 0.580 |
| Methane | 2.3 | 0.028 | 0.121 |
| VOC | 5.5 | 0.066 | 0.290 |
| HAPS | | | |
| 2-Methylnaphthalene | 2.40E-05 | 2.89E-07 | 1.26E-06 |
| Benzene | 2.10E-03 | 2.53E-05 | 1.11E-04 |
| Dichlorobenzene | 1.20E-03 | 1.44E-05 | 6.32E-05 |
| Fluoranthene | 3.00E-06 | 3.61E-08 | 1.58E-07 |
| Fluorene | 2.80E-06 | 3.37E-08 | 1.48E-07 |
| Formaldehyde | 7.50E-02 | 9.02E-04 | 3.95E-03 |
| Hexane | 1.80E+00 | 2.17E-02 | 9.48E-02 |
| Naphthalene | 6.10E-04 | 7.34E-06 | 3.21E-05 |
| Phenanathrene | 1.70E-05 | 2.04E-07 | 8.96E-07 |
| Toluene | 3.40E-03 | 4.09E-05 | 1.79E-04 |

| | lb/hr | tpy |
|---|---|---|
| TOTAL Uncontrolled VOC | 0.066 | 0.290 |
| TOTAL Uncontrolled HAPs | 0.023 | 0.099 |
| TOTAL Uncontrolled TAPs (Benzene) | 0.000 | 0.000 |
| TOTAL Uncontrolled TAPs (Formaldehyde) | 0.001 | 0.004 |
| TOTAL $CO_{2e}$ Emissions | 1,451.97 | 6,359.64 |

| **Enter any notes here:** |
|---|
| All Emission Factors based off AP-42 Sec 1.4 Natural Gas Combustion |

**Table 10**

**Enclosed Combustor Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| General Information | |
|---|---|
| Unit Name: | EC001 |

| Pollutant | Emission Factor (lb/MMscf) |
|---|---|
| NOx | 100 |
| CO | 84 |
| PM10 | 7.6 |
| PM2.5 | 5.7 |
| $SO_2$ | 0.6 |
| $CO_2$ | 120,000 |
| VOC | 5.5 |
| benzene | 2.10E-03 |
| Hexane | 1.80E+00 |
| Toluene | 3.40E-03 |
| Formaldehyde | 7.50E-02 |
| $N_2O$ | 2.20 |
| Lead | 5.00E-04 |

| Constants | |
|---|---|
| Btu/MMBtu | 1,000,000 |
| scf/MMscf | 1,000,000 |
| lb/ton | 2,000 |
| $H_2S$ molecular weight | 34.08 |
| $SO_2$ molecular weight | 64.06 |
| seconds/hour | 3,600 |
| inches/ft | 12 |

| Destruction Efficiency | |
|---|---|
| VOC percent destruction efficiency (%) | 98 |
| $H_2S$ percent destruction efficiency (%) | 98 |

| | |
|---|---|
| Enclosed Combustor operating hours | 8760 |

| Stream Information | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Stream Sent to Enclosed Combustor/Vapor Combustor (Enter Name of Each Stream Here) | pilot(s) | added fuel stream(s) | Oil Tank Flash Emissions | Water Tank Flash Emissions | Oil Tank W/B Emissions | Water Tank W/B Emissions | - |
| Maximum Expected Hourly Volumetric Flow Rate of Stream (scf/hr) | 12.6 | -- | 3,275.73 | 1,773.28 | 205.51 | 12.30 | 5,279.42 |
| Maximum Expected Annual Volumetric Flow Rate of Stream (scf/yr) | 110,376.00 | -- | 28,695,426.58 | 15,533,942.40 | 1,800,227.70 | 107,715.21 | 46,247,687.89 |
| Heating Content (Btu/ft3) | 1,247 | | 2,178.24 | 1,052.77 | 2,178.24 | 1,052.77 | 1,792.39 |

| Mass Flow Rates of the Vapors Sent to this Control Device, Hourly Basis (lb/hr) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Stream Sent to Enclosed Combustor/Vapor Combustor | pilot(s) | added fuel stream(s) | Oil Tank Flash Emissions | Water Tank Flash Emissions | Oil Tank W/B Emissions | Water Tank W/B Emissions | - |
| H2S | - | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Total VOC | - | - | 254.191 | 10.693 | 15.322 | 0.001 | 280.21 |
| Benzene | - | - | 0.150 | 0.058 | 0.000 | 0.000 | 0.208 |
| Toluene | - | - | 0.334 | 0.121 | 0.002 | 0.000 | 0.457 |
| Ethylbenzene | - | - | 0.196 | 0.070 | 0.003 | 0.000 | 0.269 |
| Xylenes | - | - | 0.353 | 0.128 | 0.005 | 0.000 | 0.486 |
| n-Hexane | - | - | 5.528 | 0.033 | 0.021 | 0.000 | 5.582 |
| HAPs | - | - | 6.560 | 0.410 | 0.031 | 0.000 | 7.001 |
| Total Mass Flow | - | - | 362.012 | 85.631 | 22.711 | 0.594 | 470.948 |
| Mass Flow Rates of the Vapors Sent to this Control Device, Annual Basis (tpy) | | | | | | | |
| H2S | - | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Total VOC | - | - | 1113.358 | 46.836 | 67.108 | 0.003 | 1227.306 |
| Benzene | - | - | 0.657 | 0.253 | 0.002 | 0.000 | 0.911 |
| Toluene | - | - | 1.463 | 0.530 | 0.010 | 0.000 | 2.002 |
| Ethylbenzene | - | - | 0.859 | 0.307 | 0.011 | 0.000 | 1.176 |
| Xylenes | - | - | 1.545 | 0.560 | 0.023 | 0.000 | 2.128 |
| n-Hexane | - | - | 24.212 | 0.145 | 0.092 | 0.000 | 24.449 |
| HAP | - | - | 28.734 | 1.794 | 0.138 | 0.000 | 30.666 |
| Total Mass Flow | - | - | 1585.614 | 375.062 | 99.475 | 2.601 | 2062.752 |

**Table 10**

**Enclosed Combustor Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| Controlled Emissions | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hourly (lb/hr) | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Stream Sent to Enclosed Combustor/Vapor Combustor | pilot(s) | added fuel stream(s) | Oil Tank Flash Emissions | Water Tank Flash Emissions | Oil Tank W/B Emissions | Water Tank W/B Emissions | - |
| NOx | 0.001 | - | 0.328 | 0.177 | 0.021 | 0.001 | 0.53 |
| CO | 0.001 | - | 0.275 | 0.149 | 0.017 | 0.001 | 0.44 |
| PM2.5 | 0.000 | - | 0.019 | 0.010 | 0.001 | 0.000 | 0.03 |
| PM10 | 0.000 | - | 0.025 | 0.013 | 0.002 | 0.000 | 0.04 |
| H2S | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| $SO_2$ | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| $CO_2$ | 1.512 | - | - | - | - | - | 1.51 |
| Total VOC | 0.000 | - | 5.084 | 0.214 | 0.306 | 0.000 | 5.60 |
| Benzene | 0.000 | - | 0.003 | 0.001 | 0.000 | 0.000 | 0.00 |
| Toluene | 0.000 | - | 0.007 | 0.002 | 0.000 | 0.000 | 0.01 |
| Ethylbenzene | 0.000 | - | 0.004 | 0.001 | 0.000 | 0.000 | 0.01 |
| Xylenes | 0.000 | - | 0.007 | 0.003 | 0.000 | 0.000 | 0.01 |
| n-Hexane | 0.000 | - | 0.111 | 0.001 | 0.000 | 0.000 | 0.11 |
| HAP | 0.000 | - | 0.131 | 0.008 | 0.001 | 0.000 | 0.14 |
| $N_2O$ | 0.000 | - | 0.007 | 0.004 | 0.000 | 0.000 | 0.01 |
| Lead | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| Formaldehyde | 0.000 | - | - | - | - | - | 0.00 |
| Annual (tpy) | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Stream Sent to Enclosed Combustor/Vapor Combustor | pilot(s) | added fuel stream(s) | Oil Tank Flash Emissions | Water Tank Flash Emissions | Oil Tank W/B Emissions | Water Tank W/B Emissions | - |
| NOx | 0.006 | - | 1.435 | 0.777 | 0.090 | 0.005 | 2.31 |
| CO | 0.005 | - | 1.205 | 0.652 | 0.076 | 0.005 | 1.94 |
| PM2.5 | 0.000 | - | 0.082 | 0.044 | 0.005 | 0.000 | 0.13 |
| PM10 | 0.000 | - | 0.109 | 0.059 | 0.007 | 0.000 | 0.18 |
| $H_2S$ | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| $SO_2$ | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| $CO_2$ | 6.623 | - | - | - | - | - | 6.62 |
| Total VOC | 0.000 | - | 22.267 | 0.937 | 1.342 | 0.000 | 24.55 |
| Benzene | 0.000 | - | 0.013 | 0.005 | 0.000 | 0.000 | 0.02 |
| Toluene | 0.000 | - | 0.029 | 0.011 | 0.000 | 0.000 | 0.04 |
| Ethylbenzene | 0.000 | - | 0.017 | 0.006 | 0.000 | 0.000 | 0.02 |
| Xylenes | 0.000 | - | 0.031 | 0.011 | 0.000 | 0.000 | 0.04 |
| n-Hexane | 0.000 | - | 0.484 | 0.003 | 0.002 | 0.000 | 0.49 |
| HAP | 0.000 | - | 0.575 | 0.036 | 0.003 | 0.000 | 0.61 |
| $N_2O$ | 0.000 | - | 0.032 | 0.017 | 0.002 | 0.000 | 0.05 |
| Lead | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| Formaldehyde | 0.000 | - | - | - | - | - | 0.00 |

| Enclosed Combustor/Vapor Combustor Total Emissions | | |
|---|---|---|
| | Hourly Emissions (lb/hr) | Annual Emissions (tpy) |
| Total VOC | 5.60 | 24.55 |
| NOx | 5.28E-01 | 2.31E+00 |
| CO | 4.43E-01 | 1.94E+00 |
| PM2.5 | 3.01E-02 | 1.32E-01 |
| PM10 | 4.01E-02 | 1.76E-01 |
| $H_2S$ | 4.02E-06 | 1.76E-05 |
| $SO_2$ | 7.56E-06 | 3.31E-05 |
| Benzene (TAPs) | 4.16E-03 | 1.82E-02 |
| Formaldehyde (TAPs) | 9.45E-07 | 4.14E-06 |
| HAPs | 0.14 | 0.61 |
| $CO_2e$ | 2679.58 | 11736.54 |
| $N_2O$ | 1.16E-02 | 5.09E-02 |
| Lead | 2.64E-06 | 1.16E-05 |

| **Enter any notes here as needed** |
|---|
| 1. Emission Factors from AP-42 Tables 1.4-1, 1.4-2, and 1.4.3 |

**Table 11**

**Enclosed Combustor GHG Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

**Enclosed Combustor $CO_2$ and $CH_4$ Emissions**

| Components | Mole fraction of oil flash gas constituents[a] | Volume of oil flash gas sent to flare *scf/year* | Mole fraction of water flash gas constituents[a] | Volume of water flash gas sent to flare *scf/year* | Mole fraction of oil tank vapors constituents[a] | Volume of oil tank vapor sent to flare *scf/year* | Mole fraction of water tank vapors constituents[a] | Volume of water tank vapors sent to flare *scf/year* | Component volume of gas sent to flare *scf/year* | Number of carbon atoms | Combustion Efficiency | Combusted $CO_2$ Volume[b] *scf/year* | Uncombusted $CO_2$ and $CH_4$ Volume[b] *scf/year* | Volume GHGs Emitted *scf/year* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ | 0.001 | 28,695,427 | 0.0470 | 15,533,942 | 0.0013 | 1,800,228 | 0.011 | 107,715 | 768,203 | 1 | 0 | -- | 768,203 | 176,970,910 |
| Methane | 0.115 | 28,695,427 | 3.8061 | 15,533,942 | 0.0250 | 1,800,228 | 0.038 | 107,715 | 62,475,745 | 1 | 0.98 | 61,226,231 | 1,249,515 | 1,249,515 |
| Ethane | 0.347 | 28,695,427 | 0.7042 | 15,533,942 | 0.4386 | 1,800,228 | 0.006 | 107,715 | 21,673,620 | 2 | 0.98 | 42,480,295 | -- | |
| Propane | 0.290 | 28,695,427 | 0.1914 | 15,533,942 | 0.3112 | 1,800,228 | 0.000 | 107,715 | 11,845,459 | 3 | 0.98 | 34,825,648 | -- | |
| i-Butane | 0.053 | 28,695,427 | 0.0080 | 15,533,942 | 0.0530 | 1,800,228 | 0.000 | 107,715 | 1,746,367 | 4 | 0.98 | 6,845,759 | -- | |
| n-Butane | 0.100 | 28,695,427 | 0.0288 | 15,533,942 | 0.0977 | 1,800,228 | 0.000 | 107,715 | 3,481,178 | 4 | 0.98 | 13,646,216 | -- | |
| Pentane | 0.053 | 28,695,427 | 0.0091 | 15,533,942 | 0.0494 | 1,800,228 | 0.000 | 107,715 | 1,762,812 | 5 | 0.98 | 8,637,781 | -- | |
| Hexane | 0.020 | 28,695,427 | 0.0019 | 15,533,942 | 0.0122 | 1,800,228 | 0.000 | 107,715 | 637,388 | 6 | 0.98 | 3,747,840 | -- | |
| Benzene | 0.000 | 28,695,427 | 0.0008 | 15,533,942 | 0.0000 | 1,800,228 | 0.000 | 107,715 | 19,300 | 6 | 0.98 | 113,485 | -- | |
| Heptanes | 0.011 | 28,695,427 | 0.0015 | 15,533,942 | 0.0065 | 1,800,228 | 0.000 | 107,715 | 339,638 | 7 | 0.98 | 2,329,920 | -- | |
| Toluene | 0.000 | 28,695,427 | 0.0015 | 15,533,942 | 0.0000 | 1,800,228 | 0.000 | 107,715 | 35,046 | 7 | 0.98 | 240,414 | -- | |
| Octane | 0.006 | 28,695,427 | 0.0011 | 15,533,942 | 0.0043 | 1,800,228 | 0.000 | 107,715 | 187,132 | 8 | 0.98 | 1,467,115 | -- | |
| Ethyl benzene | 0.000 | 28,695,427 | 0.0007 | 15,533,942 | 0.0000 | 1,800,228 | 0.000 | 107,715 | 17,731 | 8 | 0.98 | 139,011 | -- | |
| Xylenes | 0.000 | 28,695,427 | 0.0014 | 15,533,942 | 0.0001 | 1,800,228 | 0.000 | 107,715 | 32,226 | 8 | 0.98 | 252,652 | -- | |
| Nonane | 0.001 | 28,695,427 | 0.0000 | 15,533,942 | 0.0005 | 1,800,228 | 0.000 | 107,715 | 22,621 | 9 | 0.98 | 199,520 | -- | |
| Decane plus | 0.000 | 28,695,427 | 0.0000 | 15,533,942 | 0.0001 | 1,800,228 | 0.000 | 107,715 | 5,186 | 10 | 0.98 | 50,821 | -- | |
| | | | | | | | | | | | **Subtotal** | **176,202,707** | -- | |

| Pollutant | Volume Emitted *scf/year* | Density of GHG[c] *lb/scf* | Conversion Factor *lb/ton* | GWF | Emissions[c] *lbs/hr* | Emissions[c] *(tons/yr)* |
|---|---|---|---|---|---|---|
| $CO_2$ | 176,970,910 | 0.12 | 2000 | 1 | 2342.70 | 10,261.04 |
| $CH_4$ | 1,249,515 | 0.09 | 2000 | 25 | 13.27 | 58.12 |
| | | | | **$CO_2e$ Emissions** | **2,674.5** | **11714.15** |

**GHG Emissions Summary**

Notes
a Flashing/Working/Breathing Losses from ProMax output reports
b 40 CFR 98.233 (n)(4): Eqns: W-19, W-20 and W-21
c 40 CFR 98.233(v) Eqn W-36 - density at 60F and 14.7 psia

**Table 12**

**Haul Road Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

| | PM | PM10 |
|---|---|---|
| Particle Size Multiplier (k) | 0.8 | 0.36 |
| Silt Content of Road Surface Material (s) (%) | 5.1 | 5.1 |
| Days per Year with Precipitation > 0.01 in (p) | 150 | 150 |
| Control Efficiency for Watering [1] (%) | 50 | 50 |

| Tanker Truck Trip Calculation | |
|---|---|
| Condensate Production (bbl/day) | 1150 |
| PW Production (bbl/day) | 13,800 |
| Truck Capacity (bbl) | 200 |

| Pick Up Truck Trip Calculation | |
|---|---|
| No of Trips Per day | 2 |
| Trips Per Year | 730 |

| | # of Wheels | Mean Vehicle Weight (W) (tons) | Mean Vehicle Speed (S) (mph) | Miles Per Trip (miles) | Maximum Trips per Hour | Maximum Trips per Year | Vehicle Miles Travelled (miles/hr) | Vehicle Miles Travelled (miles/year) | PM (lbs/VMT) | PM10 (lbs/VMT) |
|---|---|---|---|---|---|---|---|---|---|---|
| Tanker Trucks Condensate | 10 | 40 | 10 | 0.1600 | 1 | 2099 | 0.1600 | 335.8400 | 3.8175 | 1.7179 |
| Tanker Trucks PW | 10 | 40 | 10 | 0.1600 | 1 | 25185 | 0.1600 | 4029.6000 | 3.8175 | 1.7179 |
| Pick Up Truck | 4 | 3 | 10 | 0.3100 | 1 | 730 | 0.3100 | 226.3000 | 0.3467 | 0.1560 |

| | Uncontrolled Emissions | | | | | | Controlled Emissions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PM | | | PM10 | | | PM | | | PM10 | | |
| | (lbs/hr) | (lbs/year) | (tpy) | (lbs/hr) | (lbs/year) | (tpy) | (lbs/hr) | (lbs/year) | (tpy) | (lbs/hr) | (lbs/year) | (tpy) |
| Tanker Trucks Condensate | 0.6108 | 1282.0791 | 0.6410 | 0.2749 | 576.9356 | 0.2885 | 0.3054 | 641.0395 | 0.3205 | 0.1374 | 288.4678 | 0.1442 |
| Tanker Trucks PW | 0.6108 | 15383.1164 | 7.6916 | 0.2749 | 6922.4024 | 3.4612 | 0.3054 | 7691.5582 | 3.8458 | 0.1374 | 3461.2012 | 1.7306 |
| Pick Up Truck | 0.1075 | 78.4536 | 0.0392 | 0.0484 | 35.3041 | 0.0177 | 0.0537 | 39.2268 | 0.0196 | 0.0242 | 17.6521 | 0.0088 |
| Total Emissions | 1.3291 | 16,743.6491 | 8.3718 | 0.5981 | 7,534.6421 | 3.7673 | 0.6645 | 8,371.8246 | 4.1859 | 0.2990 | 3,767.3211 | 1.8837 |

| | |
|---|---|
| **Enter any notes here:** | 1 EPA, AP-42, Volume I, Section 13.2.2 Unpaved Roads (11/06); assume 2:1 moisture ratio Section 13.2.2 Unpaved Roads (11/06)<br>Source: Attachment L, Fugitive Emissions from Unpaved Haul Roads, Rev 03/2007, West Virginia Department of Environmental Protection |

**Table 13**

**Engine Emissions**
**Edna Monroe Well Pad**
**Tyler County, West Virginia**
**Antero Resources Corporation**

**Kubota DG972-E2**

| | |
|---|---|
| Power (hp) | 24 |
| Fuel consumption (lbs/BHP-hr) [1] | 0.449 |
| Heat Content of Fuel (Btu/scf) | 1247.06 |
| Density of NG (lb/scf) | 0.056 |
| Operating Hours/year | 8760 |

| Pollutant | Emission Factors (g/hp-hr) | Emission Factors (lb/MMBtu) | lb/hr | tpy |
|---|---|---|---|---|
| NOx[1] | 5.97 | | 0.3158 | 1.3831 |
| CO[2] | 106.7 | | 5.6445 | 24.7228 |
| $CO_2$ | | 110.000 | 26.3967 | 115.62 |
| $PM_{2.5}$ | | 9.910E-03 | 0.0024 | 0.0104 |
| $PM_{10}$ | | 9.500E-03 | 0.0023 | 0.0100 |
| PM (Total) | | 9.910E-03 | 0.0024 | 0.0104 |
| $SO_2$ | | 5.880E-04 | 0.0001 | 0.0006 |
| TOC | | 0.358 | 0.0859 | 0.3763 |
| Methane | | 0.230 | 0.0552 | 0.2417 |
| VOC[3] | | 0.0296 | 0.0071 | 0.0311 |
| HAPS | | | | |
| Benzene | | 1.58E-03 | 3.79E-04 | 1.66E-03 |
| Ethylbenzene | | 2.48E-05 | 5.95E-06 | 2.61E-05 |
| Formaldehyde | | 2.05E-02 | 4.92E-03 | 2.15E-02 |
| Naphthalene | | 9.71E-05 | 2.33E-05 | 1.02E-04 |
| Toluene | | 5.58E-04 | 1.34E-04 | 5.86E-04 |
| Xylene | | 1.95E-04 | 4.68E-05 | 2.05E-04 |

| | lb/hr | tpy |
|---|---|---|
| TOTAL Uncontrolled VOC | 0.007 | 0.031 |
| TOTAL Uncontrolled NOx | 0.316 | 1.383 |
| TOTAL Uncontrolled HAPs | 0.006 | 0.024 |
| TOTAL Uncontrolled TAPs (Benzene) | 0.000 | 0.002 |
| TOTAL Uncontrolled TAPs (Formaldehyde) | 0.005 | 0.022 |
| TOTAL $CO_{2e}$ Emissions | 27.78 | 121.7 |

**Enter Any Notes Here:**

1. Emission factor used for the 24 HP engine's Nox is the 40 CFR 1054 standard indicated on the EPA's Certificate of Conformity. See Appendix P.

2. Emission factor for CO was the Certification CO level taken from EPA's Non-Road Small SI 2013 Certification issued by Office of Transportation and Air Quality, March 2014.

3. Emission factors for all other contaminants including VOCs were obtained from AP-42, Section 3.2 "Natural Gas-fired Reciprocating Engines", Table 3.2-3.


Bryan Research & Engineering, Inc.

# ProMax® 3.2

with

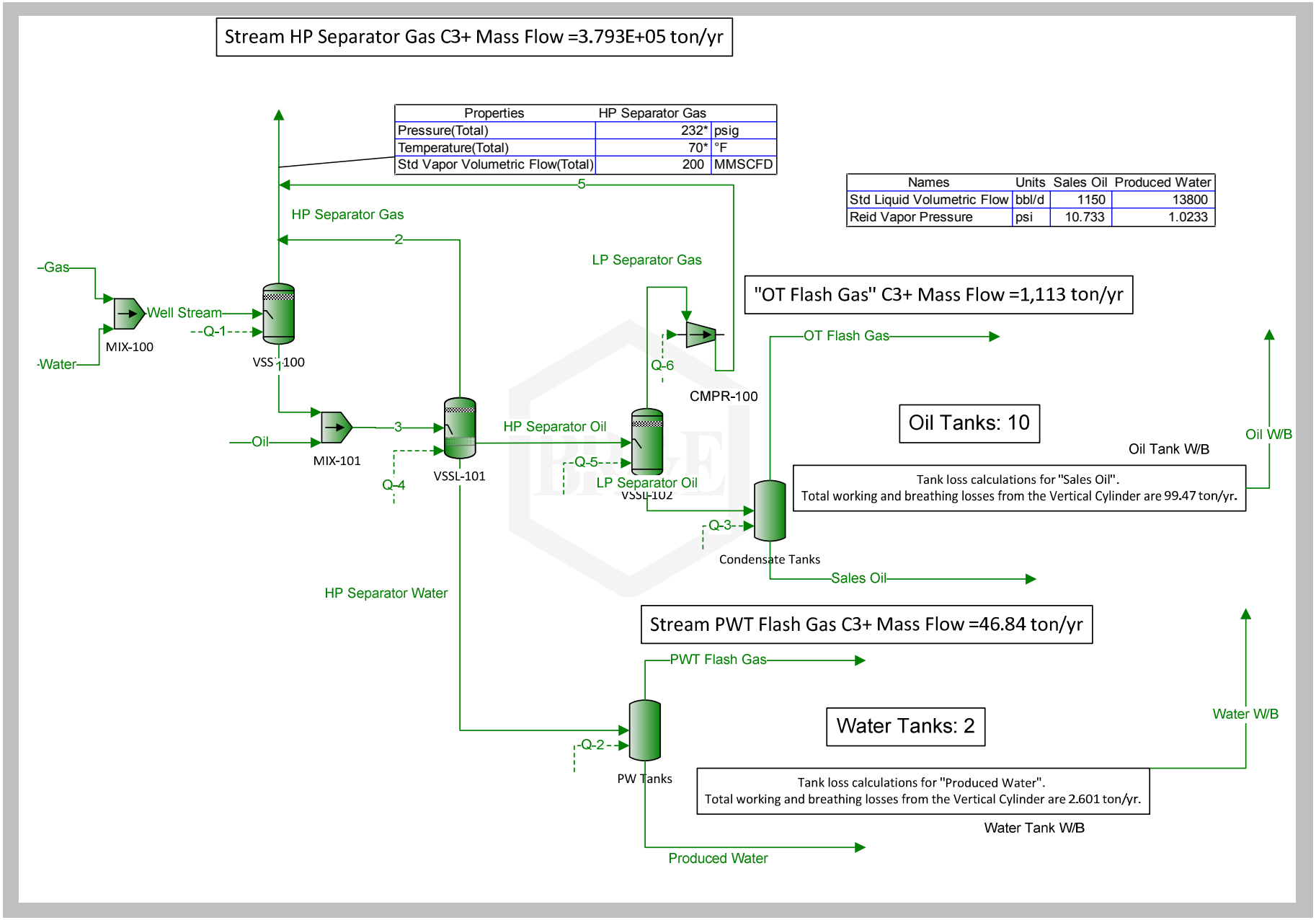
TSWEET® & PROSIM®



| Simulation Report | |
|---|---|
| Client Name: | Antero Resources Corporation |
| Location: | West Virginia |
| Job: | Edna Monroe Well Pad |

| | |
|---|---|
| Project Name: | PROMAX SCENARIO 3 |
| File Name: | ProMax@C:\Users\yichen\Documents\New Model\Antero ProMax\Antero WV_Updated 2Ph Separator\PROMAX SCENARIO 3.PMX |
| ProMax Version: | 3.2.13330.0 |

| | |
|---|---|
| Report Created: | 5/13/2015 11:46 |


Stream HP Separator Gas C3+ Mass Flow =3.793E+05 ton/yr
Properties | HP Separator Gas
Pressure(Total) | 232* | psig
Temperature(Total) | 70* | °F
Std Vapor Volumetric Flow(Total) | 200 | MMSCFD
Names | Units | Sales Oil | Produced Water
Std Liquid Volumetric Flow | bbl/d | 1150 | 13800
Reid Vapor Pressure | psi | 10.733 | 1.0233
5
HP Separator Gas
2
LP Separator Gas
"OT Flash Gas" C3+ Mass Flow =1,113 ton/yr
Gas
Well Stream
Q-1
MIX-100
Water
VSS-100
Q-6
CMPR-100
OT Flash Gas
Oil Tanks: 10
Oil W/B
Oil Tank W/B
3
HP Separator Oil
Oil
MIX-101
VSSL-101
Q-5
LP Separator Oil
VSSL-102
Q-4
Tank loss calculations for "Sales Oil".
Total working and breathing losses from the Vertical Cylinder are 99.47 ton/yr.
Q-3
Condensate Tanks
Sales Oil
HP Separator Water
Stream PWT Flash Gas C3+ Mass Flow =46.84 ton/yr
PWT Flash Gas
Water Tanks: 2
Water W/B
Q-2
PW Tanks
Tank loss calculations for "Produced Water".
Total working and breathing losses from the Vertical Cylinder are 2.601 ton/yr.
Water Tank W/B
Produced Water

| Process Streams | | Well Stream | HP Separator Gas | HP Separator Water | HP Separator Oil | OT Flash Gas | Sales Oil | Gas | Water | Oil | Produced Water | PWT Flash Gas | Oil W/B | Water W/B | 1 | 3 | LP Separator Oil |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phase: Total | Status | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved |
| Mole Fraction | | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| Water | | 33.8263 | 0.157552 | 99.9588 | 0.0501987 | 0.229379 | 0.00462880 | 0 | 100 | 0 | 99.9969 | 3.02994 | 0.000109874 | | 99.9589 | 98.8029 | 0.0214883 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 0.327334 | 0.493930 | 0.000112685 | 0.0142266 | 0.00911088 | 1.35784E-05 | 0.494658 | 0 | 0.016 | 3.26005E-06 | 0.278296 | 0.000339243 | | 0.000101795 | 0.000285662 | 0.000696006 |
| Carbon Dioxide | | 0.0970882 | 0.145923 | 0.000829929 | 0.0285456 | 0.122484 | 0.00212169 | 0.146717 | 0 | 0 | 0.000458380 | 0.945391 | 0.130788 | | 0.00116544 | 0.00115196 | 0.0111506 |
| Methane | | 51.4182 | 77.5798 | 0.0319662 | 6.36327 | 11.5107 | 0.0549825 | 77.7018 | 0 | 6.555 | 0.00184397 | 76.6094 | 2.49734 | | 0.0310988 | 0.106549 | 0.914323 |
| Ethane | | 9.39691 | 14.1779 | 0.00597218 | 6.55557 | 34.6571 | 1.05871 | 14.2004 | 0 | 6.561 | 0.000397706 | 14.1775 | 43.8560 | | 0.00607361 | 0.0818830 | 3.57907 |
| Propane | | 2.97406 | 4.48715 | 0.00163468 | 5.98557 | 28.9707 | 3.33530 | 4.49433 | 0 | 5.95 | 0.000119446 | 3.85371 | 31.1216 | | 0.00203453 | 0.0708243 | 5.25832 |
| Isobutane | | 0.374984 | 0.565850 | 6.53738E-05 | 1.82784 | 5.31811 | 1.57239 | 0.566666 | 0 | 1.825 | 1.74525E-06 | 0.161824 | 5.30483 | | 8.17882E-05 | 0.0211874 | 1.85337 |
| n-Butane | | 0.783456 | 1.18213 | 0.000241498 | 4.46074 | 9.96142 | 4.23308 | 1.18394 | 0 | 4.446 | 1.37563E-05 | 0.579212 | 9.76878 | | 0.000367047 | 0.0517820 | 4.66279 |
| Isopentane | | 0.248114 | 0.374394 | 4.24621E-05 | 2.96090 | 2.96077 | 3.25618 | 0.374944 | 0 | 2.955 | 1.68795E-06 | 0.103699 | 2.75134 | | 7.47499E-05 | 0.0342492 | 3.23402 |
| n-Pentane | | 0.192853 | 0.291007 | 3.25188E-05 | 3.11443 | 2.38069 | 3.51139 | 0.291434 | 0 | 3.109 | 1.28046E-06 | 0.0794474 | 2.18589 | | 5.64763E-05 | 0.0360122 | 3.42657 |
| 2-Methylpentane | | 0 | 0 | 5.30992E-06 | 2.68359 | 0.878065 | 3.16144 | 0 | 0 | 2.681 | 1.01661E-07 | 0.0132459 | 0.789398 | | 0 | 0.0310065 | 2.99016 |
| 3-Methylpentane | | 0 | 0 | 7.09285E-06 | 1.44904 | 0.426199 | 1.71255 | 0 | 0 | 1.448 | 3.56740E-07 | 0.0171318 | 0.382131 | | 0 | 0.0167465 | 1.61605 |
| n-Hexane | | 0.360755 | 0.544400 | 3.50085E-06 | 3.10340 | 0.735656 | 3.68797 | 0.545164 | 0 | 3.097 | 5.35076E-08 | 0.00876741 | 0.0448536 | | 3.68296E-05 | 0.0358540 | 3.46651 |
| Methylcyclopentane | | 0 | 0 | 8.14194E-06 | 0.667069 | 0.152715 | 0.793339 | 0 | 0 | 0.667 | 1.11693E-06 | 0.0178673 | 0.126811 | | 0 | 0.00771403 | 0.745283 |
| Benzene | | 0 | 0 | 5.89487E-05 | 0.0970732 | 0.0220101 | 0.115470 | 0 | 0 | 0.102 | 5.23633E-05 | 0.0168004 | 0.00113757 | | 0 | 0.00117966 | 0.108459 |
| 2-Methylhexane | | 0 | 0 | 1.47359E-06 | 2.71802 | 0.277903 | 3.27161 | 0 | 0 | 2.715 | 2.39339E-08 | 0.00368683 | 0.0158226 | | 0 | 0.0313997 | 3.04704 |
| 3-Methylhexane | | 0 | 0 | 1.19900E-06 | 2.22348 | 0.216512 | 2.67755 | 0 | 0 | 2.221 | 2.03400E-08 | 0.00299762 | 0.185684 | | 0 | 0.0256864 | 2.49294 |
| Heptane | | 0 | 0 | 2.39859E-06 | 5.34300 | 0.413355 | 6.44617 | 0 | 0 | 5.337 | 4.09139E-08 | 0.00599613 | 0.326405 | | 0 | 0.0617238 | 5.99363 |
| Methylcyclohexane | | 0 | 0 | 8.16811E-06 | 3.13194 | 0.244552 | 3.77836 | 0 | 0 | 3.129 | 7.77571E-07 | 0.0187966 | 0.194948 | | 0 | 0.0361877 | 3.51327 |
| Toluene | | 0 | 0 | 8.86372E-05 | 0.655187 | 0.0415656 | 0.791497 | 0 | 0 | 0.662 | 7.69279E-05 | 0.0298562 | 0.00453880 | | 0 | 0.00765620 | 0.735241 |
| Octane | | 0 | 0 | 1.10485E-06 | 13.2093 | 0.322359 | 16.0157 | 0 | 0 | 13.194 | 1.25097E-08 | 0.00277808 | 0.239478 | | 0 | 0.152592 | 14.8385 |
| Ethylbenzene | | 0 | 0 | 4.08593E-05 | 1.00668 | 0.0211736 | 1.22094 | 0 | 0 | 1.009 | 3.49733E-05 | 0.0150046 | 0.00435350 | | 0 | 0.0116693 | 1.13094 |
| m-Xylene | | 0 | 0 | 2.49320E-05 | 0.718709 | 0.0126632 | 0.871953 | 0 | 0 | 0.72 | 2.14459E-05 | 0.00888734 | 0.00335273 | | 0 | 0.00832699 | 0.807494 |
| o-Xylene | | 0 | 0 | 6.75755E-05 | 1.61611 | 0.0254362 | 1.96105 | 0 | 0 | 1.62 | 6.03279E-05 | 0.0184926 | 0.00583152 | | 0 | 0.0187357 | 1.81585 |
| Nonane | | 0 | 0 | 3.89733E-07 | 9.13965 | 0.0731056 | 11.0983 | 0 | 0 | 9.129 | 6.97170E-09 | 0.000973456 | 0.0491355 | | 0 | 0.105579 | 10.2713 |
| C10+ | | 0 | 0 | 9.80662E-08 | 20.8764 | 0.0162823 | 25.3673 | 0 | 0 | 20.852 | 1.95336E-09 | 0.000244438 | 0.00917666 | | 0 | 0.241159 | 23.4656 |
| Molar Flow | | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h |
| Water | | 11209.8 | 34.5978 | 11175.2 | 0.0655883 | 0.0200008 | 0.00497684 | 0 | 11209.8 | 0 | 11175.0 | 0.133193 | 5.95014E-07 | 0 | 11175.2 | 11175.2 | 0.0249777 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nitrogen | | 108.477 | 108.465 | 0.0125980 | 0.0185881 | 0.000794428 | 1.45994E-05 | 108.477 | 0 | 0.0209297 | 0.000364323 | 0.0122336 | 1.83714E-06 | 0 | 0.0113805 | 0.0323102 | 0.000809027 |
| Carbon Dioxide | | 32.1745 | 32.0442 | 0.0927842 | 0.0372970 | 0.0106801 | 0.00228122 | 32.1745 | 0 | 0 | 0.0512257 | 0.0415585 | 0.000708274 | 0 | 0.130294 | 0.130294 | 0.0129613 |
| Methane | | 17039.7 | 17036.2 | 3.57375 | 8.31409 | 1.00368 | 0.0591167 | 17039.7 | 0 | 8.57463 | 0.206071 | 3.36768 | 0.0135241 | 0 | 3.47679 | 12.0514 | 1.06280 |
| Ethane | | 3114.08 | 3113.40 | 0.667677 | 8.56534 | 3.02195 | 1.13831 | 3114.08 | 0 | 8.58248 | 0.0444452 | 0.623232 | 0.237498 | 0 | 0.679019 | 9.26150 | 4.16026 |
| Propane | | 985.588 | 985.361 | 0.182754 | 7.82059 | 2.52611 | 3.58608 | 985.588 | 0 | 7.78323 | 0.0133485 | 0.169405 | 0.168536 | 0 | 0.227457 | 8.01068 | 6.11220 |
| Isobutane | | 124.268 | 124.259 | 0.00730865 | 2.38821 | 0.463715 | 1.69062 | 124.268 | 0 | 2.38729 | 0.000195038 | 0.00711361 | 0.0287279 | 0 | 0.00914378 | 2.39644 | 2.15434 |
| n-Butane | | 259.633 | 259.592 | 0.0269989 | 5.82829 | 0.868591 | 4.55136 | 259.633 | 0 | 5.81584 | 0.00153732 | 0.0254616 | 0.0529021 | 0 | 0.0410352 | 5.85687 | 5.41995 |
| Isopentane | | 82.2237 | 82.2154 | 0.00474716 | 3.86863 | 0.258166 | 3.50101 | 82.2237 | 0 | 3.86545 | 0.000188635 | 0.00455853 | 0.0148997 | 0 | 0.00835691 | 3.87381 | 3.75918 |
| n-Pentane | | 63.9104 | 63.9040 | 0.00363553 | 4.06924 | 0.207586 | 3.77541 | 63.9104 | 0 | 4.06690 | 0.000143096 | 0.00349243 | 0.0118375 | 0 | 0.00631396 | 4.07321 | 3.98299 |
| 2-Methylpentane | | 0 | 0 | 0.000593637 | 3.50631 | 0.0765633 | 3.39915 | 0 | 0 | 3.50703 | 1.13611E-05 | 0.000582276 | 0.00427492 | 0 | 0 | 3.50703 | 3.47571 |
| 3-Methylpentane | | 0 | 0 | 0.000792965 | 1.89328 | 0.0371627 | 1.84131 | 0 | 0 | 1.89414 | 3.98670E-05 | 0.000753098 | 0.00206940 | 0 | 0 | 1.89414 | 1.87848 |
| n-Hexane | | 119.552 | 119.548 | 0.000391387 | 4.05482 | 0.0641459 | 3.96527 | 119.552 | 0 | 4.05120 | 5.97968E-06 | 0.000385407 | 0.000242901 | 0 | 0.00411749 | 4.05532 | 4.02942 |
| Methylcyclopentane | | 0 | 0 | 0.000910250 | 0.871575 | 0.0133161 | 0.852990 | 0 | 0 | 0.872506 | 0.000124821 | 0.000785430 | 0.000686734 | 0 | 0 | 0.872506 | 0.866306 |
| Benzene | | 0 | 0 | 0.00659033 | 0.126833 | 0.00191918 | 0.124152 | 0 | 0 | 0.133427 | 0.00585180 | 0.000738531 | 6.16043E-06 | 0 | 0 | 0.133427 | 0.126071 |
| 2-Methylhexane | | 0 | 0 | 0.000164744 | 3.55130 | 0.0242319 | 3.51760 | 0 | 0 | 3.55151 | 2.67471E-06 | 0.000162070 | 8.56861E-05 | 0 | 0 | 3.55151 | 3.54183 |
| 3-Methylhexane | | 0 | 0 | 0.000134045 | 2.90514 | 0.0188789 | 2.87887 | 0 | 0 | 2.90530 | 2.27307E-06 | 0.000131772 | 0.00100556 | 0 | 0 | 2.90530 | 2.89775 |
| Heptane | | 0 | 0 | 0.000268157 | 6.98103 | 0.0360427 | 6.93086 | 0 | 0 | 6.98136 | 4.57228E-06 | 0.000263584 | 0.00176762 | 0 | 0 | 6.98136 | 6.96690 |
| Methylcyclohexane | | 0 | 0 | 0.000913176 | 4.09211 | 0.0213238 | 4.06245 | 0 | 0 | 4.09306 | 8.68966E-05 | 0.000826280 | 0.00105572 | 0 | 0 | 4.09306 | 4.08378 |
| Toluene | | 0 | 0 | 0.00990944 | 0.856050 | 0.00362434 | 0.851009 | 0 | 0 | 0.865966 | 0.00859699 | 0.00131245 | 2.45795E-05 | 0 | 0 | 0.865966 | 0.854634 |
| Octane | | 0 | 0 | 0.000123520 | 17.2590 | 0.0281082 | 17.2199 | 0 | 0 | 17.2591 | 1.39801E-06 | 0.000122122 | 0.00129687 | 0 | 0 | 17.2591 | 17.2480 |
| Ethylbenzene | | 0 | 0 | 0.00456798 | 1.31531 | 0.00184625 | 1.31274 | 0 | 0 | 1.31988 | 0.00390840 | 0.000659586 | 2.35760E-05 | 0 | 0 | 1.31988 | 1.31459 |
| m-Xylene | | 0 | 0 | 0.00278734 | 0.939046 | 0.00110417 | 0.937515 | 0 | 0 | 0.941836 | 0.00239666 | 0.000390679 | 1.81564E-05 | 0 | 0 | 0.941836 | 0.938619 |
| o-Xylene | | 0 | 0 | 0.00755479 | 2.11157 | 0.00221792 | 2.10850 | 0 | 0 | 2.11913 | 0.00674187 | 0.000812919 | 3.15801E-05 | 0 | 0 | 2.11913 | 2.11071 |
| Nonane | | 0 | 0 | 4.35713E-05 | 11.9416 | 0.00637448 | 11.9328 | 0 | 0 | 11.9417 | 7.79114E-07 | 4.27922E-05 | 0.000266089 | 0 | 0 | 11.9417 | 11.9392 |
| C10+ | | 0 | 0 | 1.09636E-05 | 27.2766 | 0.00141975 | 27.2746 | 0 | 0 | 27.2766 | 2.18296E-07 | 1.07453E-05 | 4.96955E-05 | 0 | 0 | 27.2766 | 27.2761 |
| Mass Fraction | | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| Water | | 30.5974 | 0.135912 | 99.9524 | 0.00921427 | 0.0995326 | 0.000742758 | 0 | 100 | 0 | 99.9949 | 2.72578 | 4.71987E-05 | | 99.9520 | 93.9685 | 0.00361920 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 0.460411 | 0.662560 | 0.000175212 | 0.00406065 | 0.00614747 | 3.38807E-06 | 0.663391 | 0 | 0.00457137 | 5.06921E-06 | 0.389305 | 0.000226605 | | 0.000158278 | 0.000422464 | 0.000182284 |
| Carbon Dioxide | | 0.214537 | 0.307514 | 0.00202730 | 0.0128001 | 0.129837 | 0.000831699 | 0.309119 | 0 | 0 | 0.00111975 | 2.07766 | 0.137249 | | 0.00284685 | 0.00267643 | 0.00458791 |
| Methane | | 41.4168 | 59.5955 | 0.0284638 | 1.04011 | 4.44777 | 0.00785659 | 59.6762 | 0 | 1.07252 | 0.00164201 | 61.3719 | 0.955306 | | 0.0276913 | 0.0902389 | 0.137133 |
| Ethane | | 14.1871 | 20.4138 | 0.00996744 | 2.00843 | 25.1005 | 0.283553 | 20.4417 | 0 | 2.01210 | 0.000663792 | 21.2881 | 31.4443 | | 0.0101367 | 0.129983 | 1.00614 |
| Propane | | 6.58468 | 9.47457 | 0.00400092 | 2.68923 | 30.7698 | 1.30999 | 9.48766 | 0 | 2.67592 | 0.000292359 | 8.48577 | 32.7228 | | 0.00497952 | 0.164873 | 2.16777 |
| Isobutane | | 1.09432 | 1.57484 | 0.000210900 | 1.08245 | 7.44509 | 0.814031 | 1.57677 | 0 | 1.08185 | 5.63053E-06 | 0.469678 | 7.35203 | | 0.000263853 | 0.0650118 | 1.00711 |
| n-Butane | | 2.28637 | 3.29005 | 0.000779088 | 2.64166 | 13.9455 | 2.19148 | 3.29435 | 0 | 2.63556 | 4.43808E-05 | 1.68111 | 13.5387 | | 0.00118411 | 0.158888 | 2.53371 |
| Isopentane | | 0.898815 | 1.29345 | 0.000170044 | 2.17660 | 5.14522 | 2.09255 | 1.29507 | 0 | 2.17444 | 6.75989E-06 | 0.373613 | 4.73333 | | 0.000299343 | 0.130452 | 2.18143 |
| n-Pentane | | 0.698625 | 1.00537 | 0.000130225 | 2.28947 | 4.13717 | 2.25655 | 1.00663 | 0 | 2.28776 | 5.12795E-06 | 0.286237 | 3.76055 | | 0.000226165 | 0.137167 | 2.31131 |
| 2-Methylpentane | | 0 | 0 | 2.53981E-05 | 2.35628 | 1.82255 | 2.42665 | 0 | 0 | 2.35636 | 4.86284E-07 | 0.0570007 | 1.62208 | | 0 | 0.141061 | 2.40906 |
| 3-Methylpentane | | 0 | 0 | 3.39262E-05 | 1.27231 | 0.884640 | 1.31451 | 0 | 0 | 1.27266 | 1.70641E-06 | 0.0737230 | 0.785217 | | 0 | 0.0761867 | 1.30199 |
| n-Hexane | | 1.56094 | 2.24644 | 1.67451E-05 | 2.72489 | 1.52696 | 2.83080 | 2.24910 | 0 | 2.72198 | 2.55946E-07 | 0.0377287 | 0.0921668 | | 0.000176161 | 0.163115 | 2.79284 |
| Methylcyclopentane | | 0 | 0 | 3.80331E-05 | 0.572007 | 0.309568 | 0.594703 | 0 | 0 | 0.572519 | 5.21768E-06 | 0.0750894 | 0.254480 | | 0 | 0.0342733 | 0.586400 |
| Benzene | | 0 | 0 | 0.000255577 | 0.0772580 | 0.0414104 | 0.0803383 | 0 | 0 | 0.0812602 | 0.000227036 | 0.0655321 | 0.00211880 | | 0 | 0.00486457 | 0.0792048 |
| 2-Methylhexane | | 0 | 0 | 8.19567E-06 | 2.77496 | 0.670718 | 2.91995 | 0 | 0 | 2.77464 | 1.33119E-07 | 0.0184479 | 0.0378049 | | 0 | 0.166101 | 2.85446 |
| 3-Methylhexane | | 0 | 0 | 6.66847E-06 | 2.27005 | 0.522552 | 2.38975 | 0 | 0 | 2.26979 | 1.13130E-07 | 0.0149992 | 0.443654 | | 0 | 0.135879 | 2.33538 |
| Heptane | | 0 | 0 | 1.33402E-05 | 5.45493 | 0.997631 | 5.75329 | 0 | 0 | 5.45424 | 2.27561E-07 | 0.0300029 | 0.779877 | | 0 | 0.326513 | 5.61482 |
| Methylcyclohexane | | 0 | 0 | 4.45146E-05 | 3.13322 | 0.578351 | 3.30439 | 0 | 0 | 3.13340 | 4.23780E-06 | 0.0921606 | 0.456417 | | 0 | 0.187578 | 3.22502 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Toluene | | 0 | 0 | 0.000453302 | 0.615083 | 0.0922456 | 0.649573 | 0 | 0 | 0.622099 | 0.000393437 | 0.137370 | 0.00997185 | | 0 | 0.0372414 | 0.633346 |
| Octane | | 0 | 0 | 7.00501E-06 | 15.3739 | 0.886920 | 16.2952 | 0 | 0 | 15.3713 | 7.93179E-08 | 0.0158466 | 0.652279 | | 0 | 0.920192 | 15.8465 |
| Ethylbenzene | | 0 | 0 | 0.000240771 | 1.08893 | 0.0541436 | 1.15455 | 0 | 0 | 1.09253 | 0.000206095 | 0.0795465 | 0.0110208 | | 0 | 0.0654033 | 1.12251 |
| m-Xylene | | 0 | 0 | 0.000146916 | 0.777431 | 0.0323813 | 0.824542 | 0 | 0 | 0.779605 | 0.000126379 | 0.0471162 | 0.00848737 | | 0 | 0.0466704 | 0.801476 |
| o-Xylene | | 0 | 0 | 0.000398201 | 1.74816 | 0.0650436 | 1.85442 | 0 | 0 | 1.75411 | 0.000355508 | 0.0980385 | 0.0147624 | | 0 | 0.105008 | 1.80232 |
| Nonane | | 0 | 0 | 2.77443E-06 | 11.9435 | 0.225837 | 12.6786 | 0 | 0 | 11.9415 | 4.96322E-08 | 0.00623459 | 0.150267 | | 0 | 0.714867 | 12.3160 |
| C10+ | | 0 | 0 | 8.66550E-07 | 33.8631 | 0.0624354 | 35.9712 | 0 | 0 | 33.8572 | 1.72614E-08 | 0.00194325 | 0.0348355 | | 0 | 2.02683 | 34.9257 |
| **Mass Flow** | | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** |
| Water | | 201948 | 623.289 | 201324 | 1.18159 | 0.360321 | 0.0896591 | 0 | 201948 | 0 | 201321 | 2.39951 | 1.07193E-05 | 0 | 201325 | 201325 | 0.449980 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nitrogen | | 3038.80 | 3038.48 | 0.352912 | 0.520717 | 0.0222546 | 0.000408978 | 3038.80 | 0 | 0.586312 | 0.0102059 | 0.342706 | 5.14646E-05 | 0 | 0.318807 | 0.905118 | 0.0226636 |
| Carbon Dioxide | | 1415.98 | 1410.25 | 4.08339 | 1.64142 | 0.470025 | 0.100395 | 1415.98 | 0 | 0 | 2.25442 | 1.82897 | 0.0311708 | 0 | 5.73418 | 5.73418 | 0.570420 |
| Methane | | 273359 | 273303 | 57.3317 | 133.378 | 16.1015 | 0.948377 | 273359 | 0 | 137.558 | 3.30589 | 54.0258 | 0.216960 | 0 | 55.7763 | 193.334 | 17.0499 |
| Ethane | | 93637.5 | 93617.1 | 20.0764 | 257.552 | 90.8670 | 34.2279 | 93637.5 | 0 | 258.067 | 1.33642 | 18.7400 | 7.14135 | 0 | 20.4174 | 278.484 | 125.095 |
| Propane | | 43460.1 | 43450.1 | 8.05865 | 344.854 | 111.391 | 158.130 | 43460.1 | 0 | 343.206 | 0.588612 | 7.47004 | 7.43172 | 0 | 10.0298 | 353.236 | 269.521 |
| Isobutane | | 7222.71 | 7222.18 | 0.424795 | 138.808 | 26.9522 | 98.2626 | 7222.71 | 0 | 138.755 | 0.0113360 | 0.413459 | 1.66973 | 0 | 0.531456 | 139.286 | 125.215 |
| n-Butane | | 15090.4 | 15088.1 | 1.56924 | 338.753 | 50.4844 | 264.535 | 15090.4 | 0 | 338.029 | 0.0893526 | 1.47988 | 3.07478 | 0 | 2.38506 | 340.414 | 315.020 |
| Isopentane | | 5932.34 | 5931.74 | 0.342502 | 279.117 | 18.6263 | 252.594 | 5932.34 | 0 | 278.888 | 0.0136098 | 0.328892 | 1.07499 | 0 | 0.602941 | 279.491 | 271.220 |
| n-Pentane | | 4611.05 | 4610.60 | 0.262299 | 293.591 | 14.9771 | 272.391 | 4611.05 | 0 | 293.422 | 0.0103242 | 0.251975 | 0.854062 | 0 | 0.455544 | 293.877 | 287.368 |
| 2-Methylpentane | | 0 | 0 | 0.0511569 | 302.158 | 6.59787 | 292.923 | 0 | 0 | 302.220 | 0.000979043 | 0.0501778 | 0.368393 | 0 | 0 | 302.220 | 299.521 |
| 3-Methylpentane | | 0 | 0 | 0.0683341 | 163.154 | 3.20251 | 158.676 | 0 | 0 | 163.228 | 0.00343555 | 0.0648985 | 0.178331 | 0 | 0 | 163.228 | 161.878 |
| n-Hexane | | 10302.5 | 10302.1 | 0.0337279 | 349.426 | 5.52779 | 341.709 | 10302.5 | 0 | 349.114 | 0.000515301 | 0.0332126 | 0.0209321 | 0 | 0.354826 | 349.469 | 347.237 |
| Methylcyclopentane | | 0 | 0 | 0.0766062 | 73.3513 | 1.12067 | 71.7872 | 0 | 0 | 73.4297 | 0.0105048 | 0.0661014 | 0.0577952 | 0 | 0 | 73.4297 | 72.9078 |
| Benzene | | 0 | 0 | 0.514783 | 9.90719 | 0.149911 | 9.69772 | 0 | 0 | 10.4222 | 0.457095 | 0.0576880 | 0.000481203 | 0 | 0 | 10.4222 | 9.84763 |
| 2-Methylhexane | | 0 | 0 | 0.0165077 | 355.847 | 2.42808 | 352.470 | 0 | 0 | 355.868 | 0.000268011 | 0.0162397 | 0.00858592 | 0 | 0 | 355.868 | 354.898 |
| 3-Methylhexane | | 0 | 0 | 0.0134316 | 291.100 | 1.89170 | 288.469 | 0 | 0 | 291.117 | 0.000227766 | 0.0132038 | 0.100759 | 0 | 0 | 291.117 | 290.360 |
| Heptane | | 0 | 0 | 0.0268698 | 699.513 | 3.61155 | 694.486 | 0 | 0 | 699.546 | 0.000458152 | 0.0264117 | 0.177119 | 0 | 0 | 699.546 | 698.097 |
| Methylcyclohexane | | 0 | 0 | 0.0896612 | 401.788 | 2.09370 | 398.876 | 0 | 0 | 401.882 | 0.00853203 | 0.0811291 | 0.103657 | 0 | 0 | 401.882 | 400.970 |
| Toluene | | 0 | 0 | 0.913040 | 78.8751 | 0.333941 | 78.4107 | 0 | 0 | 79.7887 | 0.792113 | 0.120927 | 0.00226472 | 0 | 0 | 79.7887 | 78.7446 |
| Octane | | 0 | 0 | 0.0141095 | 1971.47 | 3.21076 | 1967.01 | 0 | 0 | 1971.49 | 0.000159692 | 0.0139498 | 0.148140 | 0 | 0 | 1971.49 | 1970.22 |
| Ethylbenzene | | 0 | 0 | 0.484960 | 139.640 | 0.196007 | 139.368 | 0 | 0 | 140.125 | 0.414935 | 0.0700250 | 0.00250295 | 0 | 0 | 140.125 | 139.564 |
| m-Xylene | | 0 | 0 | 0.295918 | 99.6939 | 0.117224 | 99.5313 | 0 | 0 | 99.9900 | 0.254442 | 0.0414765 | 0.00192758 | 0 | 0 | 99.9900 | 99.6485 |
| o-Xylene | | 0 | 0 | 0.802055 | 224.175 | 0.235466 | 223.848 | 0 | 0 | 224.977 | 0.715751 | 0.0863035 | 0.00335270 | 0 | 0 | 224.977 | 224.084 |
| Nonane | | 0 | 0 | 0.00558825 | 1531.58 | 0.817559 | 1530.44 | 0 | 0 | 1531.58 | 9.99253E-05 | 0.00548832 | 0.0341273 | 0 | 0 | 1531.58 | 1531.26 |
| C10+ | | 0 | 0 | 0.00174540 | 4342.43 | 0.226024 | 4342.12 | 0 | 0 | 4342.44 | 3.47527E-05 | 0.00171065 | 0.00791152 | 0 | 0 | 4342.44 | 4342.35 |

| **Process Streams** | | **Well Stream** | **HP Separator Gas** | **HP Separator Water** | **HP Separator Oil** | **OT Flash Gas** | **Sales Oil** | **Gas** | **Water** | **Oil** | **Produced Water** | **PWT Flash Gas** | **Oil W/B** | **Water W/B** | **1** | **3** | **LP Separator Oil** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Phase: Total** | **Status** | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved |
| **Property** | **Units** | | | | | | | | | | | | | | | | |
| Temperature | °F | 196.0 | 70.0 | 70.0 | 70.0 | 75.9 | 75.9 | 200.0 | 300.0 | 200.0 | 75.9 | 75.94 | 75.9425 | 75.9425 | 70 | 74.4472 | 70 |
| Pressure | psig | 200 | 232 | 232 | 232 | 0 | 0 | 300 | 200 | 300 | 0 | 0 | 7.86079 | | 232 | 232 | 40 |
| Mole Fraction Vapor | % | 69.7478 | 100 | 0 | 0 | 100 | 0 | 100 | 0 | 3.88063 | 0 | 100 | 100 | 100 | 0 | 0.00586936 | 0 |
| Mole Fraction Light Liquid | % | 30.2522 | 0 | 100 | 100 | 0 | 100 | 0 | 100 | 96.1194 | 100 | 0 | 0 | | 100 | 1.15245 | 100 |
| Mole Fraction Heavy Liquid | % | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 98.8417 | 0 |
| Molecular Weight | lb/lbmol | 19.9 | 20.9 | 18.0 | 98.1 | 41.5 | 112.3 | 20.9 | 18.0 | 98.0 | 18.0 | 20.0255 | 41.9378 | | 18.0165 | 18.9421 | 106.962 |
| Mass Density | lb/ft^3 | 0.9 | 1.0 | 62.3 | 43.9 | 0.1 | 44.8 | 1.0 | 57.3 | 30.2 | 62.2 | 0.0513746 | 0.168514 | | 62.2584 | 60.4428 | 44.5615 |
| Molar Flow | lbmol/h | 33139.4 | 21959.6 | 11179.8 | 130.7 | 8.7 | 107.5 | 21929.6 | 11209.8 | 130.8 | 11175.4 | 4.39591 | 0.541542 | 0 | 11179.8 | 11310.6 | 116.239 |
| Mass Flow | lb/h | 660018.4 | 458596.8 | 201419.7 | 12823.5 | 362.0 | 12071.1 | 458070.1 | 201948.3 | 12825.7 | 201331.7 | 88.0302 | 22.7111 | 0 | 201422 | 214247 | 12433.1 |
| Vapor Volumetric Flow | MCFH | 740.7 | 473.4 | 3.2 | 0.3 | 3.4 | 0.3 | 475.4 | 3.5 | 0.4 | 3.2 | 1.71350 | 0.134773 | | 3.23525 | 3.54463 | 0.279010 |
| Liquid Volumetric Flow | Mbbl/d | 3166.4 | 2023.8 | 13.8 | 1.2 | 14.4 | 1.2 | 2032.3 | 15.1 | 1.8 | 13.8 | 7.32448 | 0.576097 | | 13.8293 | 15.1518 | 1.19265 |
| Std Vapor Volumetric Flow | MMSCFD | 301.8 | 200.0 | 101.8 | 1.2 | 0.1 | 1.0 | 199.7 | 102.1 | 1.2 | 101.8 | 0.0400363 | 0.00493216 | 0 | 101.822 | 103.013 | 1.05866 |
| Std Liquid Volumetric Flow | Mbbl/d | 105.5 | 91.6 | 13.8 | 1.3 | 0.1 | 1.2 | 91.6 | 13.8 | 1.3 | 13.8 | 0.0176632 | 0.00332571 | 0 | 13.8178 | 15.0905 | 1.20230 |
| Compressibility | | 0.682 | 0.936 | 0.013 | 0.097 | 0.985 | 0.006 | 0.964 | 0.008 | 0.144 | 0.001 | 0.996597 | 0.976633 | | 0.0125593 | 0.0134879 | 0.0230970 |
| Specific Gravity | | | 0.721 | 0.998 | 0.704 | 1.433 | 0.718 | 0.721 | 0.920 | | 0.998 | 0.691426 | 1.44800 | | 0.998227 | | 0.714482 |
| API Gravity | | | | 10.1 | 68.1 | | 63.6 | | 10.0 | | 10.0 | | | | 10.0519 | | 65.2156 |
| Enthalpy | MMBtu/h | -2056.3 | -757.9 | -1374.8 | -11.4 | -0.4 | -10.3 | -723.7 | -1332.6 | -10.4 | -1373.6 | -0.161631 | -0.0239831 | 0 | -1374.80 | -1385.23 | -10.7631 |
| Mass Enthalpy | Btu/lb | -3115.5 | -1652.6 | -6825.5 | -885.1 | -1071.8 | -851.9 | -1579.9 | -6598.5 | -813.3 | -6822.4 | -1836.08 | -1056.01 | | -6825.49 | -6465.58 | -865.683 |
| Mass Cp | Btu/(lb*°F) | 0.7 | 0.5 | 1.0 | 0.5 | 0.4 | 0.5 | 0.6 | 1.0 | 0.6 | 1.0 | 0.481124 | 0.409001 | | 0.983032 | 0.953614 | 0.488559 |
| Ideal Gas CpCv Ratio | | 1.243 | 1.249 | 1.326 | 1.057 | 1.133 | 1.049 | 1.215 | 1.316 | 1.046 | 1.326 | 1.26077 | 1.13260 | | 1.32581 | 1.30847 | 1.05189 |
| Dynamic Viscosity | cP | | 0.0 | 1.0 | 0.4 | 0.0 | 0.5 | 0.0 | 0.2 | | 0.9 | 0.0107825 | 0.00851980 | | 0.995522 | | 0.496561 |
| Kinematic Viscosity | cSt | | 0.7 | 1.0 | 0.6 | 5.0 | 0.7 | 0.8 | 0.2 | | 0.9 | 13.1023 | 3.15626 | | 0.998233 | | 0.695651 |
| Thermal Conductivity | Btu/(h*ft*°F) | | 0.0 | 0.3 | 0.1 | 0.0 | 0.1 | 0.0 | 0.4 | | 0.3 | 0.0173923 | 0.0107767 | | 0.346442 | | 0.0689748 |
| Surface Tension | lbf/ft | | | 0.005 | 0.001 | | 0.001 | | 0.003 | | 0.005 | | | | 0.00503944 | | 0.00145907 |
| Net I.G. Heating Value | Btu/ft^3 | 755.6 | 1140.1 | 0.5 | 4954.3 | 2178.2 | 5648.8 | 1141.9 | 0.0 | 4950.5 | 0.0 | 1052.77 | 2203.19 | | 0.448229 | 57.6969 | 5388.44 |
| Net Liquid Heating Value | Btu/lb | 14031.1 | 20654.9 | -1049.8 | 18981.0 | 19754.5 | 18916.0 | 20684.2 | -1059.8 | 18985.5 | -1058.9 | 19868.0 | 19779.2 | | -1049.84 | 149.561 | 18940.4 |
| Gross I.G. Heating Value | Btu/ft^3 | 850.0 | 1256.9 | 50.8 | 5327.1 | 2369.3 | 6067.7 | 1258.8 | 50.3 | 5323.1 | 50.3 | 1163.41 | 2396.10 | | 50.7837 | 111.759 | 5790.26 |
| Gross Liquid Heating Value | Btu/lb | 15829.8 | 22777.9 | 10.5 | 20421.0 | 21500.6 | 20330.3 | 22808.7 | 0.0 | 20425.9 | 0.9 | 21964.7 | 21524.7 | | 10.4 | 1232.5 | 20364.4 |

| **Process Streams** | | **Well Stream** | **HP Separator Gas** | **HP Separator Water** | **HP Separator Oil** | **OT Flash Gas** | **Sales Oil** | **Gas** | **Water** | **Oil** | **Produced Water** | **PWT Flash Gas** | **Oil W/B** | **Water W/B** | **1** | **3** | **LP Separator Oil** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Phase: Vapor** | **Status** | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved |
| **Mole Fraction** | | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** |
| Water | | 5.13336 | 0.157552 | 0.157689 | 0.157689 | 0.229379 | 0.229379 | 0 | | 0 | 3.02994 | 3.02994 | 0.000109874 | | 0.157552 | 0.182990 | 0.281649 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 0.469285 | 0.493930 | 0.548628 | 0.548628 | 0.00911088 | 0.00911088 | 0.494658 | | 0.224489 | 0.278296 | 0.278296 | 0.000339243 | | 0.493930 | 0.515935 | 0.123304 |
| Carbon Dioxide | | 0.139030 | 0.145923 | 0.103900 | 0.103900 | 0.122484 | 0.122484 | 0.146717 | | 0 | 0.945391 | 0.945391 | 0.130788 | | 0.145923 | 0.108295 | 0.168776 |
| Methane | | 73.7128 | 77.5798 | 79.8412 | 79.8412 | 11.5107 | 11.5107 | 77.7018 | | 58.3535 | 76.6094 | 76.6094 | 2.49734 | | 77.5798 | 79.0443 | 50.2902 |
| Ethane | | 13.4715 | 14.1779 | 13.8988 | 13.8988 | 34.6571 | 34.6571 | 14.2004 | | 22.3546 | 14.1775 | 14.1775 | 43.8560 | | 14.1779 | 14.3493 | 30.5508 |
| Propane | | 4.26379 | 4.48715 | 3.58166 | 3.58166 | 28.9707 | 28.9707 | 4.49433 | | 9.25482 | 3.85371 | 3.85371 | 31.1216 | | 4.48715 | 3.77925 | 11.8483 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Isobutane | | 0.537616 | 0.565850 | 0.447997 | 0.447997 | 5.31811 | 5.31811 | 0.566666 | | 1.57691 | 0.161824 | 0.161824 | 5.30483 | | 0.565850 | 0.478424 | 1.62199 |
| n-Butane | | 1.12320 | 1.18213 | 0.769918 | 0.769918 | 9.96142 | 9.96142 | 1.18394 | | 3.07001 | 0.579212 | 0.579212 | 9.76878 | | 1.18213 | 0.826418 | 2.83198 |
| Isopentane | | 0.355720 | 0.374394 | 0.210020 | 0.210020 | 2.96077 | 2.96077 | 0.374944 | | 1.11534 | 0.103699 | 0.103699 | 2.75134 | | 0.374394 | 0.227999 | 0.759089 |
| n-Pentane | | 0.276489 | 0.291007 | 0.165308 | 0.165308 | 2.38069 | 2.38069 | 0.291434 | | 0.981701 | 0.0794474 | 0.0794474 | 2.18589 | | 0.291007 | 0.180307 | 0.598147 |
| 2-Methylpentane | | 0 | 0 | 0.0603885 | 0.0603885 | 0.878065 | 0.878065 | 0 | | 0.472998 | 0.0132459 | 0.0132459 | 0.789398 | | 0 | 0.0665990 | 0.212222 |
| 3-Methylpentane | | 0 | 0 | 0.0292592 | 0.0292592 | 0.426199 | 0.426199 | 0 | | 0.236740 | 0.0171318 | 0.0171318 | 0.382131 | | 0 | 0.0323092 | 0.102684 |
| n-Hexane | | 0.517220 | 0.544400 | 0.0508416 | 0.0508416 | 0.735656 | 0.735656 | 0.545164 | | 0.447750 | 0.00876741 | 0.00876741 | 0.0448536 | | 0.544400 | 0.0563469 | 0.176190 |
| Methylcyclopentane | | 0 | 0 | 0.0103552 | 0.0103552 | 0.152715 | 0.152715 | 0 | | 0.0898031 | 0.0178673 | 0.0178673 | 0.126811 | | 0 | 0.0114655 | 0.0365423 |
| Benzene | | 0 | 0 | 0.00148635 | 0.00148635 | 0.0220101 | 0.0220101 | 0 | | 0.0134706 | 0.0168004 | 0.0168004 | 0.00113757 | | 0 | 0.00164406 | 0.00528803 |
| 2-Methylhexane | | 0 | 0 | 0.0199041 | 0.0199041 | 0.277903 | 0.277903 | 0 | | 0.238108 | 0.00368683 | 0.00368683 | 0.0158226 | | 0 | 0.0223566 | 0.0656847 |
| 3-Methylhexane | | 0 | 0 | 0.0155017 | 0.0155017 | 0.216512 | 0.216512 | 0 | | 0.184720 | 0.00299762 | 0.00299762 | 0.185684 | | 0 | 0.0174020 | 0.0512034 |
| Heptane | | 0 | 0 | 0.0301303 | 0.0301303 | 0.413355 | 0.413355 | 0 | | 0.376547 | 0.00599613 | 0.00599613 | 0.326405 | | 0 | 0.0338657 | 0.0979494 |
| Methylcyclohexane | | 0 | 0 | 0.0173517 | 0.0173517 | 0.244552 | 0.244552 | 0 | | 0.208174 | 0.0187966 | 0.0187966 | 0.194948 | | 0 | 0.0194695 | 0.0578076 |
| Toluene | | 0 | 0 | 0.00293425 | 0.00293425 | 0.0415656 | 0.0415656 | 0 | | 0.0378441 | 0.0298562 | 0.0298562 | 0.00453880 | | 0 | 0.00329813 | 0.00982322 |
| Octane | | 0 | 0 | 0.0248326 | 0.0248326 | 0.322359 | 0.322359 | 0 | | 0.446831 | 0.00277808 | 0.00277808 | 0.239478 | | 0 | 0.0283272 | 0.0758277 |
| Ethylbenzene | | 0 | 0 | 0.00158175 | 0.00158175 | 0.0211736 | 0.0211736 | 0 | | 0.0286106 | 0.0150046 | 0.0150046 | 0.00435350 | | 0 | 0.00180352 | 0.00496769 |
| m-Xylene | | 0 | 0 | 0.000952294 | 0.000952294 | 0.0126632 | 0.0126632 | 0 | | 0.0185371 | 0.00888734 | 0.00888734 | 0.00335273 | | 0 | 0.00108926 | 0.00296403 |
| o-Xylene | | 0 | 0 | 0.00191269 | 0.00191269 | 0.0254362 | 0.0254362 | 0 | | 0.0380905 | 0.0184926 | 0.0184926 | 0.00583152 | | 0 | 0.00218939 | 0.00595036 |
| Nonane | | 0 | 0 | 0.00590535 | 0.00590535 | 0.0731056 | 0.0731056 | 0 | | 0.151645 | 0.000973456 | 0.000973456 | 0.0491355 | | 0 | 0.00683429 | 0.0169791 |
| C10+ | | 0 | 0 | 0.00148354 | 0.00148354 | 0.0162823 | 0.0162823 | 0 | | 0.0787916 | 0.000244438 | 0.000244438 | 0.00917666 | | 0 | 0.00176839 | 0.00376527 |
| **Molar Flow** | | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** |
| Water | | 1186.53 | 34.5978 | 0 | 0 | 0.0200008 | 0 | 0 | | 0 | 0 | 0.133193 | 5.95014E-07 | | 0 | 0.00121480 | 0 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 108.471 | 108.465 | 0 | 0 | 0.000794428 | 0 | 108.477 | | 0.0113957 | 0 | 0.0122336 | 1.83714E-06 | | 0 | 0.00342510 | 0 |
| Carbon Dioxide | | 32.1355 | 32.0442 | 0 | 0 | 0.0106801 | 0 | 32.1745 | | 0 | 0 | 0.0415585 | 0.000708274 | | 0 | 0.000718933 | 0 |
| Methane | | 17038.0 | 17036.2 | 0 | 0 | 1.00368 | 0 | 17039.7 | | 2.96218 | 0 | 3.36768 | 0.0135241 | | 0 | 0.524745 | 0 |
| Ethane | | 3113.80 | 3113.40 | 0 | 0 | 3.02195 | 0 | 3114.08 | | 1.13478 | 0 | 0.623232 | 0.237498 | | 0 | 0.0952598 | 0 |
| Propane | | 985.532 | 985.361 | 0 | 0 | 2.52611 | 0 | 985.588 | | 0.469800 | 0 | 0.169405 | 0.168536 | | 0 | 0.0250890 | 0 |
| Isobutane | | 124.265 | 124.259 | 0 | 0 | 0.463715 | 0 | 124.268 | | 0.0800481 | 0 | 0.00711361 | 0.0287279 | | 0 | 0.00317607 | 0 |
| n-Butane | | 259.617 | 259.592 | 0 | 0 | 0.868591 | 0 | 259.633 | | 0.155842 | 0 | 0.0254616 | 0.0529021 | | 0 | 0.00548627 | 0 |
| Isopentane | | 82.2212 | 82.2154 | 0 | 0 | 0.258166 | 0 | 82.2237 | | 0.0566176 | 0 | 0.00455853 | 0.0148997 | | 0 | 0.00151360 | 0 |
| n-Pentane | | 63.9078 | 63.9040 | 0 | 0 | 0.207586 | 0 | 63.9104 | | 0.0498338 | 0 | 0.00349243 | 0.0118375 | | 0 | 0.00119699 | 0 |
| 2-Methylpentane | | 0 | 0 | 0 | 0 | 0.0765633 | 0 | 0 | | 0.0240106 | 0 | 0.000582276 | 0.00427492 | | 0 | 0.000442126 | 0 |
| 3-Methylpentane | | 0 | 0 | 0 | 0 | 0.0371627 | 0 | 0 | | 0.0120176 | 0 | 0.000753098 | 0.00206940 | | 0 | 0.000214489 | 0 |
| n-Hexane | | 119.550 | 119.548 | 0 | 0 | 0.0641459 | 0 | 119.552 | | 0.0227290 | 0 | 0.000385407 | 0.000242901 | | 0 | 0.000374066 | 0 |
| Methylcyclopentane | | 0 | 0 | 0 | 0 | 0.0133161 | 0 | 0 | | 0.00455865 | 0 | 0.000785430 | 0.000686734 | | 0 | 7.61148E-05 | 0 |
| Benzene | | 0 | 0 | 0 | 0 | 0.00191918 | 0 | 0 | | 0.000683803 | 0 | 0.000738531 | 6.16043E-06 | | 0 | 1.09143E-05 | 0 |
| 2-Methylhexane | | 0 | 0 | 0 | 0 | 0.0242319 | 0 | 0 | | 0.0120870 | 0 | 0.000162070 | 8.56861E-05 | | 0 | 0.000148417 | 0 |
| 3-Methylhexane | | 0 | 0 | 0 | 0 | 0.0188789 | 0 | 0 | | 0.00937689 | 0 | 0.000131772 | 0.00100556 | | 0 | 0.000115525 | 0 |
| Heptane | | 0 | 0 | 0 | 0 | 0.0360427 | 0 | 0 | | 0.0191145 | 0 | 0.000263584 | 0.00176762 | | 0 | 0.000224822 | 0 |
| Methylcyclohexane | | 0 | 0 | 0 | 0 | 0.0213238 | 0 | 0 | | 0.0105675 | 0 | 0.000826280 | 0.00105572 | | 0 | 0.000129251 | 0 |
| Toluene | | 0 | 0 | 0 | 0 | 0.00362434 | 0 | 0 | | 0.00192107 | 0 | 0.00131245 | 2.45795E-05 | | 0 | 2.18951E-05 | 0 |
| Octane | | 0 | 0 | 0 | 0 | 0.0281082 | 0 | 0 | | 0.0226824 | 0 | 0.000122122 | 0.00129687 | | 0 | 0.000188054 | 0 |
| Ethylbenzene | | 0 | 0 | 0 | 0 | 0.00184625 | 0 | 0 | | 0.00145235 | 0 | 0.000659586 | 2.35760E-05 | | 0 | 1.19729E-05 | 0 |
| m-Xylene | | 0 | 0 | 0 | 0 | 0.00110417 | 0 | 0 | | 0.000940994 | 0 | 0.000390679 | 1.81564E-05 | | 0 | 7.23119E-06 | 0 |
| o-Xylene | | 0 | 0 | 0 | 0 | 0.00221792 | 0 | 0 | | 0.00193358 | 0 | 0.000812919 | 3.15801E-05 | | 0 | 1.45345E-05 | 0 |
| Nonane | | 0 | 0 | 0 | 0 | 0.00637448 | 0 | 0 | | 0.00769794 | 0 | 4.27922E-05 | 0.000266089 | | 0 | 4.53703E-05 | 0 |
| C10+ | | 0 | 0 | 0 | 0 | 0.00141975 | 0 | 0 | | 0.00399967 | 0 | 1.07453E-05 | 4.96955E-05 | | 0 | 1.17397E-05 | 0 |
| **Mass Fraction** | | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** |
| Water | | 4.45879 | 0.135912 | 0.141807 | 0.141807 | 0.0995326 | 0.0995326 | 0 | | 0 | 2.72578 | 2.72578 | 4.71987E-05 | | 0.135912 | 0.162957 | 0.187408 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 0.633836 | 0.662560 | 0.767183 | 0.767183 | 0.00614747 | 0.00614747 | 0.663391 | | 0.228800 | 0.389305 | 0.389305 | 0.000226605 | | 0.662560 | 0.714440 | 0.127580 |
| Carbon Dioxide | | 0.295006 | 0.307514 | 0.228252 | 0.228252 | 0.129837 | 0.129837 | 0.309119 | | 0 | 2.07766 | 2.07766 | 0.137249 | | 0.307514 | 0.235592 | 0.274345 |
| Methane | | 57.0148 | 59.5955 | 63.9371 | 63.9371 | 4.44777 | 4.44777 | 59.6762 | | 34.0591 | 61.3719 | 61.3719 | 0.955306 | | 59.5955 | 62.6825 | 29.7984 |
| Ethane | | 19.5303 | 20.4138 | 20.8618 | 20.8618 | 25.1005 | 25.1005 | 20.4417 | | 24.4558 | 21.2881 | 21.2881 | 31.4443 | | 20.4138 | 21.3283 | 33.9298 |
| Propane | | 9.06494 | 9.47457 | 7.88378 | 7.88378 | 30.7698 | 30.7698 | 9.48766 | | 14.8477 | 8.48577 | 8.48577 | 32.7228 | | 9.47457 | 8.23770 | 19.2970 |
| Isobutane | | 1.50657 | 1.57484 | 1.29978 | 1.29978 | 7.44509 | 7.44509 | 1.57677 | | 3.33460 | 0.469678 | 0.469678 | 7.35203 | | 1.57484 | 1.37455 | 3.48201 |
| n-Butane | | 3.14756 | 3.29005 | 2.23378 | 2.23378 | 13.9455 | 13.9455 | 3.29435 | | 6.49199 | 1.68111 | 1.68111 | 13.5387 | | 3.29005 | 2.37436 | 6.07955 |
| Isopentane | | 1.23740 | 1.29345 | 0.756387 | 0.756387 | 5.14522 | 5.14522 | 1.29507 | | 2.92773 | 0.373613 | 0.373613 | 4.73333 | | 1.29345 | 0.813144 | 2.02284 |
| n-Pentane | | 0.961792 | 1.00537 | 0.595358 | 0.595358 | 4.13717 | 4.13717 | 1.00663 | | 2.57694 | 0.286237 | 0.286237 | 3.76055 | | 1.00537 | 0.643052 | 1.59396 |
| 2-Methylpentane | | 0 | 0 | 0.259772 | 0.259772 | 1.82255 | 1.82255 | 0 | | 1.48299 | 0.0570007 | 0.0570007 | 1.62208 | | 0 | 0.283697 | 0.675479 |
| 3-Methylpentane | | 0 | 0 | 0.125864 | 0.125864 | 0.884640 | 0.884640 | 0 | | 0.742251 | 0.0737230 | 0.0737230 | 0.785217 | | 0 | 0.137630 | 0.326831 |
| n-Hexane | | 2.14898 | 2.24644 | 0.218704 | 0.218704 | 1.52696 | 1.52696 | 2.24910 | | 1.40383 | 0.0377287 | 0.0377287 | 0.0921668 | | 2.24644 | 0.240026 | 0.560795 |
| Methylcyclopentane | | 0 | 0 | 0.0435025 | 0.0435025 | 0.309568 | 0.309568 | 0 | | 0.274973 | 0.0750894 | 0.0750894 | 0.254480 | | 0 | 0.0476979 | 0.113589 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benzene | | 0 | 0 | 0.00579552 | 0.00579552 | 0.0414104 | 0.0414104 | 0 | | 0.0382823 | 0.0655321 | 0.0655321 | 0.00211880 | | 0 | 0.00634805 | 0.0152563 |
| 2-Methylhexane | | 0 | 0 | 0.0995573 | 0.0995573 | 0.670718 | 0.670718 | 0 | | 0.868053 | 0.0184479 | 0.0184479 | 0.0378049 | | 0 | 0.110735 | 0.243097 |
| 3-Methylhexane | | 0 | 0 | 0.0775372 | 0.0775372 | 0.522552 | 0.522552 | 0 | | 0.673419 | 0.0149992 | 0.0149992 | 0.443654 | | 0 | 0.0861946 | 0.189502 |
| Heptane | | 0 | 0 | 0.150708 | 0.150708 | 0.997631 | 0.997631 | 0 | | 1.37275 | 0.0300029 | 0.0300029 | 0.779877 | | 0 | 0.167742 | 0.362508 |
| Methylcyclohexane | | 0 | 0 | 0.0850446 | 0.0850446 | 0.578351 | 0.578351 | 0 | | 0.743657 | 0.0921606 | 0.0921606 | 0.456417 | | 0 | 0.0944952 | 0.209640 |
| Toluene | | 0 | 0 | 0.0134956 | 0.0134956 | 0.0922456 | 0.0922456 | 0 | | 0.126863 | 0.137370 | 0.137370 | 0.00997185 | | 0 | 0.0150215 | 0.0334298 |
| Octane | | 0 | 0 | 0.141596 | 0.141596 | 0.886920 | 0.886920 | 0 | | 1.85701 | 0.0158466 | 0.0158466 | 0.652279 | | 0 | 0.159950 | 0.319920 |
| Ethylbenzene | | 0 | 0 | 0.00838248 | 0.00838248 | 0.0541436 | 0.0541436 | 0 | | 0.110511 | 0.0795465 | 0.0795465 | 0.0110208 | | 0 | 0.00946468 | 0.0194794 |
| m-Xylene | | 0 | 0 | 0.00504670 | 0.00504670 | 0.0323813 | 0.0323813 | 0 | | 0.0716010 | 0.0471162 | 0.0471162 | 0.00848737 | | 0 | 0.00571634 | 0.0116226 |
| o-Xylene | | 0 | 0 | 0.0101363 | 0.0101363 | 0.0650436 | 0.0650436 | 0 | | 0.147128 | 0.0980385 | 0.0980385 | 0.0147624 | | 0 | 0.0114897 | 0.0233327 |
| Nonane | | 0 | 0 | 0.0378072 | 0.0378072 | 0.225837 | 0.225837 | 0 | | 0.707620 | 0.00623459 | 0.00623459 | 0.150267 | | 0 | 0.0433284 | 0.0804321 |
| C10+ | | 0 | 0 | 0.0117896 | 0.0117896 | 0.0624354 | 0.0624354 | 0 | | 0.456371 | 0.00194325 | 0.00194325 | 0.0348355 | | 0 | 0.0139164 | 0.0221401 |
| **Mass Flow** | | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** |
| Water | | 21375.6 | 623.289 | 0 | 0 | 0.360321 | 0 | 0 | | 0 | 0 | 2.39951 | 1.07193E-05 | | 0 | 0.0218850 | 0 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 3038.63 | 3038.48 | 0 | 0 | 0.0222546 | 0 | 3038.80 | | 0.319232 | 0 | 0.342706 | 5.14646E-05 | | 0 | 0.0959487 | 0 |
| Carbon Dioxide | | 1414.27 | 1410.25 | 0 | 0 | 0.470025 | 0 | 1415.98 | | 0 | 0 | 1.82897 | 0.0311708 | | 0 | 0.0316399 | 0 |
| Methane | | 273331 | 273303 | 0 | 0 | 16.1015 | 0 | 273359 | | 47.5207 | 0 | 54.0258 | 0.216960 | | 0 | 8.41820 | 0 |
| Ethane | | 93629.0 | 93617.1 | 0 | 0 | 90.8670 | 0 | 93637.5 | | 34.1217 | 0 | 18.7400 | 7.14135 | | 0 | 2.86437 | 0 |
| Propane | | 43457.7 | 43450.1 | 0 | 0 | 111.391 | 0 | 43460.1 | | 20.7161 | 0 | 7.47004 | 7.43172 | | 0 | 1.10632 | 0 |
| Isobutane | | 7222.53 | 7222.18 | 0 | 0 | 26.9522 | 0 | 7222.71 | | 4.65257 | 0 | 0.413459 | 1.66973 | | 0 | 0.184600 | 0 |
| n-Butane | | 15089.5 | 15088.1 | 0 | 0 | 50.4844 | 0 | 15090.4 | | 9.05788 | 0 | 1.47988 | 3.07478 | | 0 | 0.318874 | 0 |
| Isopentane | | 5932.16 | 5931.74 | 0 | 0 | 18.6263 | 0 | 5932.34 | | 4.08489 | 0 | 0.328892 | 1.07499 | | 0 | 0.109205 | 0 |
| n-Pentane | | 4610.87 | 4610.60 | 0 | 0 | 14.9771 | 0 | 4611.05 | | 3.59545 | 0 | 0.251975 | 0.854062 | | 0 | 0.0863613 | 0 |
| 2-Methylpentane | | 0 | 0 | 0 | 0 | 6.59787 | 0 | 0 | | 2.06913 | 0 | 0.0501778 | 0.368393 | | 0 | 0.0381003 | 0 |
| 3-Methylpentane | | 0 | 0 | 0 | 0 | 3.20251 | 0 | 0 | | 1.03562 | 0 | 0.0648985 | 0.178331 | | 0 | 0.0184837 | 0 |
| n-Hexane | | 10302.3 | 10302.1 | 0 | 0 | 5.52779 | 0 | 10302.5 | | 1.95868 | 0 | 0.0332126 | 0.0209321 | | 0 | 0.0322352 | 0 |
| Methylcyclopentane | | 0 | 0 | 0 | 0 | 1.12067 | 0 | 0 | | 0.383654 | 0 | 0.0661014 | 0.0577952 | | 0 | 0.00640578 | 0 |
| Benzene | | 0 | 0 | 0 | 0 | 0.149911 | 0 | 0 | | 0.0534131 | 0 | 0.0576880 | 0.000481203 | | 0 | 0.000852538 | 0 |
| 2-Methylhexane | | 0 | 0 | 0 | 0 | 2.42808 | 0 | 0 | | 1.21114 | 0 | 0.0162397 | 0.00858592 | | 0 | 0.0148717 | 0 |
| 3-Methylhexane | | 0 | 0 | 0 | 0 | 1.89170 | 0 | 0 | | 0.939582 | 0 | 0.0132038 | 0.100759 | | 0 | 0.0115759 | 0 |
| Heptane | | 0 | 0 | 0 | 0 | 3.61155 | 0 | 0 | | 1.91531 | 0 | 0.0264117 | 0.177119 | | 0 | 0.0225276 | 0 |
| Methylcyclohexane | | 0 | 0 | 0 | 0 | 2.09370 | 0 | 0 | | 1.03758 | 0 | 0.0811291 | 0.103657 | | 0 | 0.0126906 | 0 |
| Toluene | | 0 | 0 | 0 | 0 | 0.333941 | 0 | 0 | | 0.177004 | 0 | 0.120927 | 0.00226472 | | 0 | 0.00201738 | 0 |
| Octane | | 0 | 0 | 0 | 0 | 3.21076 | 0 | 0 | | 2.59097 | 0 | 0.0139498 | 0.148140 | | 0 | 0.0214811 | 0 |
| Ethylbenzene | | 0 | 0 | 0 | 0 | 0.196007 | 0 | 0 | | 0.154189 | 0 | 0.0700250 | 0.00250295 | | 0 | 0.00127110 | 0 |
| m-Xylene | | 0 | 0 | 0 | 0 | 0.117224 | 0 | 0 | | 0.0999006 | 0 | 0.0414765 | 0.00192758 | | 0 | 0.000767700 | 0 |
| o-Xylene | | 0 | 0 | 0 | 0 | 0.235466 | 0 | 0 | | 0.205278 | 0 | 0.0863035 | 0.00335270 | | 0 | 0.00154306 | 0 |
| Nonane | | 0 | 0 | 0 | 0 | 0.817559 | 0 | 0 | | 0.987300 | 0 | 0.00548832 | 0.0341273 | | 0 | 0.00581897 | 0 |
| C10+ | | 0 | 0 | 0 | 0 | 0.226024 | 0 | 0 | | 0.636748 | 0 | 0.00171065 | 0.00791152 | | 0 | 0.00186896 | 0 |

| **Process Streams** | | **Well Stream** | **HP Separator Gas** | **HP Separator Water** | **HP Separator Oil** | **OT Flash Gas** | **Sales Oil** | **Gas** | **Water** | **Oil** | **Produced Water** | **PWT Flash Gas** | **Oil W/B** | **Water W/B** | **1** | **3** | **LP Separator Oil** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Phase: Vapor** | **Status** | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved |
| **Property** | **Units** | | | | | | | | | | | | | | | | |
| Temperature | °F | 196.0 | 70.0 | 70.0 | 70.0 | 75.9 | 75.9 | 200.0 | | 200.0 | 75.9 | 75.94 | 75.9425 | | 70 | 74.4472 | 70 |
| Pressure | psig | 200 | 232 | 232 | 232 | 0 | 0 | 300 | | 300 | 0 | 0 | 7.86079 | | 232 | 232 | 40 |
| Mole Fraction Vapor | % | 100 | 100 | 100 | 100 | 100 | 100 | 100 | | 100 | 100 | 100 | 100 | | 100 | 100 | 100 |
| Mole Fraction Light Liquid | % | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Mole Fraction Heavy Liquid | % | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Molecular Weight | lb/lbmol | 20.7 | 20.9 | 20.0 | 20.0 | 41.5 | 41.5 | 20.9 | | 27.5 | 20.0 | 20.0255 | 41.9378 | | 20.8836 | 20.2300 | 27.0745 |
| Mass Density | lb/ft^3 | 0.6 | 1.0 | 0.9 | 0.9 | 0.1 | 0.1 | 1.0 | | 1.3 | 0.1 | 0.0513746 | 0.168514 | | 0.968639 | 0.924813 | 0.267108 |
| Molar Flow | lbmol/h | 23114.0 | 21959.6 | 0.0 | 0.0 | 8.7 | 0.0 | 21929.6 | | 5.1 | 0.0 | 4.39591 | 0.541542 | | 0 | 0.663862 | 0 |
| Mass Flow | lb/h | 479403.8 | 458596.8 | 0.0 | 0.0 | 362.0 | 0.0 | 458070.1 | | 139.5 | 0.0 | 88.0302 | 22.7111 | | 0 | 13.4299 | 0 |
| Vapor Volumetric Flow | MCFH | 737.7 | 473.4 | 0.0 | 0.0 | 3.4 | 0.0 | 475.4 | | 0.1 | 0.0 | 1.71350 | 0.134773 | | 0 | 0.0145218 | 0 |
| Liquid Volumetric Flow | Mbbl/d | 3153.5 | 2023.8 | 0.0 | 0.0 | 14.4 | 0.0 | 2032.3 | | 0.5 | 0.0 | 7.32448 | 0.576097 | | 0 | 0.0620745 | 0 |
| Std Vapor Volumetric Flow | MMSCFD | 210.5 | 200.0 | 0.0 | 0.0 | 0.1 | 0.0 | 199.7 | | 0.0 | 0.0 | 0.0400363 | 0.00493216 | | 0 | 0.00604621 | 0 |
| Std Liquid Volumetric Flow | Mbbl/d | 93.1 | 91.6 | 0.0 | 0.0 | 0.1 | 0.0 | 91.6 | | 0.0 | 0.0 | 0.0176632 | 0.00332571 | | 0 | 0.00273728 | 0 |
| Compressibility | | 0.974 | 0.936 | 0.941 | 0.941 | 0.985 | 0.985 | 0.964 | | 0.931 | 0.997 | 0.996597 | 0.976633 | | 0.935701 | 0.941462 | 0.975346 |
| Specific Gravity | | 0.716 | 0.721 | 0.692 | 0.692 | 1.433 | 1.433 | 0.721 | | 0.949 | 0.691 | 0.691426 | 1.44800 | | 0.721056 | 0.698486 | 0.934809 |
| API Gravity | | | | | | | | | | | | | | | | | |
| Enthalpy | MMBtu/h | -845.7 | -757.9 | 0.0 | 0.0 | -0.4 | 0.0 | -723.7 | | -0.2 | 0.0 | -0.161631 | -0.0239831 | | 0 | -0.0226063 | 0 |
| Mass Enthalpy | Btu/lb | -1764.0 | -1652.6 | -1695.8 | -1695.8 | -1071.8 | -1071.8 | -1579.9 | | -1305.5 | -1836.1 | -1836.08 | -1056.01 | | -1652.59 | -1683.28 | -1376.04 |
| Mass Cp | Btu/(lb*°F) | 0.5 | 0.5 | 0.5 | 0.5 | 0.4 | 0.4 | 0.6 | | 0.5 | 0.5 | 0.481124 | 0.409001 | | 0.511047 | 0.515331 | 0.448184 |
| Ideal Gas CpCv Ratio | | 1.220 | 1.249 | 1.258 | 1.258 | 1.133 | 1.133 | 1.215 | | 1.165 | 1.261 | 1.26077 | 1.13260 | | 1.24907 | 1.25517 | 1.20007 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dynamic Viscosity | cP | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0107825 | 0.00851980 | | 0.0108061 | 0.0109382 | 0.00979749 |
| Kinematic Viscosity | cSt | 1.2 | 0.7 | 0.7 | 0.7 | 5.0 | 5.0 | 0.8 | | 0.6 | 13.1 | 13.1023 | 3.15626 | | 0.696444 | 0.738367 | 2.28985 |
| Thermal Conductivity | Btu/(h*ft*°F) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0173923 | 0.0107767 | | 0.0178833 | 0.0182457 | 0.0147553 |
| Surface Tension | lbf/ft | | | | | | | | | | | | | | | | |
| Net I.G. Heating Value | Btu/ft^3 | 1083.3 | 1140.1 | 1097.7 | 1097.7 | 2178.2 | 2178.2 | 1141.9 | | 1478.1 | 1052.8 | 1052.77 | 2203.19 | | 1140.11 | 1107.68 | 1454.42 |
| Net Liquid Heating Value | Btu/lb | 19714.7 | 20654.9 | 20737.1 | 20737.1 | 19754.5 | 19754.5 | 20684.2 | | 20299.7 | 19868.0 | 19868.0 | 19779.2 | | 20654.9 | 20720.0 | 20273.8 |
| Gross I.G. Heating Value | Btu/ft^3 | 1196.8 | 1256.9 | 1211.4 | 1211.4 | 2369.3 | 2369.3 | 1258.8 | | 1619.0 | 1163.4 | 1163.41 | 2396.10 | | 1256.94 | 1222.17 | 1593.74 |
| Gross Liquid Heating Value | Btu/lb | 21791.7 | 22777.9 | 22892.1 | 22892.1 | 21500.6 | 21500.6 | 22808.7 | | 22243.9 | 21964.7 | 21964.7 | 21524.7 | | 22777.9 | 22867.6 | 22226.5 |

| Process Streams | | Well Stream | HP Separator Gas | HP Separator Water | HP Separator Oil | OT Flash Gas | Sales Oil | Gas | Water | Oil | Produced Water | PWT Flash Gas | Oil W/B | Water W/B | 1 | 3 | LP Separator Oil |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Phase: Light Liquid** | **Status** | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved |
| **Mole Fraction** | | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| Water | | 99.9789 | 99.9589 | 99.9588 | 0.0501987 | 0.00462880 | 0.00462880 | | 100 | 0 | 99.9969 | 99.9969 | 3.09946E-06 | | 99.9589 | 0.0564055 | 0.0214883 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 5.85400E-05 | 0.000101795 | 0.000112685 | 0.0142266 | 1.35784E-05 | 1.35784E-05 | | 0 | 0.00758266 | 3.26005E-06 | 3.26005E-06 | 8.05777E-07 | | 0.000101795 | 0.0133286 | 0.000696006 |
| Carbon Dioxide | | 0.000388856 | 0.00116544 | 0.000829929 | 0.0285456 | 0.00212169 | 0.00212169 | | 0 | 0 | 0.000458380 | 0.000458380 | 0.00338399 | | 0.00116544 | 0.0287796 | 0.0111506 |
| Methane | | 0.0170314 | 0.0310988 | 0.0319662 | 6.36327 | 0.0549825 | 0.0549825 | | 0 | 4.46374 | 0.00184397 | 0.00184397 | 0.0187897 | | 0.0310988 | 6.20443 | 0.914323 |
| Ethane | | 0.00283744 | 0.00607361 | 0.00597218 | 6.55557 | 1.05871 | 1.05871 | | 0 | 5.92336 | 0.000397706 | 0.000397706 | 2.07549 | | 0.00607361 | 6.52335 | 3.57907 |
| Propane | | 0.000557248 | 0.00203453 | 0.00163468 | 5.98557 | 3.33530 | 3.33530 | | 0 | 5.81657 | 0.000119446 | 0.000119446 | 5.50989 | | 0.00203453 | 5.98821 | 5.25832 |
| Isobutane | | 3.07495E-05 | 8.17882E-05 | 6.53738E-05 | 1.82784 | 1.57239 | 1.57239 | | 0 | 1.83502 | 1.74525E-06 | 1.74525E-06 | 2.37939 | | 8.17882E-05 | 1.83039 | 1.85337 |
| n-Butane | | 0.000162735 | 0.000367047 | 0.000241498 | 4.46074 | 4.23308 | 4.23308 | | 0 | 4.50155 | 1.37563E-05 | 1.37563E-05 | 6.29140 | | 0.000367047 | 4.46782 | 4.66279 |
| Isopentane | | 2.53167E-05 | 7.47499E-05 | 4.24621E-05 | 2.96090 | 3.25618 | 3.25618 | | 0 | 3.02927 | 1.68795E-06 | 1.68795E-06 | 4.56963 | | 7.47499E-05 | 2.96701 | 3.23402 |
| n-Pentane | | 2.58072E-05 | 5.64763E-05 | 3.25188E-05 | 3.11443 | 3.51139 | 3.51139 | | 0 | 3.19489 | 1.28046E-06 | 1.28046E-06 | 4.85687 | | 5.64763E-05 | 3.12104 | 3.42657 |
| 2-Methylpentane | | 0 | 0 | 5.30992E-06 | 2.68359 | 3.16144 | 3.16144 | | 0 | 2.77014 | 1.01661E-07 | 1.01661E-07 | 4.27791 | | 0 | 2.68967 | 2.99016 |
| 3-Methylpentane | | 0 | 0 | 7.09285E-06 | 1.44904 | 1.71255 | 1.71255 | | 0 | 1.49690 | 3.56740E-07 | 3.56740E-07 | 2.30742 | | 0 | 1.45233 | 1.61605 |
| n-Hexane | | 1.92384E-05 | 3.68296E-05 | 3.50085E-06 | 3.10340 | 3.68797 | 3.68797 | | 0 | 3.20396 | 5.35076E-08 | 5.35076E-08 | 0.337708 | | 3.68296E-05 | 3.11052 | 3.46651 |
| Methylcyclopentane | | 0 | 0 | 8.14194E-06 | 0.667069 | 0.793339 | 0.793339 | | 0 | 0.690303 | 1.11693E-06 | 1.11693E-06 | 0.982869 | | 0 | 0.668604 | 0.745283 |
| Benzene | | 0 | 0 | 5.89487E-05 | 0.0970732 | 0.115470 | 0.115470 | | 0 | 0.105574 | 5.23633E-05 | 5.23633E-05 | 0.00872975 | | 0 | 0.0972302 | 0.108459 |
| 2-Methylhexane | | 0 | 0 | 1.47359E-06 | 2.71802 | 3.27161 | 3.27161 | | 0 | 2.81500 | 2.39339E-08 | 2.39339E-08 | 0.276638 | | 0 | 2.72437 | 3.04704 |
| 3-Methylhexane | | 0 | 0 | 1.19900E-06 | 2.22348 | 2.67755 | 2.67755 | | 0 | 2.30321 | 2.03400E-08 | 2.03400E-08 | 3.40629 | | 0 | 2.22867 | 2.49294 |
| Heptane | | 0 | 0 | 2.39859E-06 | 5.34300 | 6.44617 | 6.44617 | | 0 | 5.53727 | 4.09139E-08 | 4.09139E-08 | 7.52717 | | 0 | 5.35552 | 5.99363 |
| Methylcyclohexane | | 0 | 0 | 8.16811E-06 | 3.13194 | 3.77836 | 3.77836 | | 0 | 3.24692 | 7.77571E-07 | 7.77571E-07 | 4.45233 | | 0 | 3.13926 | 3.51327 |
| Toluene | | 0 | 0 | 8.86372E-05 | 0.655187 | 0.791497 | 0.791497 | | 0 | 0.687199 | 7.69279E-05 | 7.69279E-05 | 0.127275 | | 0 | 0.656492 | 0.735241 |
| Octane | | 0 | 0 | 1.10485E-06 | 13.2093 | 16.0157 | 16.0157 | | 0 | 13.7086 | 1.25097E-08 | 1.25097E-08 | 17.4932 | | 0 | 13.2405 | 14.8385 |
| Ethylbenzene | | 0 | 0 | 4.08593E-05 | 1.00668 | 1.22094 | 1.22094 | | 0 | 1.04858 | 3.49733E-05 | 3.49733E-05 | 0.367056 | | 0 | 1.00899 | 1.13094 |
| m-Xylene | | 0 | 0 | 2.49320E-05 | 0.718709 | 0.871953 | 0.871953 | | 0 | 0.748320 | 2.14459E-05 | 2.14459E-05 | 0.337292 | | 0 | 0.720337 | 0.807494 |
| o-Xylene | | 0 | 0 | 6.75755E-05 | 1.61611 | 1.96105 | 1.96105 | | 0 | 1.68387 | 6.03279E-05 | 6.03279E-05 | 0.655596 | | 0 | 1.61972 | 1.81585 |
| Nonane | | 0 | 0 | 3.89733E-07 | 9.13965 | 11.0983 | 11.0983 | | 0 | 9.49144 | 6.97170E-09 | 6.97170E-09 | 11.0431 | | 0 | 9.16125 | 10.2713 |
| C10+ | | 0 | 0 | 9.80662E-08 | 20.8764 | 25.3673 | 25.3673 | | 0 | 21.6907 | 1.95336E-09 | 1.95336E-09 | 20.6945 | | 0 | 20.9258 | 23.4656 |
| **Molar Flow** | | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h | lbmol/h |
| Water | | 10023.3 | 0 | 11175.2 | 0.0655883 | 0 | 0.00497684 | | 11209.8 | 0 | 11175.0 | 0 | 0 | | 11175.2 | 0.0735240 | 0.0249777 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 0.00586888 | 0 | 0.0125980 | 0.0185881 | 0 | 1.45994E-05 | | 0 | 0.00953401 | 0.000364323 | 0 | 0 | | 0.0113805 | 0.0173738 | 0.000809027 |
| Carbon Dioxide | | 0.0389845 | 0 | 0.0927842 | 0.0372970 | 0 | 0.00228122 | | 0 | 0 | 0.0512257 | 0 | 0 | | 0.130294 | 0.0375139 | 0.0129613 |
| Methane | | 1.70747 | 0 | 3.57375 | 8.31409 | 0 | 0.0591167 | | 0 | 5.61245 | 0.206071 | 0 | 0 | | 3.47679 | 8.08741 | 1.06280 |
| Ethane | | 0.284465 | 0 | 0.667677 | 8.56534 | 0 | 1.13831 | | 0 | 7.44770 | 0.0444452 | 0 | 0 | | 0.679019 | 8.50312 | 4.16026 |
| Propane | | 0.0558665 | 0 | 0.182754 | 7.82059 | 0 | 3.58608 | | 0 | 7.31343 | 0.0133485 | 0 | 0 | | 0.227457 | 7.80557 | 6.11220 |
| Isobutane | | 0.00308276 | 0 | 0.00730865 | 2.38821 | 0 | 1.69062 | | 0 | 2.30724 | 0.000195038 | 0 | 0 | | 0.00914378 | 2.38589 | 2.15434 |
| n-Butane | | 0.0163149 | 0 | 0.0269989 | 5.82829 | 0 | 4.55136 | | 0 | 5.65999 | 0.00153732 | 0 | 0 | | 0.0410352 | 5.82376 | 5.41995 |
| Isopentane | | 0.00253811 | 0 | 0.00474716 | 3.86863 | 0 | 3.50101 | | 0 | 3.80883 | 0.000188635 | 0 | 0 | | 0.00835691 | 3.86746 | 3.75918 |
| n-Pentane | | 0.00258728 | 0 | 0.00363553 | 4.06924 | 0 | 3.77541 | | 0 | 4.01707 | 0.000143096 | 0 | 0 | | 0.00631396 | 4.06825 | 3.98299 |
| 2-Methylpentane | | 0 | 0 | 0.000593637 | 3.50631 | 0 | 3.39915 | | 0 | 3.48302 | 1.13611E-05 | 0 | 0 | | 0 | 3.50596 | 3.47571 |
| 3-Methylpentane | | 0 | 0 | 0.000792965 | 1.89328 | 0 | 1.84131 | | 0 | 1.88212 | 3.98670E-05 | 0 | 0 | | 0 | 1.89310 | 1.87848 |
| n-Hexane | | 0.00192873 | 0 | 0.000391387 | 4.05482 | 0 | 3.96527 | | 0 | 4.02847 | 5.97968E-06 | 0 | 0 | | 0.00411749 | 4.05453 | 4.02942 |
| Methylcyclopentane | | 0 | 0 | 0.000910250 | 0.871575 | 0 | 0.852990 | | 0 | 0.867948 | 0.000124821 | 0 | 0 | | 0 | 0.871519 | 0.866306 |
| Benzene | | 0 | 0 | 0.00659033 | 0.126833 | 0 | 0.124152 | | 0 | 0.132743 | 0.00585180 | 0 | 0 | | 0 | 0.126739 | 0.126071 |
| 2-Methylhexane | | 0 | 0 | 0.000164744 | 3.55130 | 0 | 3.51760 | | 0 | 3.53942 | 2.67471E-06 | 0 | 0 | | 0 | 3.55119 | 3.54183 |
| 3-Methylhexane | | 0 | 0 | 0.000134045 | 2.90514 | 0 | 2.87887 | | 0 | 2.89592 | 2.27307E-06 | 0 | 0 | | 0 | 2.90505 | 2.89775 |
| Heptane | | 0 | 0 | 0.000268157 | 6.98103 | 0 | 6.93086 | | 0 | 6.96224 | 4.57228E-06 | 0 | 0 | | 0 | 6.98087 | 6.96690 |
| Methylcyclohexane | | 0 | 0 | 0.000913176 | 4.09211 | 0 | 4.06245 | | 0 | 4.08249 | 8.68966E-05 | 0 | 0 | | 0 | 4.09199 | 4.08378 |
| Toluene | | 0 | 0 | 0.00990944 | 0.856050 | 0 | 0.851009 | | 0 | 0.864045 | 0.00859699 | 0 | 0 | | 0 | 0.855730 | 0.854634 |
| Octane | | 0 | 0 | 0.000123520 | 17.2590 | 0 | 17.2199 | | 0 | 17.2365 | 1.39801E-06 | 0 | 0 | | 0 | 17.2588 | 17.2480 |
| Ethylbenzene | | 0 | 0 | 0.00456798 | 1.31531 | 0 | 1.31274 | | 0 | 1.31843 | 0.00390840 | 0 | 0 | | 0 | 1.31520 | 1.31459 |
| m-Xylene | | 0 | 0 | 0.00278734 | 0.939046 | 0 | 0.937515 | | 0 | 0.940895 | 0.00239666 | 0 | 0 | | 0 | 0.938952 | 0.938619 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| o-Xylene | | 0 | 0 | 0.00755479 | 2.11157 | 0 | 2.10850 | | 0 | 2.11720 | 0.00674187 | 0 | 0 | | 0 | 2.11128 | 2.11071 |
| Nonane | | 0 | 0 | 4.35713E-05 | 11.9416 | 0 | 11.9328 | | 0 | 11.9340 | 7.79114E-07 | 0 | 0 | | 0 | 11.9416 | 11.9392 |
| C10+ | | 0 | 0 | 1.09636E-05 | 27.2766 | 0 | 27.2746 | | 0 | 27.2726 | 2.18296E-07 | 0 | 0 | | 0 | 27.2766 | 27.2761 |
| **Mass Fraction** | | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** |
| Water | | 99.9768 | 99.9520 | 99.9524 | 0.00921427 | 0.000742758 | 0.000742758 | | 100 | 0 | 99.9949 | 99.9949 | 5.26991E-07 | | 99.9520 | 0.0103346 | 0.00361920 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 9.10266E-05 | 0.000158278 | 0.000175212 | 0.00406065 | 3.38807E-06 | 3.38807E-06 | | 0 | 0.00210528 | 5.06921E-06 | 5.06921E-06 | 2.13038E-07 | | 0.000158278 | 0.00379739 | 0.000182284 |
| Carbon Dioxide | | 0.000949916 | 0.00284685 | 0.00202730 | 0.0128001 | 0.000831699 | 0.000831699 | | 0 | 0 | 0.00111975 | 0.00111975 | 0.00140557 | | 0.00284685 | 0.0128814 | 0.00458791 |
| Methane | | 0.0151660 | 0.0276913 | 0.0284638 | 1.04011 | 0.00785659 | 0.00785659 | | 0 | 0.709728 | 0.00164201 | 0.00164201 | 0.00284490 | | 0.0276913 | 1.01229 | 0.137133 |
| Ethane | | 0.00473582 | 0.0101367 | 0.00996744 | 2.00843 | 0.283553 | 0.283553 | | 0 | 1.76527 | 0.000663792 | 0.000663792 | 0.589003 | | 0.0101367 | 1.99491 | 1.00614 |
| Propane | | 0.00136393 | 0.00497952 | 0.00400092 | 2.68923 | 1.30999 | 1.30999 | | 0 | 2.54205 | 0.000292359 | 0.000292359 | 2.29305 | | 0.00497952 | 2.68550 | 2.16777 |
| Isobutane | | 9.92041E-05 | 0.000263853 | 0.000210900 | 1.08245 | 0.814031 | 0.814031 | | 0 | 1.05707 | 5.63053E-06 | 5.63053E-06 | 1.30522 | | 0.000263853 | 1.08198 | 1.00711 |
| n-Butane | | 0.000525018 | 0.00118411 | 0.000779088 | 2.64166 | 2.19148 | 2.19148 | | 0 | 2.59314 | 4.43808E-05 | 4.43808E-05 | 3.45116 | | 0.00118411 | 2.64101 | 2.53371 |
| Isopentane | | 0.000101388 | 0.000299343 | 0.000170044 | 2.17660 | 2.09255 | 2.09255 | | 0 | 2.16615 | 6.75989E-06 | 6.75989E-06 | 3.11162 | | 0.000299343 | 2.17711 | 2.18143 |
| n-Pentane | | 0.000103352 | 0.000226165 | 0.000130225 | 2.28947 | 2.25655 | 2.25655 | | 0 | 2.28458 | 5.12795E-06 | 5.12795E-06 | 3.30721 | | 0.000226165 | 2.29014 | 2.31131 |
| 2-Methylpentane | | 0 | 0 | 2.53981E-05 | 2.35628 | 2.42665 | 2.42665 | | 0 | 2.36596 | 4.86284E-07 | 4.86284E-07 | 3.47930 | | 0 | 2.35730 | 2.40906 |
| 3-Methylpentane | | 0 | 0 | 3.39262E-05 | 1.27231 | 1.31451 | 1.31451 | | 0 | 1.27849 | 1.70641E-06 | 1.70641E-06 | 1.87666 | | 0 | 1.27286 | 1.30199 |
| n-Hexane | | 9.20240E-05 | 0.000176161 | 1.67451E-05 | 2.72489 | 2.83080 | 2.83080 | | 0 | 2.73648 | 2.55946E-07 | 2.55946E-07 | 0.274663 | | 0.000176161 | 2.72615 | 2.79284 |
| Methylcyclopentane | | 0 | 0 | 3.80331E-05 | 0.572007 | 0.594703 | 0.594703 | | 0 | 0.575791 | 5.21768E-06 | 5.21768E-06 | 0.780683 | | 0 | 0.572275 | 0.586400 |
| Benzene | | 0 | 0 | 0.000255577 | 0.0772580 | 0.0803383 | 0.0803383 | | 0 | 0.0817329 | 0.000227036 | 0.000227036 | 0.00643569 | | 0 | 0.0772415 | 0.0792048 |
| 2-Methylhexane | | 0 | 0 | 8.19567E-06 | 2.77496 | 2.91995 | 2.91995 | | 0 | 2.79561 | 1.33119E-07 | 1.33119E-07 | 0.261616 | | 0 | 2.77636 | 2.85446 |
| 3-Methylhexane | | 0 | 0 | 6.66847E-06 | 2.27005 | 2.38975 | 2.38975 | | 0 | 2.28735 | 1.13130E-07 | 1.13130E-07 | 3.22132 | | 0 | 2.27120 | 2.33538 |
| Heptane | | 0 | 0 | 1.33402E-05 | 5.45493 | 5.75329 | 5.75329 | | 0 | 5.49913 | 2.27561E-07 | 2.27561E-07 | 7.11842 | | 0 | 5.45771 | 5.61482 |
| Methylcyclohexane | | 0 | 0 | 4.45146E-05 | 3.13322 | 3.30439 | 3.30439 | | 0 | 3.15969 | 4.23780E-06 | 4.23780E-06 | 4.12585 | | 0 | 3.13480 | 3.22502 |
| Toluene | | 0 | 0 | 0.000453302 | 0.615083 | 0.649573 | 0.649573 | | 0 | 0.627546 | 0.000393437 | 0.000393437 | 0.110678 | | 0 | 0.615181 | 0.633346 |
| Octane | | 0 | 0 | 7.00501E-06 | 15.3739 | 16.2952 | 16.2952 | | 0 | 15.5200 | 7.93179E-08 | 7.93179E-08 | 18.8591 | | 0 | 15.3819 | 15.8465 |
| Ethylbenzene | | 0 | 0 | 0.000240771 | 1.08893 | 1.15455 | 1.15455 | | 0 | 1.10333 | 0.000206095 | 0.000206095 | 0.367782 | | 0 | 1.08943 | 1.12251 |
| m-Xylene | | 0 | 0 | 0.000146916 | 0.777431 | 0.824542 | 0.824542 | | 0 | 0.787392 | 0.000126379 | 0.000126379 | 0.337959 | | 0 | 0.777767 | 0.801476 |
| o-Xylene | | 0 | 0 | 0.000398201 | 1.74816 | 1.85442 | 1.85442 | | 0 | 1.77179 | 0.000355508 | 0.000355508 | 0.656891 | | 0 | 1.74885 | 1.80232 |
| Nonane | | 0 | 0 | 2.77443E-06 | 11.9435 | 12.6786 | 12.6786 | | 0 | 12.0650 | 4.96322E-08 | 4.96322E-08 | 13.3672 | | 0 | 11.9498 | 12.3160 |
| C10+ | | 0 | 0 | 8.66550E-07 | 33.8631 | 35.9712 | 35.9712 | | 0 | 34.2246 | 1.72614E-08 | 1.72614E-08 | 31.0939 | | 0 | 33.8812 | 34.9257 |
| **Mass Flow** | | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** |
| Water | | 180573 | 0 | 201324 | 1.18159 | 0 | 0.0896591 | | 201948 | 0 | 201321 | 0 | 0 | | 201325 | 1.32456 | 0.449980 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Nitrogen | | 0.164407 | 0 | 0.352912 | 0.520717 | 0 | 0.000408978 | | 0 | 0.267080 | 0.0102059 | 0 | 0 | | 0.318807 | 0.486698 | 0.0226636 |
| Carbon Dioxide | | 1.71569 | 0 | 4.08339 | 1.64142 | 0 | 0.100395 | | 0 | 0 | 2.25442 | 0 | 0 | | 5.73418 | 1.65097 | 0.570420 |
| Methane | | 27.3921 | 0 | 57.3317 | 133.378 | 0 | 0.948377 | | 0 | 90.0375 | 3.30589 | 0 | 0 | | 55.7763 | 129.742 | 17.0499 |
| Ethane | | 8.55359 | 0 | 20.0764 | 257.552 | 0 | 34.2279 | | 0 | 223.945 | 1.33642 | 0 | 0 | | 20.4174 | 255.681 | 125.095 |
| Propane | | 2.46347 | 0 | 8.05865 | 344.854 | 0 | 158.130 | | 0 | 322.490 | 0.588612 | 0 | 0 | | 10.0298 | 344.191 | 269.521 |
| Isobutane | | 0.179177 | 0 | 0.424795 | 138.808 | 0 | 98.2626 | | 0 | 134.102 | 0.0113360 | 0 | 0 | | 0.531456 | 138.673 | 125.215 |
| n-Butane | | 0.948259 | 0 | 1.56924 | 338.753 | 0 | 264.535 | | 0 | 328.971 | 0.0893526 | 0 | 0 | | 2.38506 | 338.490 | 315.020 |
| Isopentane | | 0.183122 | 0 | 0.342502 | 279.117 | 0 | 252.594 | | 0 | 274.803 | 0.0136098 | 0 | 0 | | 0.602941 | 279.033 | 271.220 |
| n-Pentane | | 0.186669 | 0 | 0.262299 | 293.591 | 0 | 272.391 | | 0 | 289.826 | 0.0103242 | 0 | 0 | | 0.455544 | 293.519 | 287.368 |
| 2-Methylpentane | | 0 | 0 | 0.0511569 | 302.158 | 0 | 292.923 | | 0 | 300.150 | 0.000979043 | 0 | 0 | | 0 | 302.128 | 299.521 |
| 3-Methylpentane | | 0 | 0 | 0.0683341 | 163.154 | 0 | 158.676 | | 0 | 162.192 | 0.00343555 | 0 | 0 | | 0 | 163.138 | 161.878 |
| n-Hexane | | 0.166209 | 0 | 0.0337279 | 349.426 | 0 | 341.709 | | 0 | 347.155 | 0.000515301 | 0 | 0 | | 0.354826 | 349.401 | 347.237 |
| Methylcyclopentane | | 0 | 0 | 0.0766062 | 73.3513 | 0 | 71.7872 | | 0 | 73.0460 | 0.0105048 | 0 | 0 | | 0 | 73.3466 | 72.9078 |
| Benzene | | 0 | 0 | 0.514783 | 9.90719 | 0 | 9.69772 | | 0 | 10.3688 | 0.457095 | 0 | 0 | | 0 | 9.89978 | 9.84763 |
| 2-Methylhexane | | 0 | 0 | 0.0165077 | 355.847 | 0 | 352.470 | | 0 | 354.657 | 0.000268011 | 0 | 0 | | 0 | 355.836 | 354.898 |
| 3-Methylhexane | | 0 | 0 | 0.0134316 | 291.100 | 0 | 288.469 | | 0 | 290.177 | 0.000227766 | 0 | 0 | | 0 | 291.092 | 290.360 |
| Heptane | | 0 | 0 | 0.0268698 | 699.513 | 0 | 694.486 | | 0 | 697.630 | 0.000458152 | 0 | 0 | | 0 | 699.497 | 698.097 |
| Methylcyclohexane | | 0 | 0 | 0.0896612 | 401.788 | 0 | 398.876 | | 0 | 400.844 | 0.00853203 | 0 | 0 | | 0 | 401.776 | 400.970 |
| Toluene | | 0 | 0 | 0.913040 | 78.8751 | 0 | 78.4107 | | 0 | 79.6117 | 0.792113 | 0 | 0 | | 0 | 78.8457 | 78.7446 |
| Octane | | 0 | 0 | 0.0141095 | 1971.47 | 0 | 1967.01 | | 0 | 1968.90 | 0.000159692 | 0 | 0 | | 0 | 1971.45 | 1970.22 |
| Ethylbenzene | | 0 | 0 | 0.484960 | 139.640 | 0 | 139.368 | | 0 | 139.971 | 0.414935 | 0 | 0 | | 0 | 139.628 | 139.564 |
| m-Xylene | | 0 | 0 | 0.295918 | 99.6939 | 0 | 99.5313 | | 0 | 99.8901 | 0.254442 | 0 | 0 | | 0 | 99.6838 | 99.6485 |
| o-Xylene | | 0 | 0 | 0.802055 | 224.175 | 0 | 223.848 | | 0 | 224.772 | 0.715751 | 0 | 0 | | 0 | 224.144 | 224.084 |
| Nonane | | 0 | 0 | 0.00558825 | 1531.58 | 0 | 1530.44 | | 0 | 1530.60 | 9.99253E-05 | 0 | 0 | | 0 | 1531.57 | 1531.26 |
| C10+ | | 0 | 0 | 0.00174540 | 4342.43 | 0 | 4342.12 | | 0 | 4341.80 | 3.47527E-05 | 0 | 0 | | 0 | 4342.43 | 4342.35 |

| **Process Streams** | | **Well Stream** | **HP Separator Gas** | **HP Separator Water** | **HP Separator Oil** | **OT Flash Gas** | **Sales Oil** | **Gas** | **Water** | **Oil** | **Produced Water** | **PWT Flash Gas** | **Oil W/B** | **Water W/B** | **1** | **3** | **LP Separator Oil** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Phase: Light Liquid** | **Status** | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved |
| **Property** | **Units** | | | | | | | | | | | | | | | | |
| Temperature | °F | 196.0 | 70.0 | 70.0 | 70.0 | 75.9 | 75.9 | | 300.0 | 200.0 | 75.9 | 75.94 | 75.9425 | | 70 | 74.4472 | 70 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pressure | psig | 200 | 232 | 232 | 232 | 0 | 0 | | 200 | 300 | 0 | 0 | 7.86079 | | 232 | 232 | 40 |
| Mole Fraction Vapor | % | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Mole Fraction Light Liquid | % | 100 | 100 | 100 | 100 | 100 | 100 | | 100 | 100 | 100 | 100 | 100 | | 100 | 100 | 100 |
| Mole Fraction Heavy Liquid | % | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| Molecular Weight | lb/lbmol | 18.0 | 18.0 | 18.0 | 98.1 | 112.3 | 112.3 | | 18.0 | 100.9 | 18.0 | 18.0156 | 105.956 | | 18.0165 | 98.3257 | 106.962 |
| Mass Density | lb/ft^3 | 60.2 | 62.3 | 62.3 | 43.9 | 44.8 | 44.8 | | 57.3 | 39.9 | 62.2 | 62.2170 | 43.9457 | | 62.2584 | 43.7805 | 44.5615 |
| Molar Flow | lbmol/h | 10025.4 | 0.0 | 11179.8 | 130.7 | 0.0 | 107.5 | | 11209.8 | 125.7 | 11175.4 | 0 | 0 | | 11179.8 | 130.349 | 116.239 |
| Mass Flow | lb/h | 180614.6 | 0.0 | 201419.7 | 12823.5 | 0.0 | 12071.1 | | 201948.3 | 12686.2 | 201331.7 | 0 | 0 | | 201422 | 12816.7 | 12433.1 |
| Vapor Volumetric Flow | MCFH | 3.0 | 0.0 | 3.2 | 0.3 | 0.0 | 0.3 | | 3.5 | 0.3 | 3.2 | 0 | 0 | | 3.23525 | 0.292748 | 0.279010 |
| Liquid Volumetric Flow | Mbbl/d | 12.8 | 0.0 | 13.8 | 1.2 | 0.0 | 1.2 | | 15.1 | 1.4 | 13.8 | 0 | 0 | | 13.8293 | 1.25138 | 1.19265 |
| Std Vapor Volumetric Flow | MMSCFD | 91.3 | 0.0 | 101.8 | 1.2 | 0.0 | 1.0 | | 102.1 | 1.1 | 101.8 | 0 | 0 | | 101.822 | 1.18717 | 1.05866 |
| Std Liquid Volumetric Flow | Mbbl/d | 12.4 | 0.0 | 13.8 | 1.3 | 0.0 | 1.2 | | 13.8 | 1.2 | 13.8 | 0 | 0 | | 13.8178 | 1.27060 | 1.20230 |
| Compressibility | | 0.009 | 0.013 | 0.013 | 0.097 | 0.006 | 0.006 | | 0.008 | 0.112 | 0.001 | 0.000740330 | 0.00946170 | | 0.0125593 | 0.0966602 | 0.0230970 |
| Specific Gravity | | 0.966 | 0.998 | 0.998 | 0.704 | 0.718 | 0.718 | | 0.920 | 0.640 | 0.998 | 0.997563 | 0.704607 | | 0.998227 | 0.701959 | 0.714482 |
| API Gravity | | 10.0 | 10.1 | 10.1 | 68.1 | 63.6 | 63.6 | | 10.0 | 66.8 | 10.0 | 10.0154 | 67.1452 | | 10.0519 | 67.9990 | 65.2156 |
| Enthalpy | MMBtu/h | -1210.6 | 0.0 | -1374.8 | -11.4 | 0.0 | -10.3 | | -1332.6 | -10.2 | -1373.6 | 0 | 0 | | -1374.80 | -11.3115 | -10.7631 |
| Mass Enthalpy | Btu/lb | -6702.7 | -6825.5 | -6825.5 | -885.1 | -851.9 | -851.9 | | -6598.5 | -807.9 | -6822.4 | -6822.37 | -894.385 | | -6825.49 | -882.565 | -865.683 |
| Mass Cp | Btu/(lb*°F) | 1.0 | 1.0 | 1.0 | 0.5 | 0.5 | 0.5 | | 1.0 | 0.6 | 1.0 | 0.982733 | 0.495520 | | 0.983032 | 0.496970 | 0.488559 |
| Ideal Gas CpCv Ratio | | 1.320 | 1.326 | 1.326 | 1.057 | 1.049 | 1.049 | | 1.316 | 1.045 | 1.326 | 1.32555 | 1.05147 | | 1.32581 | 1.05599 | 1.05189 |
| Dynamic Viscosity | cP | 0.3 | 1.0 | 1.0 | 0.4 | 0.5 | 0.5 | | 0.2 | 0.2 | 0.9 | 0.924439 | 0.464685 | | 0.995522 | 0.412845 | 0.496561 |
| Kinematic Viscosity | cSt | 0.3 | 1.0 | 1.0 | 0.6 | 0.7 | 0.7 | | 0.2 | 0.4 | 0.9 | 0.927573 | 0.660118 | | 0.998233 | 0.588688 | 0.695651 |
| Thermal Conductivity | Btu/(h*ft*°F) | 0.4 | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | | 0.4 | 0.1 | 0.3 | 0.349783 | 0.0684782 | | 0.346442 | 0.0679228 | 0.0689748 |
| Surface Tension | lbf/ft | 0.004 | 0.005 | 0.005 | 0.001 | 0.001 | 0.001 | | 0.003 | 0.001 | 0.005 | 0.00499713 | 0.00142196 | | 0.00503944 | 0.00128518 | 0.00145907 |
| Net I.G. Heating Value | Btu/ft^3 | 0.2 | 0.4 | 0.5 | 4954.3 | 5648.8 | 5648.8 | | 0.0 | 5090.7 | 0.0 | 0.0376228 | 5353.06 | | 0.448229 | 4963.09 | 5388.44 |
| Net Liquid Heating Value | Btu/lb | -1054.8 | -1049.8 | -1049.8 | 18981.0 | 18916.0 | 18916.0 | | -1059.8 | 18971.1 | -1058.9 | -1058.92 | 19002.0 | | -1049.84 | 18979.8 | 18940.4 |
| Gross I.G. Heating Value | Btu/ft^3 | 50.5 | 50.8 | 50.8 | 5327.1 | 6067.7 | 6067.7 | | 50.3 | 5472.6 | 50.3 | 50.3493 | 5757.94 | | 50.7837 | 5336.53 | 5790.26 |
| Gross Liquid Heating Value | Btu/lb | 5.2 | 10.4 | 10.5 | 20421.0 | 20330.3 | 20330.3 | | 0.0 | 20406.0 | 0.9 | 0.856779 | 20451.0 | | 10.3851 | 20419.5 | 20364.4 |

| **Process Streams** | | **Well Stream** | **HP Separator Gas** | **HP Separator Water** | **HP Separator Oil** | **OT Flash Gas** | **Sales Oil** | **Gas** | **Water** | **Oil** | **Produced Water** | **PWT Flash Gas** | **Oil W/B** | **Water W/B** | **1** | **3** | **LP Separator Oil** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Phase: Heavy Liquid** | **Status** | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved |
| **Mole Fraction** | | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** |
| Water | | | | | 99.9588 | | | | | | | | | | | 99.9600 | |
| H2S | | | | | 0 | | | | | | | | | | | 0 | |
| Nitrogen | | | | | 0.000112685 | | | | | | | | | | | 0.000102967 | |
| Carbon Dioxide | | | | | 0.000829929 | | | | | | | | | | | 0.000823473 | |
| Methane | | | | | 0.0319662 | | | | | | | | | | | 0.0307637 | |
| Ethane | | | | | 0.00597218 | | | | | | | | | | | 0.00593152 | |
| Propane | | | | | 0.00163468 | | | | | | | | | | | 0.00161029 | |
| Isobutane | | | | | 6.53738E-05 | | | | | | | | | | | 6.59153E-05 | |
| n-Butane | | | | | 0.000241498 | | | | | | | | | | | 0.000247087 | |
| Isopentane | | | | | 4.24621E-05 | | | | | | | | | | | 4.32177E-05 | |
| n-Pentane | | | | | 3.25188E-05 | | | | | | | | | | | 3.37314E-05 | |
| 2-Methylpentane | | | | | 5.30992E-06 | | | | | | | | | | | 5.59628E-06 | |
| 3-Methylpentane | | | | | 7.09285E-06 | | | | | | | | | | | 7.39150E-06 | |
| n-Hexane | | | | | 3.50085E-06 | | | | | | | | | | | 3.69537E-06 | |
| Methylcyclopentane | | | | | 8.14194E-06 | | | | | | | | | | | 8.14905E-06 | |
| Benzene | | | | | 5.89487E-05 | | | | | | | | | | | 5.97267E-05 | |
| 2-Methylhexane | | | | | 1.47359E-06 | | | | | | | | | | | 1.48986E-06 | |
| 3-Methylhexane | | | | | 1.19900E-06 | | | | | | | | | | | 1.21512E-06 | |
| Heptane | | | | | 2.39859E-06 | | | | | | | | | | | 2.35359E-06 | |
| Methylcyclohexane | | | | | 8.16811E-06 | | | | | | | | | | | 8.45018E-06 | |
| Toluene | | | | | 8.86372E-05 | | | | | | | | | | | 9.13564E-05 | |
| Octane | | | | | 1.10485E-06 | | | | | | | | | | | 1.17734E-06 | |
| Ethylbenzene | | | | | 4.08593E-05 | | | | | | | | | | | 4.17166E-05 | |
| m-Xylene | | | | | 2.49320E-05 | | | | | | | | | | | 2.57348E-05 | |
| o-Xylene | | | | | 6.75755E-05 | | | | | | | | | | | 7.00662E-05 | |
| Nonane | | | | | 3.89733E-07 | | | | | | | | | | | 4.15654E-07 | |
| C10+ | | | | | 9.80662E-08 | | | | | | | | | | | 1.05052E-07 | |
| **Molar Flow** | | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** | **lbmol/h** |
| Water | | | | | 0 | | | | | | | | | | | 11175.2 | |
| H2S | | | | | 0 | | | | | | | | | | | 0 | |
| Nitrogen | | | | | 0 | | | | | | | | | | | 0.0115113 | |
| Carbon Dioxide | | | | | 0 | | | | | | | | | | | 0.0920612 | |
| Methane | | | | | 0 | | | | | | | | | | | 3.43926 | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ethane | | | | | 0 | | | | | | | | | | | 0.663122 | |
| Propane | | | | | 0 | | | | | | | | | | | 0.180024 | |
| Isobutane | | | | | 0 | | | | | | | | | | | 0.00736909 | |
| n-Butane | | | | | 0 | | | | | | | | | | | 0.0276234 | |
| Isopentane | | | | | 0 | | | | | | | | | | | 0.00483158 | |
| n-Pentane | | | | | 0 | | | | | | | | | | | 0.00377104 | |
| 2-Methylpentane | | | | | 0 | | | | | | | | | | | 0.000625643 | |
| 3-Methylpentane | | | | | 0 | | | | | | | | | | | 0.000826342 | |
| n-Hexane | | | | | 0 | | | | | | | | | | | 0.000413129 | |
| Methylcyclopentane | | | | | 0 | | | | | | | | | | | 0.000911033 | |
| Benzene | | | | | 0 | | | | | | | | | | | 0.00667723 | |
| 2-Methylhexane | | | | | 0 | | | | | | | | | | | 0.000166561 | |
| 3-Methylhexane | | | | | 0 | | | | | | | | | | | 0.000135845 | |
| Heptane | | | | | 0 | | | | | | | | | | | 0.000263123 | |
| Methylcyclohexane | | | | | 0 | | | | | | | | | | | 0.000944699 | |
| Toluene | | | | | 0 | | | | | | | | | | | 0.0102133 | |
| Octane | | | | | 0 | | | | | | | | | | | 0.000131623 | |
| Ethylbenzene | | | | | 0 | | | | | | | | | | | 0.00466376 | |
| m-Xylene | | | | | 0 | | | | | | | | | | | 0.00287705 | |
| o-Xylene | | | | | 0 | | | | | | | | | | | 0.00783314 | |
| Nonane | | | | | 0 | | | | | | | | | | | 4.64686E-05 | |
| C10+ | | | | | 0 | | | | | | | | | | | 1.17444E-05 | |
| **Mass Fraction** | | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** |
| Water | | | | | 99.9524 | | | | | | | | | | | 99.9535 | |
| H2S | | | | | 0 | | | | | | | | | | | 0 | |
| Nitrogen | | | | | 0.000175212 | | | | | | | | | | | 0.000160101 | |
| Carbon Dioxide | | | | | 0.00202730 | | | | | | | | | | | 0.00201153 | |
| Methane | | | | | 0.0284638 | | | | | | | | | | | 0.0273930 | |
| Ethane | | | | | 0.00996744 | | | | | | | | | | | 0.00989956 | |
| Propane | | | | | 0.00400092 | | | | | | | | | | | 0.00394121 | |
| Isobutane | | | | | 0.000210900 | | | | | | | | | | | 0.000212647 | |
| n-Butane | | | | | 0.000779088 | | | | | | | | | | | 0.000797118 | |
| Isopentane | | | | | 0.000170044 | | | | | | | | | | | 0.000173070 | |
| n-Pentane | | | | | 0.000130225 | | | | | | | | | | | 0.000135081 | |
| 2-Methylpentane | | | | | 2.53981E-05 | | | | | | | | | | | 2.67678E-05 | |
| 3-Methylpentane | | | | | 3.39262E-05 | | | | | | | | | | | 3.53546E-05 | |
| n-Hexane | | | | | 1.67451E-05 | | | | | | | | | | | 1.76755E-05 | |
| Methylcyclopentane | | | | | 3.80331E-05 | | | | | | | | | | | 3.80663E-05 | |
| Benzene | | | | | 0.000255577 | | | | | | | | | | | 0.000258950 | |
| 2-Methylhexane | | | | | 8.19567E-06 | | | | | | | | | | | 8.28614E-06 | |
| 3-Methylhexane | | | | | 6.66847E-06 | | | | | | | | | | | 6.75810E-06 | |
| Heptane | | | | | 1.33402E-05 | | | | | | | | | | | 1.30900E-05 | |
| Methylcyclohexane | | | | | 4.45146E-05 | | | | | | | | | | | 4.60518E-05 | |
| Toluene | | | | | 0.000453302 | | | | | | | | | | | 0.000467208 | |
| Octane | | | | | 7.00501E-06 | | | | | | | | | | | 7.46464E-06 | |
| Ethylbenzene | | | | | 0.000240771 | | | | | | | | | | | 0.000245822 | |
| m-Xylene | | | | | 0.000146916 | | | | | | | | | | | 0.000151646 | |
| o-Xylene | | | | | 0.000398201 | | | | | | | | | | | 0.000412877 | |
| Nonane | | | | | 2.77443E-06 | | | | | | | | | | | 2.95895E-06 | |
| C10+ | | | | | 8.66550E-07 | | | | | | | | | | | 9.28276E-07 | |
| **Mass Flow** | | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** | **lb/h** |
| Water | | | | | 0 | | | | | | | | | | | 201324 | |
| H2S | | | | | 0 | | | | | | | | | | | 0 | |
| Nitrogen | | | | | 0 | | | | | | | | | | | 0.322472 | |
| Carbon Dioxide | | | | | 0 | | | | | | | | | | | 4.05157 | |
| Methane | | | | | 0 | | | | | | | | | | | 55.1743 | |
| Ethane | | | | | 0 | | | | | | | | | | | 19.9394 | |
| Propane | | | | | 0 | | | | | | | | | | | 7.93828 | |
| Isobutane | | | | | 0 | | | | | | | | | | | 0.428308 | |
| n-Butane | | | | | 0 | | | | | | | | | | | 1.60553 | |
| Isopentane | | | | | 0 | | | | | | | | | | | 0.348593 | |
| n-Pentane | | | | | 0 | | | | | | | | | | | 0.272076 | |
| 2-Methylpentane | | | | | 0 | | | | | | | | | | | 0.0539150 | |
| 3-Methylpentane | | | | | 0 | | | | | | | | | | | 0.0712103 | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n-Hexane | | | | | 0 | | | | | | | | | | | 0.0356015 | |
| Methylcyclopentane | | | | | 0 | | | | | | | | | | | 0.0766721 | |
| Benzene | | | | | 0 | | | | | | | | | | | 0.521571 | |
| 2-Methylhexane | | | | | 0 | | | | | | | | | | | 0.0166897 | |
| 3-Methylhexane | | | | | 0 | | | | | | | | | | | 0.0136120 | |
| Heptane | | | | | 0 | | | | | | | | | | | 0.0263654 | |
| Methylcyclohexane | | | | | 0 | | | | | | | | | | | 0.0927563 | |
| Toluene | | | | | 0 | | | | | | | | | | | 0.941038 | |
| Octane | | | | | 0 | | | | | | | | | | | 0.0150351 | |
| Ethylbenzene | | | | | 0 | | | | | | | | | | | 0.495128 | |
| m-Xylene | | | | | 0 | | | | | | | | | | | 0.305442 | |
| o-Xylene | | | | | 0 | | | | | | | | | | | 0.831605 | |
| Nonane | | | | | 0 | | | | | | | | | | | 0.00595983 | |
| C10+ | | | | | 0 | | | | | | | | | | | 0.00186971 | |

| Process Streams | | Well Stream | HP Separator Gas | HP Separator Water | HP Separator Oil | OT Flash Gas | Sales Oil | Gas | Water | Oil | Produced Water | PWT Flash Gas | Oil W/B | Water W/B | 1 | 3 | LP Separator Oil |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phase: Heavy Liquid | Status | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved |
| Property | Units | | | | | | | | | | | | | | | | |
| Temperature | °F | | | | 70.0 | | | | | | | | | | | 74.4472 | |
| Pressure | psig | | | | 232 | | | | | | | | | | | 232 | |
| Mole Fraction Vapor | % | | | | 0 | | | | | | | | | | | 0 | |
| Mole Fraction Light Liquid | % | | | | 0 | | | | | | | | | | | 0 | |
| Mole Fraction Heavy Liquid | % | | | | 100 | | | | | | | | | | | 100 | |
| Molecular Weight | lb/lbmol | | | | 18.0 | | | | | | | | | | | 18.0165 | |
| Mass Density | lb/ft^3 | | | | 62.3 | | | | | | | | | | | 62.2165 | |
| Molar Flow | lbmol/h | | | | 0.0 | | | | | | | | | | | 11179.6 | |
| Mass Flow | lb/h | | | | 0.0 | | | | | | | | | | | 201417 | |
| Vapor Volumetric Flow | MCFH | | | | 0.0 | | | | | | | | | | | 3.23736 | |
| Liquid Volumetric Flow | Mbbl/d | | | | 0.0 | | | | | | | | | | | 13.8384 | |
| Std Vapor Volumetric Flow | MMSCFD | | | | 0.0 | | | | | | | | | | | 101.820 | |
| Std Liquid Volumetric Flow | Mbbl/d | | | | 0.0 | | | | | | | | | | | 13.8171 | |
| Compressibility | | | | | 0.013 | | | | | | | | | | | 0.0124631 | |
| Specific Gravity | | | | | 0.998 | | | | | | | | | | | 0.997555 | |
| API Gravity | | | | | 10.1 | | | | | | | | | | | 10.0503 | |
| Enthalpy | MMBtu/h | | | | 0.0 | | | | | | | | | | | -1373.90 | |
| Mass Enthalpy | Btu/lb | | | | -6825.5 | | | | | | | | | | | -6821.16 | |
| Mass Cp | Btu/(lb*°F) | | | | 1.0 | | | | | | | | | | | 0.982701 | |
| Ideal Gas CpCv Ratio | | | | | 1.326 | | | | | | | | | | | 1.32559 | |
| Dynamic Viscosity | cP | | | | 1.0 | | | | | | | | | | | 0.941676 | |
| Kinematic Viscosity | cSt | | | | 1.0 | | | | | | | | | | | 0.944876 | |
| Thermal Conductivity | Btu/(h*ft*°F) | | | | 0.3 | | | | | | | | | | | 0.348511 | |
| Surface Tension | lbf/ft | | | | 0.005 | | | | | | | | | | | 0.00500564 | |
| Net I.G. Heating Value | Btu/ft^3 | | | | 0.5 | | | | | | | | | | | 0.440061 | |
| Net Liquid Heating Value | Btu/lb | | | | -1049.8 | | | | | | | | | | | -1050.03 | |
| Gross I.G. Heating Value | Btu/ft^3 | | | | 50.8 | | | | | | | | | | | 50.7749 | |
| Gross Liquid Heating Value | Btu/lb | | | | 10.5 | | | | | | | | | | | 10.2 | |

October 7, 2013

**FESCO, Ltd.**
**1100 FESCO Avenue - Alice, Texas 78332**

**For:** Antero Resources Appalachian Corp.
1625 17th Street
Denver, Colorado 80202

**Sample:** Sweeny No. 2H (Forest Well Pad)
Separator Hydrocarbon Liquid
Sampled @ 265 psig & 72 °F

Date Sampled: 09/20/13 Job Number: 35822.002

**CHROMATOGRAPH EXTENDED ANALYSIS - GPA 2186-M**

| COMPONENT | MOL % | LIQ VOL % | WT % |
|---|---|---|---|
| Nitrogen | 0.016 | 0.004 | 0.005 |
| Carbon Dioxide | 0.000 | 0.000 | 0.000 |
| Methane | 6.555 | 2.493 | 1.079 |
| Ethane | 6.561 | 3.938 | 2.025 |
| Propane | 5.950 | 3.679 | 2.693 |
| Isobutane | 1.825 | 1.340 | 1.088 |
| n-Butane | 4.352 | 3.079 | 2.596 |
| 2,2 Dimethylpropane | 0.094 | 0.081 | 0.070 |
| Isopentane | 2.955 | 2.425 | 2.188 |
| n-Pentane | 3.109 | 2.529 | 2.302 |
| 2,2 Dimethylbutane | 0.233 | 0.218 | 0.206 |
| Cyclopentane | 0.000 | 0.000 | 0.000 |
| 2,3 Dimethylbutane | 0.371 | 0.341 | 0.328 |
| 2 Methylpentane | 2.077 | 1.935 | 1.837 |
| 3 Methylpentane | 1.448 | 1.327 | 1.281 |
| n-Hexane | 3.097 | 2.858 | 2.739 |
| Heptanes Plus | 61.357 | 73.752 | 79.565 |
| Totals: | 100.000 | 100.000 | 100.000 |

**Characteristics of Heptanes Plus:**

| | | |
|---|---|---|
| Specific Gravity | 0.7476 | (Water=1) |
| °API Gravity | 57.76 | @ 60°F |
| Molecular Weight | 126.4 | |
| Vapor Volume | 18.78 | CF/Gal |
| Weight | 6.23 | Lbs/Gal |

**Characteristics of Total Sample:**

| | | |
|---|---|---|
| Specific Gravity | 0.6930 | (Water=1) |
| °API Gravity | 72.68 | @ 60°F |
| Molecular Weight | 97.4 | |
| Vapor Volume | 22.57 | CF/Gal |
| Weight | 5.77 | Lbs/Gal |

Base Conditions: 14.850 PSI & 60 °F

Certified: FESCO, Ltd. - Alice, Texas

Analyst: XG
Processor: JCdjv
Cylinder ID: W-1002

David Dannhaus 361-661-7015

## TANKS DATA INPUT REPORT

| COMPONENT | Mol % | LiqVol % | Wt % |
|---|---|---|---|
| Carbon Dioxide | 0.000 | 0.000 | 0.000 |
| Nitrogen | 0.016 | 0.004 | 0.005 |
| Methane | 6.555 | 2.493 | 1.079 |
| Ethane | 6.561 | 3.938 | 2.025 |
| Propane | 5.950 | 3.679 | 2.693 |
| Isobutane | 1.825 | 1.340 | 1.088 |
| n-Butane | 4.446 | 3.160 | 2.665 |
| Isopentane | 2.955 | 2.425 | 2.188 |
| n-Pentane | 3.109 | 2.529 | 2.302 |
| Other C-6's | 4.129 | 3.821 | 3.652 |
| Heptanes | 10.940 | 10.981 | 11.026 |
| Octanes | 16.323 | 17.415 | 18.233 |
| Nonanes | 9.129 | 11.236 | 11.888 |
| Decanes Plus | 20.852 | 30.674 | 34.062 |
| Benzene | 0.102 | 0.064 | 0.082 |
| Toluene | 0.662 | 0.498 | 0.626 |
| E-Benzene | 1.009 | 0.874 | 1.099 |
| Xylenes | 2.340 | 2.009 | 2.549 |
| n-Hexane | 3.097 | 2.858 | 2.739 |
| 2,2,4 Trimethylpentane | 0.000 | 0.000 | 0.000 |
| Totals: | 100.000 | 100.000 | 100.000 |

**Characteristics of Total Sample:**

| | | |
|---|---|---|
| Specific Gravity | 0.6930 | (Water=1) |
| °API Gravity | 72.68 | @ 60°F |
| Molecular Weight | 97.4 | |
| Vapor Volume | 22.57 | CF/Gal |
| Weight | 5.77 | Lbs/Gal |

**Characteristics of Decanes (C10) Plus:**

| | | |
|---|---|---|
| Specific Gravity | 0.7696 | (Water=1) |
| Molecular Weight | 159.2 | |

**Characteristics of Atmospheric Sample:**

| | | |
|---|---|---|
| °API Gravity | 61.33 | @ 60°F |
| Reid Vapor Pressure (ASTM D-5191) | 2.65 | psi |

| QUALITY CONTROL CHECK | | | |
|---|---|---|---|
| | Sampling Conditions | Test Samples | |
| Cylinder Number | ------ | W-1002* | T-3030 |
| Pressure, PSIG | 265 | 232 | 231 |
| Temperature, °F | 72 | 70 | 70 |

* Sample used for analysis

**TOTAL EXTENDED REPORT**

| COMPONENT | Mol % | LiqVol % | Wt % |
|---|---|---|---|
| Nitrogen | 0.016 | 0.004 | 0.005 |
| Carbon Dioxide | 0.000 | 0.000 | 0.000 |
| Methane | 6.555 | 2.493 | 1.079 |
| Ethane | 6.561 | 3.938 | 2.025 |
| Propane | 5.950 | 3.679 | 2.693 |
| Isobutane | 1.825 | 1.340 | 1.088 |
| n-Butane | 4.352 | 3.079 | 2.596 |
| 2,2 Dimethylpropane | 0.094 | 0.081 | 0.070 |
| Isopentane | 2.955 | 2.425 | 2.188 |
| n-Pentane | 3.109 | 2.529 | 2.302 |
| 2,2 Dimethylbutane | 0.233 | 0.218 | 0.206 |
| Cyclopentane | 0.000 | 0.000 | 0.000 |
| 2,3 Dimethylbutane | 0.371 | 0.341 | 0.328 |
| 2 Methylpentane | 2.077 | 1.935 | 1.837 |
| 3 Methylpentane | 1.448 | 1.327 | 1.281 |
| n-Hexane | 3.097 | 2.858 | 2.739 |
| Methylcyclopentane | 0.667 | 0.530 | 0.576 |
| Benzene | 0.102 | 0.064 | 0.082 |
| Cyclohexane | 0.624 | 0.476 | 0.539 |
| 2-Methylhexane | 2.715 | 2.833 | 2.792 |
| 3-Methylhexane | 2.221 | 2.288 | 2.283 |
| 2,2,4 Trimethylpentane | 0.000 | 0.000 | 0.000 |
| Other C-7's | 1.061 | 1.073 | 1.080 |
| n-Heptane | 3.652 | 3.781 | 3.755 |
| Methylcyclohexane | 3.129 | 2.823 | 3.153 |
| Toluene | 0.662 | 0.498 | 0.626 |
| Other C-8's | 9.393 | 10.222 | 10.624 |
| n-Octane | 3.801 | 4.370 | 4.455 |
| E-Benzene | 1.009 | 0.874 | 1.099 |
| M & P Xylenes | 0.720 | 0.627 | 0.784 |
| O-Xylene | 1.620 | 1.383 | 1.765 |
| Other C-9's | 6.182 | 7.514 | 8.009 |
| n-Nonane | 2.948 | 3.722 | 3.879 |
| Other C-10's | 6.082 | 8.124 | 8.817 |
| n-decane | 2.003 | 2.760 | 2.925 |
| Undecanes(11) | 5.075 | 6.955 | 7.656 |
| Dodecanes(12) | 2.899 | 4.291 | 4.789 |
| Tridecanes(13) | 1.869 | 2.966 | 3.356 |
| Tetradecanes(14) | 1.118 | 1.901 | 2.180 |
| Pentadecanes(15) | 0.652 | 1.188 | 1.379 |
| Hexadecanes(16) | 0.379 | 0.738 | 0.864 |
| Heptadecanes(17) | 0.250 | 0.514 | 0.607 |
| Octadecanes(18) | 0.184 | 0.399 | 0.475 |
| Nonadecanes(19) | 0.121 | 0.274 | 0.328 |
| Eicosanes(20) | 0.077 | 0.181 | 0.218 |
| Heneicosanes(21) | 0.047 | 0.115 | 0.140 |
| Docosanes(22) | 0.032 | 0.081 | 0.099 |
| Tricosanes(23) | 0.020 | 0.054 | 0.066 |
| Tetracosanes(24) | 0.015 | 0.040 | 0.050 |
| Pentacosanes(25) | 0.009 | 0.027 | 0.033 |
| Hexacosanes(26) | 0.006 | 0.017 | 0.021 |
| Heptacosanes(27) | 0.004 | 0.012 | 0.016 |
| Octacosanes(28) | 0.003 | 0.009 | 0.011 |
| Nonacosanes(29) | 0.002 | 0.008 | 0.010 |
| Triacontanes(30) | 0.002 | 0.005 | 0.007 |
| Hentriacontanes Plus(31+) | 0.003 | 0.012 | 0.016 |
| Total | 100.000 | 100.000 | 100.000 |

**FESCO, Ltd.**
**1100 Fesco Avenue - Alice, Texas 78332**

**For:** Antero Resources Appalachian Corp.
1625 17th Street
Denver, Colorado 80202

**Date Sampled:** 09/20/13

**Date Analyzed:** 10/02/13

**Sample:** Sweeny No. 2H (Forest Well Pad)

**Job Number:** J35822

| FLASH LIBERATION OF HYDROCARBON LIQUID | | |
|---|---|---|
| | **Separator HC Liquid** | **Stock Tank** |
| Pressure, psig | 265 | 0 |
| Temperature, °F | 72 | 70 |
| Gas Oil Ratio (1) | ------ | 209 |
| Gas Specific Gravity (2) | ------ | 1.225 |
| Separator Volume Factor (3) | 1.1348 | 1.000 |

| STOCK TANK FLUID PROPERTIES | |
|---|---|
| Shrinkage Recovery Factor (4) | 0.8812 |
| Oil API Gravity at 60 °F | 61.33 |
| Reid Vapor Pressure, psi (5) | 2.65 |

| Quality Control Check | | | |
|---|---|---|---|
| | **Sampling Conditions** | **Test Samples** | |
| Cylinder No. | ------ | W-1002* | T-3030 |
| Pressure, psig | 265 | 232 | 231 |
| Temperature, °F | 72 | 70 | 70 |

(1) - Scf of flashed vapor per barrel of stock tank oil
(2) - Air = 1.000
(3) - Separator volume / Stock tank volume
(4) - Fraction of first stage separator liquid
(5) - Absolute pressure at 100 deg F
Analyst: M. G.
* Sample used for flash study
**Base Conditions: 14.85 PSI & 60 °F**

Certified: FESCO, Ltd. - Alice, Texas

David Dannhaus 361-661-7015

**FESCO, Ltd.**
**1100 Fesco Ave. - Alice, Texas 78332**

**For:** Antero Resources Appalachian Corp.
1625 17th Street
Denver, Colorado 80202

**Sample:** Sweeny No. 2H (Forest Well Pad)
Gas Evolved from Hydrocarbon Liquid Flashed
From 265 psig & 72 °F to 0 psig & 70 °F

Date Sampled: 09/20/13 Job Number: 35822.001

## CHROMATOGRAPH EXTENDED ANALYSIS - SUMMATION REPORT

| COMPONENT | MOL% | GPM |
|---|---|---|
| Hydrogen Sulfide* | < 0.001 | |
| Nitrogen | 0.042 | |
| Carbon Dioxide | 0.128 | |
| Methane | 33.021 | |
| Ethane | 28.999 | 7.817 |
| Propane | 19.505 | 5.416 |
| Isobutane | 3.942 | 1.300 |
| n-Butane | 7.039 | 2.237 |
| 2-2 Dimethylpropane | 0.112 | 0.043 |
| Isopentane | 2.264 | 0.835 |
| n-Pentane | 1.810 | 0.661 |
| Hexanes | 1.577 | 0.655 |
| Heptanes Plus | 1.561 | 0.703 |
| Totals | 100.000 | 19.666 |

**Computed Real Characteristics Of Heptanes Plus:**

| | | |
|---|---|---|
| Specific Gravity | 3.626 | (Air=1) |
| Molecular Weight | 103.80 | |
| Gross Heating Value | 5537 | BTU/CF |

**Computed Real Characteristics Of Total Sample:**

| | | |
|---|---|---|
| Specific Gravity | 1.225 | (Air=1) |
| Compressibility (Z) | 0.9884 | |
| Molecular Weight | 35.07 | |
| Gross Heating Value | | |
| Dry Basis | 2069 | BTU/CF |
| Saturated Basis | 2033 | BTU/CF |

*Hydrogen Sulfide tested in laboratory by: Stained Tube Method (GPA 2377)
Results: 0.063 Gr/100 CF, 1.0 PPMV or 0.0001 Mol %

Base Conditions: 14.850 PSI & 60 Deg F

Certified: FESCO, Ltd. - Alice, Texas

Analyst: MR
Processor: ANB
Cylinder ID: FL# 4 S

David Dannhaus 361-661-7015

## CHROMATOGRAPH EXTENDED ANALYSIS
## TOTAL REPORT

| COMPONENT | MOL % | GPM | WT % |
|---|---|---|---|
| Hydrogen Sulfide* | < 0.001 | | < 0.001 |
| Nitrogen | 0.042 | | 0.034 |
| Carbon Dioxide | 0.128 | | 0.161 |
| Methane | 33.021 | | 15.106 |
| Ethane | 28.999 | 7.817 | 24.867 |
| Propane | 19.505 | 5.416 | 24.528 |
| Isobutane | 3.942 | 1.300 | 6.534 |
| n-Butane | 7.039 | 2.237 | 11.667 |
| 2,2 Dimethylpropane | 0.112 | 0.043 | 0.230 |
| Isopentane | 2.264 | 0.835 | 4.658 |
| n-Pentane | 1.810 | 0.661 | 3.724 |
| 2,2 Dimethylbutane | 0.086 | 0.036 | 0.211 |
| Cyclopentane | 0.015 | 0.006 | 0.030 |
| 2,3 Dimethylbutane | 0.102 | 0.042 | 0.251 |
| 2 Methylpentane | 0.510 | 0.213 | 1.253 |
| 3 Methylpentane | 0.317 | 0.130 | 0.779 |
| n-Hexane | 0.547 | 0.227 | 1.344 |
| Methylcyclopentane | 0.054 | 0.019 | 0.130 |
| Benzene | 0.020 | 0.006 | 0.045 |
| Cyclohexane | 0.072 | 0.025 | 0.173 |
| 2-Methylhexane | 0.160 | 0.075 | 0.457 |
| 3-Methylhexane | 0.158 | 0.073 | 0.452 |
| 2,2,4 Trimethylpentane | 0.000 | 0.000 | 0.000 |
| Other C7's | 0.171 | 0.075 | 0.484 |
| n-Heptane | 0.197 | 0.092 | 0.563 |
| Methylcyclohexane | 0.165 | 0.067 | 0.462 |
| Toluene | 0.038 | 0.013 | 0.100 |
| Other C8's | 0.264 | 0.124 | 0.830 |
| n-Octane | 0.066 | 0.034 | 0.215 |
| Ethylbenzene | 0.003 | 0.001 | 0.009 |
| M & P Xylenes | 0.019 | 0.007 | 0.058 |
| O-Xylene | 0.003 | 0.001 | 0.009 |
| Other C9's | 0.106 | 0.054 | 0.382 |
| n-Nonane | 0.022 | 0.012 | 0.080 |
| Other C10's | 0.035 | 0.021 | 0.141 |
| n-Decane | 0.004 | 0.002 | 0.016 |
| Undecanes (11) | 0.004 | 0.002 | 0.017 |
| Totals | 100.000 | 19.666 | 100.000 |

**Computed Real Characteristics Of Total Sample:**

| | | |
|---|---|---|
| Specific Gravity | 1.225 | (Air=1) |
| Compressibility (Z) | 0.9884 | |
| Molecular Weight | 35.07 | |

Gross Heating Value

| | | |
|---|---|---|
| Dry Basis | 2069 | BTU/CF |
| Saturated Basis | 2033 | BTU/CF |

**Antero Resources**
**Sweeney Unit 2H - Forest Pad**

| Tag Name | Value | Units | Timestamp |
|---|---|---|---|
| Accumulated Gas Flow | 733909.8 | MCF | 12/6/2013 11:05:27 |
| Casing Pressure | 504.96 | PSIA | 12/6/2013 11:05:40 |
| Current Day Gas Flow | 488.7 | MCF | 12/6/2013 11:05:27 |
| Differential Pressure | 7.88 | inH2O | 12/6/2013 11:05:27 |
| Flow Rate | 3760.18 | MCF Per Day | 12/6/2013 11:05:27 |
| Pressure | 209.88 | PSIA | 12/6/2013 11:05:27 |
| Previous Day Energy | 3854.11 | MBTU | 12/6/2013 11:05:28 |
| Previous Day Gas Flow | 3090.55 | MCF | 12/6/2013 11:05:28 |
| Temperature | 68.16 | F | 12/6/2013 11:05:27 |
| Tubing Pressure | 504.05 | PSIA | 12/6/2013 11:05:40 |
| Daily AP | 3.63 | PSIA | 12/6/2013 09:00:00 |
| Daily DP | 310 | inH2O | 12/6/2013 09:00:00 |
| Daily Energy | 3854.1 | MBTU | 12/6/2013 09:00:00 |
| Daily Flow | 3090.55 | MCF | 12/6/2013 09:00:00 |
| Daily Tf | 70.89 | F | 12/6/2013 09:00:00 |
| Hourly AP | 280.83 | PSIA | 12/6/2013 09:00:00 |
| Hourly DP | 4.8 | Inches | 12/6/2013 09:00:00 |
| Hourly Energy | 175.9 | MBTU | 12/6/2013 09:00:00 |
| Hourly Flow Time | 3600 | Seconds | 12/6/2013 09:00:00 |
| Hourly Tf | 69.9 | F | 12/6/2013 09:00:00 |
| Hourly Volume | 141.1 | MCF | 12/6/2013 09:00:00 |
| Audited Accumulated Gas Volume | | MCF | |
| Audited Casing Pressure | 526 | PSI | 12/4/2013 09:00:00 |
| Audited Gas Volume | 3849.42 | MCF | 12/4/2013 09:00:00 |
| Audited Oil Volume | 183.7 | Barrels | 12/4/2013 09:00:00 |
| Audited Tubing Pressure | 465 | PSI | 12/4/2013 09:00:00 |
| Audited Water Volume | 0 | Barrels | 12/4/2013 09:00:00 |
| Argon | 0 | % | 12/6/2013 11:05:33 |
| BTU | 1247.06 | BTU | 12/6/2013 11:05:27 |
| C02 | 0.1467 | % | 12/6/2013 11:05:33 |
| Carbon Monoxide | 0 | % | 12/6/2013 11:05:33 |
| Decane | 0 | % | 12/6/2013 11:05:33 |
| Ethane | 14.1987 | % | 12/6/2013 11:05:33 |
| Helium | 0 | % | 12/6/2013 11:05:33 |
| Heptane | 0 | % | 12/6/2013 11:05:33 |
| Hexane | 0.5451 | % | 12/6/2013 11:05:33 |
| Hydrogen | 0 | % | 12/6/2013 11:05:33 |
| Hydrogen Sulfide | 0 | % | 12/6/2013 11:05:33 |
| Iso-Butane | 0.5666 | % | 12/6/2013 11:05:33 |
| Iso-Pentane | 0.3749 | % | 12/6/2013 11:05:33 |
| Methane | 77.6927 | % | 12/6/2013 11:05:33 |
| N2 | 0.4946 | % | 12/6/2013 11:05:33 |
| N-Butane | 1.1838 | % | 12/6/2013 11:05:33 |
| Nonane | 0 | % | 12/6/2013 11:05:33 |
| N-Pentane | 0.2914 | % | 12/6/2013 11:05:33 |
| Octane | 0 | % | 12/6/2013 11:05:33 |
| Oxygen | 0.0117 | % | 12/6/2013 11:05:33 |
| Plate Size | 3.75 | Inches | 12/6/2013 11:05:38 |
| Propane | 4.4938 | % | 12/6/2013 11:05:33 |
| SPG | 0.7248 | | 12/6/2013 11:05:27 |
| Water | 0 | % | 12/6/2013 11:05:33 |
| Water | 0 | % | 12/6/2013 11:06:26 |

# Attachment J

## Class I Legal Advertisement

**Attachment J**

**Air Quality Permit Notice**
**Notice of Application**
**Edna Monroe Well Pad**
**Antero Resources Corporation**
**Tyler County, West Virginia**

Notice is given that Antero Resources Corporation has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a General Permit Registration for an Oil and Natural Gas facility located near 0.84 mile east from the intersection of Purgatory Run Rd. (WV 30/1) and (Conaway Run Rd) WV 48 in Tyler County, West Virginia.

The latitude and longitude coordinates are: 39.422626 degrees N and -80.873179 degrees W

The applicant estimates the potential to discharge the following Regulated Air Pollutants will be:

| Pollutants | TOTALS (tpy): |
|---|---|
| VOC | 47.4640 |
| $NO_X$ | 8.9639 |
| $CO_{2e}$ | 18624.3000 |
| CO | 31.0906 |
| $SO_2$ | 0.0323 |
| $PM_{2.5}$ | 0.5426 |
| $PM_{10}$ | 2.4698 |
| Lead | 3.79E-05 |
| Total HAPs | 2.2301 |
| Benzene | 0.0305 |
| Formaldehyde | 0.0255 |
| Xylenes | 0.3655 |

Startup in operation is planned to begin in January 2016. Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice.

Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1227, during normal business hours.
Dated this the __ day of _____, 2015

By: Antero Resources Corporation
Barry Schatz
Senior Environmental & Regulatory Manager
1615 Wynkoop Street
Denver, CO 80202

# Attachment K

## Electronic Submittal

**Attachment K**

**Electronic Submittal**
**Edna Monroe Well Pad**
**Antero Resources Corporation**
**Tyler, West Virginia**

No electronic submission was made.

# Attachment L

## General Permit Registration Application Fee

Conestoga-Rovers & Associates, Inc.

▼ PLEASE DETACH AND RETAIN FOR YOUR RECORDS ▼

| INVOICE NUMBER | DATE | | VOUCHER NO. | AMOUNT |
|---|---|---|---|---|
| Account Number: | | 40WVDEPAQ | 397724 | |
| CR20915 | 2/9/2015 | 400935604 | | 1,500.00 |
| | | | TOTAL: | 1,500.00 |

THIS DOCUMENT IS PROTECTED BY A MICRO-PRINT SIGNATURE LINE, FLUORESCENT PAPER FIBERS, A WATERMARKED BACKER, AND IS REACTIVE TO CHEMICAL ALTERATION

**Conestoga-Rovers & Associates, Inc.**
2055 NIAGARA FALLS BLVD, SUITE 3
NIAGARA FALLS, NY 14304

**M&T BANK**
MANUFACTURERS AND TRADERS TRUST COMPANY
Commercial Banking
Main Office, Ithaca, NY 14850
50-7063-2213

2/10/2015 NO. 397724

PAY **********1,500 DOLLARS AND********00 CENTS $**********1,500.00

TO THE ORDER OF
**WV Dept. of Environmental Protectio**
**Division Air Quality**
**601 57th Street SE**
**Charleston,, WV 25304 US**

Conestoga-Rovers & Associates, Inc.

AUTHORIZED SIGNATURES

WARNING: THIS DOCUMENT IS VOID IF ACCOUNT NUMBER DOES NOT APPEAR ON THE REVERSE SIDE IN RED

⑈397724⑈ ⑆221370632⑆6100000011891O⑈

# Attachment M

## Siting Criteria Waiver

**Attachment M**

**Siting Waiver**
**Edna Monroe Well Pad**
**Antero Resources Corporation**
**Tyler County, West Virginia**

A Siting Waiver form is not required because there are no occupied dwelling structures within 300 feet of Edna Monroe Well Pad.

# Attachment N

## Material Safety Data Sheet

**Attachment N**

**Description of Material Safety Data Sheets (MSDS)**
**Edna Monroe Well Pad**
**Antero Resources Corporation**
**Tyler County, West Virginia**

Three generic Material Safety Data Sheets (MSDS), and analysis of the condensate and produced water of a similar well with the same formation are provided. Antero Resources Corporation has developed its own MSDS for these materials.

1. Natural Gas: The MSDS for natural gas reflects pipeline quality odorized gas. This is essentially the same as the material delivered to the metering and downstream gathering lines from the Antero well pad.
2. Condensate: Condensate is the hydrocarbon liquid that has been separated from raw natural gas through the well pad gas production unit. The liquid is often characterized as having a gasoline-like odor and consistency.
3. Produced Water: Produced water is primarily groundwater with residual trace hydrocarbons that has been withdrawn from the ground during the gas extraction process and then separated from the natural gas and condensate in the gas production units.

# SAFETY DATA SHEET

**Material Name: Dry Field Natural Gas** **US GHS**

SYNONYMS: **CNG, Natural Gas, Methane.**

## * * * Section 1 – PRODUCT AND COMPANY IDENTIFICATION * * *

PRODUCT NAME: **Dry Field Natural Gas**
PRODUCT CODES: **CAS Reg. No. 68410-63-9**

EMERGENCY PHONE: **(800) 878-1373**
AFTER HOURS: **(800) 878-1373**

PRODUCER: **Antero Resources**
ADDRESS: **1615 Wynkoop Street**
**Denver, Colorado 80202**

CHEMTREC PHONE: **(800) 424-9300**

## * * * Section 2 – HAZARDS IDENTIFICATION * * *

**GHS Classification:**

Flammable Gas – Category 1.
Gases Under Pressure – Gas.
Specific Target Organ Systemic Toxicity (STOT) – Single Exposure Category 2.

**GHS LABEL ELEMENTS**

**Symbol(s)**

**Signal Word**

Danger

**Hazard Statements**

Extremely flammable gas.
Contains gas under pressure, may explode if heated.
May cause damage to central nervous and respiratory systems.

**Precautionary Statements**

**Prevention**

Keep away from heat/sparks/open flames/hot surfaces. No smoking.
Do not breathe fume/gas/mist/vapors/spray.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.

**Response**

Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.
If exposed to gas, or concerned about possible exposure: Call a POISON CENTER or doctor/physician.

**Storage**

Protect from sunlight. Store in a well-ventilated place.
Store in a secure area.

**Disposal**

Dispose of contents/containers in accordance with local/regional/national/international regulations.

## * * * Section 3 – COMPOSITION / INFORMATION ON INGREDIENTS * * *

| CAS # | Component | Percent |
|---|---|---|
| 74-82-8 | Methane | 95.01 |
| 78-84-0 | Ethane | 3.99 |
| 74-98-6 | Propane | 0.32 |
| 106-97-8 | Butanes | 0.07 |
| 109-66-0 | Pentanes | 0.02 |
| 110-54-3 | Hexanes | 0.01 |
| 7727-37-9 | Nitrogen | 0.35 |
| 124-38-9 | Carbon Dioxide | 0.19 |
| 7782-44-7 | Oxygen | 0.03 |

Because natural gas is a natural product, composition can vary greatly.

## * * * Section 4 – FIRST AID MEASURES * * *

**First Aid: Eyes**

In case of freeze burn, cover eyes to protect from light. Flush eyes with running water for at least fifteen (15) minutes. Following flushing, seek medical attention.

**First Aid: Skin**

Remove contaminated clothing. In case of blistering, frostbite or freeze burns, seek immediate medical attention.

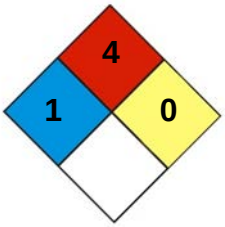
**First Aid: Ingestion**

Risk of ingestion is extremely low. However, if oral exposure occurs, seek immediate medical assistance.

**First Aid: Inhalation**

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

## * * * Section 5 – FIRE FIGHTING MEASURES * * *




**NFPA 704 Hazard Class**

Health: **1** Flammability: **4** Instability: **0** (0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)

**General Fire Hazards**

See Section 9 for Flammability Properties.
Forms a flammable mixture with air. If released, the resulting vapors will disperse with the prevailing wind. If a source of ignition is present where the vapor exists at a 5 – 15% concentration in air, the vapor will burn along the flame front toward the source of the fuel.

**Hazardous Combustion Products**

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

**Extinguishing Media**

Any extinguisher suitable for Class B fires, dry chemical, fire fighting foam, CO2, and other gaseous agents. However, fire should not be extinguished unless flow of gas can be immediately stopped.

**Unsuitable Extinguishing Media**

None.

**Fire Fighting Equipment / Instructions**

Gas fires should not be extinguished unless flow of gas can be immediately stopped. Shut off gas source and allow gas to burn out. If spill or leak has not ignited, determine

if water spray may assist in dispersing gas or vapor to protect personnel attempting to stop leak. Use water to cool equipment, surfaces and piping exposed to fire and excessive heat. For large fire, the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Isolate area, particularly around piping. Let the fire burn unless leak can be stopped. Concentrate fire-fighting efforts on objects / materials ignited by the initial fire. Withdraw immediately in the event of a rising sound from a venting safety device.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH-approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

## * * * Section 6 – ACCIDENTAL RELEASE MEASURES * * *

**Recovery and Neutralization**

Stop the source of the release, if safe to do so.

**Materials and Methods for Clean-Up**

Consider the use of water spray to disperse gas vapors. Do not use water spray to direct gas vapors toward sewer or drainage systems. Isolate the area until gas has dispersed. Ventilate and gas test area before entering.

**Emergency Measures**

Evacuate nonessential personnel and secure all ignition sources. No road flares, smoking or flames in hazard area. Consider wind direction. Stay upwind and uphill, if possible. Vapor cloud may be white, but color will dissipate as cloud disperses. Fire and explosion hazard is still present.

**Personal Precautions and Protective Equipment**

Cooling effect of expanding gas from leak may present frostbite / freeze burn hazard. Wear flame retardant (FR) clothing around un-ignited leak. Wear fire protective clothing around an active fire.

**Environmental Precautions**

Do not flush gas vapors toward sewer or drainage systems.

**Prevention of Secondary Hazards**

None.

## * * * Section 7 – HANDLING AND STORAGE * * *

### Handling Procedures

Keep away from flame, sparks and excessive temperatures. Bond and ground containers. Use only in well ventilated areas.

### Storage Procedures

Natural gas will be contained in the pipeline. Keep away from flame, sparks, excessive temperatures and open flames. Empty pipeline segments may contain explosive residues from natural gas liquids. Do not cut, heat, weld or expose containers to sources of ignition sections of pipeline unless the sections have been purged of natural gas residues.

### Incompatibilities

Keep away from strong oxidizers, ignition sources and heat.

## * * * Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION * * *

### Component Exposure Limits

**Methane (74-82-8)**

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

**Ethane (74-84-0)**

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

**Propane (74-98-6)**

ACGIH: 2500 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

**Butane (106-97-8)**

ACGIH: 800 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

**Pentanes (109-66-0)**

ACGIH: 600 ppm TWA (listed under Pentane, all isomers)

**Hexanes (110-54-3)**

ACGIH: 50 ppm TWA (listed under n-Hexane)

**Nitrogen (7727-37-9)**

Simple Asphyxiant

**Carbon Dioxide (124-38-9)**

ACGIH: 5000 ppm TWA (listed under Carbon Dioxide)

**Oxygen (7782-44-7)**

N/A – Necessary for life

**Engineering Measures**

Use adequate ventilation to keep gas and vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Use explosion-proof equipment and lighting in classified / controlled areas.

**Personal Protective Equipment: Respiratory**

Use a NIOSH approved positive-pressure, supplied air respirator with escape bottle or self-contained breathing apparatus (SCBA) for gas concentrations above occupational exposure limits, for potential for uncontrolled release, if exposure levels are not known, or in an oxygen-deficient atmosphere. CAUTION: Flammability limits (i.e., explosion hazard should be considered when assessing the need to expose personnel to concentrations requiring respiratory protection.

**Personal Protective Equipment: Hands**

Use cold-impervious, insulating flame-retardant (FR) gloves where contact with pressurized gas may occur.

**Personal Protective Equipment: Eyes**

Where there is a possibility of pressurized gas contact, wear splash-proof safety goggles and faceshield.

**Personal Protective Equipment: Skin and Body**

Where contact with pressurized gas may occur, wear flame-retardant (FR) and a faceshield.

## * * * Section 9 – PHYSICAL AND CHEMICAL PROPERTIES * * *

| | | | |
|---|---|---|---|
| **Appearance:** | Colorless | **Odor:** | Odorless to slight petroleum odor |
| **Physical State:** | Gas | **pH:** | ND |
| **Vapor Pressure:** | 40 atm @ -187°F (-86°C) | **Vapor Density:** | 0.6 |
| **Boiling Point:** | -259°F (-162°C) | **Melting Point:** | ND |
| **Solubility (H2O):** | 3.5% | **Specific Gravity:** | 0.4 @ -263°F (-164°C) |

| | | | |
|---|---|---|---|
| **Evaporation Rate:** | ND | **VOC:** | ND |
| **Octanol / H2O Coeff.:** | ND | **Flash Point:** | Flammable Gas |
| **Flash Point Method:** | N/A | | |
| **Lower Flammability Limit: (LFL):** | 3.8 – 6.5 | **Upper Flammability Limit: (UFL):** | 13-17 |
| **Auto Ignition:** | 900-1170°F (482-632°C) | **Burning Rate:** | ND |

## * * * Section 10 – CHEMICAL STABILITY & REACTIVITY INFORMATION * * *

**Chemical Stability**

This is a stable material.

**Hazardous Reaction Potential**

Will not occur.

**Conditions to Avoid**

Keep away from strong oxidizers, ignition sources and heat.

**Hazardous Decomposition Products**

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

## * * * Section 11 – TOXICOLOGICAL INFORMATION * * *

**Acute Toxicity**

**A: General Product Information**

Methane and ethane, the main components of natural gas, are considered practically inert in terms of physiological effects. At high concentrations these materials act as simple asphyxiants and may cause death due to lack of oxygen.

**B. Component Analysis – LD50/LC50**

**Methane (74-82-8)**

Inhalation LC50 Mouse 326 g/m3 2h

**Ethane (74-84-0)**

Inhalation LC50 Rat 658 mg/l 4h

**Propane (74-98-6)**

Inhalation LC50 Rat 658 mg/l 4h

**Butanes (106-97-8)**
Inhalation LC50 Rat 658 g/m3 4h

**Pentanes (109-66-0)**
Inhalation LD50 Rat 364 g/m3 4h

**Hexanes (110-54-3)**
Inhalation LC50 Rat > 20 mg/l 4h

**Nitrogen (7727-37-9)**
Simple Asphyxiant

**Carbon Dioxide (124-38-9)**
Inhalation LC50 Human 100,000 ppm 1minute

**Oxygen (7782-44-7)**
N/A – Necessary for life

**Potential Health Effects: Skin Corrosion Property / Stimulativeness**
This product is not reported to have any skin sensitization effects.

**Generative Cell Mutagenicity**
This product is not reported to have any mutagenic effects.

**Carcinogenicity**

**A: General Product Information**
This product is not reported to have any carcinogenic effects.

**B: Component Carcinogenicity**
None of this product's components are listed by ACGIH, IARC, OSHA, NIOSH, or NTP.

**Reproductive Toxicity**
This product is not reported to have any reproductive toxicity effects.

**Specified Target Organ General Toxicity: Single Exposure**
This product may cause damage to the heart.

**Specified Target Organ General Toxicity: Repeated Exposure**
This product is not reported to have any specific target organ repeat effects.

**Aspiration Respiratory Organs Hazard**
This product is not reported to have any aspiration hazard effects.

## * * * Section 12 – ECOLOGICAL INFORMATION * * *

**Ecotoxicity**

**A: General Product Information**

Keep gas and vapors out of sewers, drainage areas, and waterways. Report spills and releases, as applicable under Federal and State regulations.

**B: Component Analysis – Ecotoxicity – Aquatic Toxicity**

No ecotoxicity data are available for this product's components.

**Persistance / Degradability**

No information available.

**Bioaccumulation**

No information available.

**Mobility in Soil**

No information available.

## * * * Section 13 – DISPOSAL CONSIDERATIONS * * *

**Waste Disposal Instructions**

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment Recommendations.

**Disposal of Contaminated Containers or Packaging**

Dispose of contents / container in accordance with local / regional / national / international regulations.

## * * * Section 14 – TRANSPORTATION INFORMATION * * *

**DOT Information**

**Shipping Name:** Natural Gas, Compressed

**UN #:** 1971 **Hazard Class:** 2.1

Placard:

## * * * Section 15 – REGULATORY INFORMATION * * *

### Regulatory Information

### Component Analysis

None of this products components are listed under SARA Section 302 (40 CFR 355 Appendix A.
n-hexane is listed under SARA Section 313 (40 CFR 372.65). However the concentration of this component is approximately 0.01 % in compressed natural gas and is therefore far under the reporting threshold for the chemical.

n-hexane is listed under CERCLA (40 CFR 302.4). However the concentration of this component is approximately 0.01 % in compressed natural gas and is therefore far under the reporting threshold for the chemical.

### SARA Section 311/312 – Hazard Classes

| Acute Health | Chronic Health | Fire | Sudden Release of Pressure | Reactive |
|---|---|---|---|---|
| --- | --- | X | X | --- |

### SARA Section 313 – Supplier Notification

This product contains one chemical (n-Hexane) that is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-to-know act (EPCRA) of 1986 and of 40 CFR 372. However the concentration of this component is approximately 0.01 % in compressed natural gas and is therefore far under the reporting threshold for the chemical.

### State Regulations

### Component Analysis – State

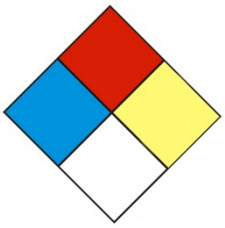
The following components appear on one or more of the following state hazardous substances lists:

| Component | CAS | CA | MA | MN | NJ | PA | RI |
|---|---|---|---|---|---|---|---|
| Methane | 74-82-8 | No | No | Yes | Yes | Yes | No |
| Ethane | 78-84-0 | No | No | Yes | Yes | Yes | No |
| Propane | 74-98-6 | No | No | Yes | Yes | Yes | Yes |
| Butane | 106-97-8 | Yes | No | Yes | Yes | Yes | Yes |
| Pentanes | 109-66-0 | Yes | No | Yes | Yes | Yes | Yes |
| Hexanes | 110-54-3 | Yes | Yes | Yes | Yes | Yes | Yes |
| Nitrogen | 7727-37-9 | No | No | No | No | No | No |
| Carbon Dioxide | 124-38-9 | Yes | No | Yes | Yes | Yes | Yes |
| Oxygen | 7782-44-7 | No | No | No | No | No | No |

## * * * Section 16 – OTHER INFORMATION * * *

**NFPA® Hazard Rating**

| | |
|---|---|
| Health | 1 |
| Fire | 4 |
| Reactivity | 0 |



**HMIS® Hazard Rating**

| | | |
|---|---|---|
| Health | 1 | Moderate |
| Fire | 4 | Severe |
| Physical | 0 | Minimal |
| | | * Chronic |

**Key/Legend**

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act: ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NJTSR = New Jersey Trade Secret Registry.

**Literature References**

None

**Other Information**

The information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

**Date of Preparation: January 30, 2014**

**Date of Last Revision: March 4, 2014**

End of Sheet

# SAFETY DATA SHEET

**Material Name: Natural Gas Condensate** **US GHS**

SYNONYMS: **Drips; Condensate; Field Condensate; Gas Well Condensate; High Pressure Inlet Liquids; Lease Condensate; Natural Gas Liquids; Pipeline Liquids**

## * * * Section 1 – PRODUCT AND COMPANY IDENTIFICATION * * *

PRODUCT NAME: **Natural Gas Condensate**
PRODUCT CODES: **64741-47-5**

EMERGENCY PHONE: **(800) 878-1373**
AFTER HOURS: **(800) 878-1373**

PRODUCER: **Antero Resources**
ADDRESS: **1615 Wynkoop Street**
**Denver, Colorado 80202**

CHEMTREC PHONE: **(800) 424-9300**

## * * * Section 2 – HAZARDS IDENTIFICATION * * *

**GHS Classification:**

Flammable Liquids – Category 2.
Acute Toxicity Inhalation – Category 3
Germ Cell Mutagenicity – Category 1B
Carcinogenicity – Category 1A
Specific Target Organ Systemic Toxicity (STOT) – Single Exposure Category 3
Specific Target Organ Systemic Toxicity (STOT) – Repeat Exposure Category 1
Aspiration Toxicity – Category 1
Toxic to the Aquatic Environment Acute – Category 3

**GHS LABEL ELEMENTS**

**Symbol(s)**

**Signal Word**

Danger

## Hazard Statements

Highly flammable liquid and vapor.
Toxic if inhaled.
May cause genetic defects.
May cause cancer.
May cause respiratory irritation.
May cause drowsiness or dizziness.
May cause damage to organs (liver, kidneys, blood, nervous system, and skin) through prolonged or repeated exposure.
May be fatal if swallowed and enters airways.
Harmful to aquatic life.

## Precautionary Statements

### Prevention

Keep away from heat/sparks/open flames/hot surfaces. No smoking.
Keep container tightly closed.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilating/lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Wear protective gloves/protective clothing/eye protection/face protection.
Do not breathe gas/mist/vapors/spray.
Do not handle until all safety precautions have been read and understood.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in a well-ventilated area.
Avoid release to the environment.

### Response

If on SKIN (or hair): Wash with plenty of soap and water. Remove / Take off all contaminated clothing immediately. Rinse skin with water/shower.
If INHALED: Remove victim to fresh air and keep comfortable for breathing. Call a poison center/doctor if the victim feels unwell.
If SWALLOWED: Immediately call a poison center or doctor / physician. Do not Induce vomiting.
If exposed or concerned: Get medical advice/attention.
In case of fire: Use water spray, fog or fire-fighting foam.

### Storage

Store in a well-ventilated place. Keep cool.
Store in a secure area.

**Disposal**

Dispose of contents/containers in accordance with local/regional/national/international regulations.

## * * * Section 3 – COMPOSITION / INFORMATION ON INGREDIENTS * * *

| CAS # | Component | Percent |
|---|---|---|
| 111-65-9 | Octanes | 25 - 95 |
| 142-82-5 | Heptanes | 25 - 95 |
| 110-54-3 | Hexanes as n-Hexane | 25 - 95 |
| 109-66-0 | Pentanes as n-Pentane | 5 - 70 |
| 106-97-8 | N-butane | 0 - 45 |
| 74-98-6 | Propane | 0 - 15 |
| 78-84-0 | Ethane | 0 - 5 |
| 71-43-2 | Benzene | < 1 |
| 108-88-3 | Toluene | < 1 |
| 1330-20-7 | m-,o-,p-Xylene | < 1 |

Because natural gas condensate is a natural product, composition can vary greatly.

## * * * Section 4 – FIRST AID MEASURES * * *

**First Aid: Eyes**

Flush eyes with clean running water for at least fifteen (15) minutes. Following flushing, seek medical attention.

**First Aid: Skin**

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops. Wash contaminated clothing before reuse.

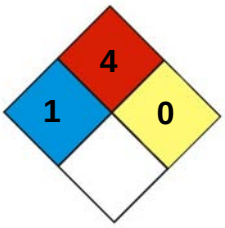
**First Aid: Ingestion (swallowing)**

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean the victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

**First Aid: Inhalation (breathing)**

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

## * * * Section 5 – FIRE FIGHTING MEASURES * * *




**NFPA 704 Hazard Class**

**Health:** 1 **Flammability:** 4 **Instability:** 0 (0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)

**General Fire Hazards**

See Section 9 for Flammability Properties.
Extremely flammable. Vapors may be ignited rapidly when exposed to heat, spark, open flame, or other source of ignition (e.g., static electricity, pilot lights, mechanical / electrical equipment, and electronic devices such as cell phones, computers, calculators, and pagers which have not been certified as intrinsically safe). Flammable vapors can burn in the open or explode in confined spaces. Vapors are heavier than air, and may travel distances to an ignition source and flash back. Runoff to sewer systems may cause fire or explosion.

**Hazardous Combustion Products**

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

**Extinguishing Media**

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, firefighting foam, water spray, carbon dioxide ($CO_2$), or other gaseous extinguishing agents. Use caution when applying CO2 in confined spaces.

LARGE FIRES: Water spray, fog or fire-fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

**Unsuitable Extinguishing Media**

None

**Fire Fighting Equipment / Instructions**

Small fires in the beginning stage may typically be extinguished using handheld portable fire extinguishers and other firefighting equipment. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied firefighting foam.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full face piece and full protective clothing.

## * * * Section 6 – ACCIDENTAL RELEASE MEASURES * * *

**Recovery and Neutralization**

Contain and stop the source of the spill, if safe to do so.

**Materials and Methods for Clean-Up**

Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken.

**Emergency Measures**

Evacuate nonessential personnel and secure all ignition sources. No road flares, smoking or flames in hazard area. Consider wind direction. Stay upwind and uphill, if possible. Vapor cloud may be white, but color will dissipate as cloud disperses. Fire and explosion hazard is still present.

**Personal Precautions and Protective Equipment**

Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8). Extremely flammable. Spillages of liquid product will create a fire hazard and may form an explosive atmosphere. Keep all sources of

ignition and hot metal surfaces away from spill/release if safe to do so.

The use of explosion-proof electrical equipment is recommended. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons downwind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

**Environmental Precautions**

Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of firefighting foam may be useful in certain situations to reduce vapors. If spill occurs on water notify appropriate authorities and advise shipping of any hazard. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on the surface of the water, may require notification of the National Response Center (phone number 800-424-8802).

**Prevention of Secondary Hazards**

None

## * * * Section 7 – HANDLING AND STORAGE * * *

**Handling Procedures**

Keep away from flame, sparks and excessive temperatures. Bond and ground containers. Use non-sparking tools. Use only outdoors or in well ventilated areas. Wear protective gloves / clothing and eye / face protection. Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8).

**Storage Procedures**

Store only in approved containers. Bond and ground containers. Keep away from flame, sparks, excessive temperatures and open flames. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks."

**Incompatibilities**

Keep away from strong oxidizers, ignition sources and heat.

## * * * Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION * * *

**Component Exposure Limits**

**Octanes (111-65-9)**

ACGIH: 300 ppm TWA (listed under Octane, all isomers)

**Heptanes (142-82-5)**

ACGIH: 400 ppm TWA (listed under n-Heptane)

**n-Hexane (110-54-3)**

ACGIH: 20 ppm TWA (listed under n-Hexane)

**n-Pentane (109-66-0)**

ACGIH: 600 ppm TWA (listed under Pentane, all isomers)

**n-Butane (106-97-8)**

ACGIH: 600 ppm TWA (listed under n-Butane)

**Propane (74-98-6)**

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases C1-C4)

**Ethane (74-84-0)**

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases C1-C4)

**Benzene (71-43-2)**

ACGIH: 0.5 ppm (TWA); NIOSH: 0.1 ppm (TWA); OSHA 1 ppm (TWA)

**Toluene (108-88-3)**

ACGIH: 20 ppm TWA (listed under Toluene)

**m-, o-, p-Xylene (1330-20-7)**

ACGIH: 100 ppm TWA (listed under Xylene o, m & p isomers)

**Engineering Measures**

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Use explosion-proof equipment and lighting in classified / controlled areas.

**Personal Protective Equipment: Respiratory**

Use a NIOSH-approved positive-pressure, supplied air respirator with escape bottle or self-contained breathing apparatus (SCBA) for gas concentrations above occupational exposure limits, for potential for uncontrolled release, if exposure levels are not known, or in an oxygen-deficient atmosphere (oxygen content less than 19.5 percent). A respiratory program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant the use of a respirator.

If benzene concentrations equal or exceed applicable exposure limits, OSHA requirements for personal protective equipment, exposure monitoring, and training may apply (29 CFR 1910.1028 – Benzene).

CAUTION: Flammability limits (i.e., explosion hazard should be considered when assessing the need to expose personnel to concentrations requiring respiratory protection.

**Personal Protective Equipment: Hands**

Gloves constructed of nitrile or neoprene are recommended.

**Personal Protective Equipment: Eyes**

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying. Eye protection that meets or exceeds ANSI Z.87.1 is recommended. Depending on conditions of use, a face shield may be necessary.

**Personal Protective Equipment: Skin and Body**

Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

**Hygiene Measures**

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use gasoline or solvents (naphtha, kerosene, etc.) for washing this product from

exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

## * * * Section 9 – PHYSICAL AND CHEMICAL PROPERTIES * * *

| | | | |
|---|---|---|---|
| **Appearance:** | Colorless to straw yellow | **Odor:** | Aromatic, Gasoline; |
| **Physical State:** | Liquid | **pH:** | ND |
| **Vapor Pressure:** | 110 – 200 psia (Reid VP) @ 100°F/37.8°C | **Vapor Density (air = 1):** | > 1 |
| **Boiling Point:** | Approx. 85 - 437°F (39 – 200°C) | **Melting Point:** | ND |
| **Solubility (H2O):** | Insoluble to slightly soluble | **Specific Gravity:** | AP 0.62-0.76 (varies) |
| **Evaporation Rate:** | High | **VOC:** | ND |
| **Octanol / H2O Coeff.:** | ND | **Flash Point:** | -40°F<br>-40°C |
| **Flash Point Method:** | Tag Closed Cup (TCC) | | |
| **Lower Flammability Limit: (LFL):** | ND (NFPA Gasoline 1.4) | **Upper Flammability Limit: (UFL):** | ND (NFPA Gasoline 7.6) |
| **Auto Ignition:** | AP 480°F (250°C) | **Burning Rate:** | ND |

## * * * Section 10 – CHEMICAL STABILITY & REACTIVITY INFORMATION * * *

### Chemical Stability

This is a stable material.

### Hazardous Reaction Potential

Will not occur.

### Conditions to Avoid

Keep away from ignition sources and high temperatures.

### Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

## * * * Section 11 – TOXICOLOGICAL INFORMATION * * *

**Acute Toxicity**

**A: General Product Information**

Harmful if swallowed.

**B. Component Analysis – LD50/LC50**

**Octanes (111-65-9)**
Inhalation LC50 rat = 118,000 mg/m3 / 4H

**Heptanes (142-82-5)**
Inhalation LC50 rat = 103,000 mg/m3 / 4H

**Hexanes as n-Hexane (110-53-3)**
Inhalation LC50 rat = 48,000 ppm / 4H

**Pentanes as n-Pentane (109-66-0)**
Inhalation LC50 rat = 364,000 mg/m3 / 4H

**Butanes as n-Butane (106-97-8)**
Inhalation LC50 rat 658,000 mg/l / 4H

**Propane (74-98-6)**
Inhalation LC50 Rat > 800,000 ppm / 0.25H

**Ethane (74-84-0)**
Inhalation LC50 Rat 658,000 mg/l / 4H

**Benzene (71-43-2)**
Inhalation LC50 Rat 44,700 mg/m3 /

**Toluene (108-88-3)**
Inhalation LD50 Rat 12/5 mg/l / 4H

**m-, o-, p-Xylene (1330-20-7)**
Inhalation LC50 Rat 5000 ppm / 4H

**Potential Health Effects: Skin Corrosion Property / Stimulativeness**

May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

**Potential Health Effects: Eye Critical Damage / Stimulativeness**

Contact with eyes may cause moderate irritation.

**Potential Health Effects: Ingestion (swallowing)**

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

**Potential Health Effects: Inhalation (breathing)**

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

**Respiratory Organs Sensitization / Skin Sensitization**

This product is not reported to have any skin sensitization effects.

**Generative Cell Mutagenicity**

May cause genetic defects. Some crude oils and crude oil fractions have been positive in mutagenicity studies.

**Carcinogenicity**

**A: General Product Information**

May cause cancer.

This product contains benzene, although at very low concentrations. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

Exposure to light hydrocarbons in the same boiling range as this product have been associated in animal studies with effects to the central nervous system, peripheral nervous system, liver, and kidneys. The significance of these animal models to predict similar human response is uncertain. Observing good work practices and personal hygiene procedures (Sections 7 and 8) can minimize potential risks to humans.

**B: Component Carcinogenicity**

**Benzene (71-43-2)**

| | |
|---|---|
| ACGIH: | A1 - Confirmed Human Carcinogen |
| OSHA: | 5 ppm STEL (Cancer hazard, Flammable, See 29 CFR 1910.1028, 15 min); 0.5 ppm Action Level; 1 ppm TWA |
| NIOSH: | potential occupational carcinogen |
| NTP: | Known Human Carcinogen (Select Carcinogen) |

IARC: Monograph 100F [in preparation]; Supplement 7 [1987]; Monograph 29 [1982] (Group 1 (carcinogenic to humans))

**Reproductive Toxicity**

This product is not reported to have any reproductive toxicity effects.

**Specified Target Organ General Toxicity: Single Exposure**

This product is not reported to have any specific target organ general toxicity single exposure effects.

**Specified Target Organ General Toxicity: Repeated Exposure**

May cause damage to organs (liver, kidneys, blood, nervous system and skin) through prolonged or repeated exposure.

**Aspiration Respiratory Organs Hazard**

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

## * * * Section 12 – ECOLOGICAL INFORMATION * * *

**Ecotoxicity**

**A: General Product Information**

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable under Federal and State regulations.

**B: Component Analysis – Ecotoxicity – Aquatic Toxicity**

**Benzene (71-43-2)**

| Test and Species | Conditions |
|---|---|
| 96 Hr LC50 Pimephales promelas | 10.7-14.7 mg/L [flow-through] |
| 96 Hr LC50 Oncorhynchus mykiss | 5.3 mg/L [flow-through] |
| 96 Hr LC50 Lepomis macrochirus | 22.49 mg/L [static] |
| 96 Hr LC50 Poecilia reticulata | 28.6 mg/L [static] |
| 96 Hr LC50 Pimephales promelas | 22330-41160 µg/L [static] |
| 96 Hr LC50 Lepomis macrochirus | 70000-142000 µg/L [static] |
| 72 Hr EC50 Pseudokirchneriella subcapitata | 29 mg/L |
| 48 Hr EC50 Daphnia magna | 8.76 - 15.6 mg/L [static] |
| 48 Hr EC50 Daphnia magna | 10 mg/L |

**Natural Gas condensates (68919-39-1)**

| Test and Species | Conditions |
|---|---|
| 96 Hr LC50 Alburnus alburnus | 119 mg/L [static] |
| 96 Hr LC50 Cyprinodon variegatus | 82 mg/L [static] |
| 72 Hr EC50 Pseudokirchneriella subcapitata | 56 mg/L |
| 24 Hr EC50 Daphnia magna | 170 mg/L |

**Persistence / Degradability**

No information available

**Bioaccumulation**

No information available

**Mobility in Soil**

No information available

## * * * Section 13 – DISPOSAL CONSIDERATIONS * * *

**Waste Disposal Instructions**

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment Recommendations.

**Disposal of Contaminated Containers or Packaging**

Recover or recycle if possible. It is the responsibility of the generator to determine the toxicity and physical properties of the material generated so as to properly classify the waste and ensure disposal methods comply with applicable regulations.
This material, if discarded should be fully characterized for ignitability (D001), reactivity (D003) and benzene (D018) prior to disposal (40 CFR261). Use which results in chemical or physical change or contamination may subject it to regulation as a hazardous waste. Along with properly characterizing all waste materials, consult state and local regulations regarding the proper disposal of this material. Do not dispose of by draining onto the ground. This will result in soil and groundwater contamination. Waste arising from spillage or tank cleaning should be disposed of in accordance with applicable regulations.

Container contents should be completely used and containers should be emptied prior to discard. Container rinsate could be considered a RCRA hazardous waste and must be disposed of with care and in full compliance with federal, state and local regulations. Larger empty containers, such as drums, should be returned to the distributor or to a qualified drum reconditioner. To assure proper disposal of smaller empty containers, consult with state and local regulations and disposal authorities.

## * * * Section 14 – TRANSPORTATION INFORMATION * * *

**DOT Information**

**Shipping Name:** Petroleum Products, n.o.s. (condensate)

**UN #:** 1268 **Hazard Class:** 3

**Additional Info.:** Dependent on the product's properties, the shipper may also elect to classify as Gasoline UN1203 or Petroleum Crude Oil UN1267 - reference 49 CFR 172.101 for further description (e.g., packing group determination).

**Placard:**


## * * * Section 15 – REGULATORY INFORMATION * * *

**Regulatory Information**

**Component Analysis**

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

**Benzene (71-43-2)**

SARA 313: 0.1% de minimis concentration

CERCLA: 10 lb final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule)

**SARA Section 311/312 – Hazard Classes**

| Acute Health | Chronic Health | Fire | Sudden Release of Pressure | Reactive |
|---|---|---|---|---|
| X | X | X | -- | -- |

**SARA SECTION 313 – SUPPLIER NOTIFICATION**

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

| INGREDIENT NAME (CAS NUMBER) | CONCENTRATION PERCENT BY WEIGHT |
|---|---|
| Benzene (71-43-2) | <0.1 to 2 |

**Canadian Regulatory Information**

| | |
|---|---|
| **DSL/NDSL Inventory** | This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all the information required by the Regulations. |
| **Workplace Hazardous Materials Information System** | B2 - Flammable Liquid<br>D1A – Material Causing Immediate and Serious Toxic Effects - Very Toxic Material<br>D2A: Material Causing Other Toxic Effects Very Toxic<br>D2B - Material Causing Other Toxic Effects - Toxic Material |

**European Union Regulatory Information**

| | |
|---|---|
| **Labeling** | Product is dangerous as defined by the European Union Dangerous Substances / Preparations Directives.<br>Contains: Low Boiling Point Naphtha |
| **Symbol** | **F+** Extremely Flammable<br>**T** Toxic<br>**N** Dangerous for the Environment |
| **Risk Phrases** | R12-45-38-65-67-51/53<br>Extremely flammable. May cause cancer. Irritating to skin. Harmful: may cause lung damage if swallowed. Vapors may cause drowsiness and dizziness. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. |
| **Safety Phrases** | S16-53-45-2-23-24-29-43-62<br>Keep away from sources of ignition – No smoking. Avoid exposure – obtain special instructions before use. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Keep out of reach of children. Do not breathe vapor. Avoid contact with skin. Do not empty into drains. In case of fire use foam/dry powder/CO2. If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label. |

## State Regulations

### Component Analysis – State

The following components appear on one or more of the following state hazardous substances lists

| Component | CAS | CA | MA | MN | NJ | PA | RI |
|---|---|---|---|---|---|---|---|
| Octanes | 111-65-9 | Yes | No | Yes | Yes | Yes | Yes |
| Heptanes | 142-82-5 | Yes | No | Yes | Yes | Yes | Yes |
| n-Hexane | 110-54-3 | Yes | Yes | Yes | Yes | Yes | Yes |
| n-Pentane | 109-66-0 | Yes | No | Yes | Yes | Yes | Yes |
| n-Butane | 106-97-8 | Yes | No | Yes | Yes | Yes | Yes |
| Propane | 74-98-6 | No | No | Yes | Yes | Yes | Yes |
| Ethane | 78-84-0 | No | No | Yes | Yes | Yes | No |
| Benzene | 71-43-2 | Yes | Yes | Yes | Yes | Yes | Yes |
| Toluene | 108-88-3 | Yes | Yes | Yes | Yes | Yes | Yes |
| m-, o-, p-Xylene | 1330-20-7 | Yes | Yes | Yes | Yes | Yes | Yes |

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.

WARNING! This product contains a chemical known to the state of California to cause Reproductive / developmental effects.

### Component Analysis – WHMIS IDL

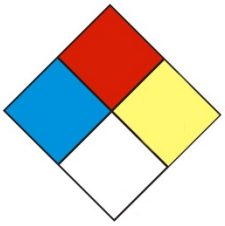
The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

| Component | CAS # | Minimum Concentration |
|---|---|---|
| Benzene | 71-43-2 | 0.1% |

## * * * Section 16 – OTHER INFORMATION * * *

**NFPA® Hazard Rating**

Health 1
Fire 4
Reactivity 0



**HMIS® Hazard Rating**

| | | |
|---|---|---|
| Health | 1 | Slight |
| Fire | 4 | Severe |
| Physical | 0 | Minimal |
| | | * Chronic |

## Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act: ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NJTSR = New Jersey Trade Secret Registry.

## Literature References

None

## Other Information

The information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

**Date of Preparation: January 29, 2014**

**Date of Last Revision: March 4, 2014**

End of Sheet

# SAFETY DATA SHEET

**Material Name: Produced Water** **US GHS**

SYNONYMS: **Produced Brine Water, Brine, Brine Water, Formation Water**

## * * * Section 1 – PRODUCT AND COMPANY IDENTIFICATION * * *

PRODUCT NAME: **Produced Water**
PRODUCT CODES: **Mixture**

EMERGENCY PHONE: **(800) 878-1373**
AFTER HOURS: **(800) 878-1373**

PRODUCER: **Antero Resources**
ADDRESS: **1615 Wynkoop Street**
**Denver, Colorado 80202**

CHEMTREC PHONE: **(800) 424-9300**

## * * * Section 2 – HAZARDS IDENTIFICATION * * *

**GHS Classification:**

Eye Irritant – Category 2A.

**GHS LABEL ELEMENTS**
**Symbol(s)**

**Signal Word**

Warning

**Hazard Statements**

Causes serious eye irritation

**Precautionary Statements**

**Prevention**

Wear protective gloves/protective clothing/eye protection/face protection.

**Response**

If on SKIN (or hair): Rinse skin with water / shower. Remove / Take off all contaminated clothing immediately.

If in EYES: Rinse cautiously with water for at least fifteen (15) minutes. Remove Contact Lenses, if present and easy to do. Continue rinsing.

If EYE irritation persists, get medical advice / attention.

**Storage**
Store in a secure area.

**Disposal**
Dispose of contents/containers in accordance with regulations.

## * * * Section 3 – COMPOSITION / INFORMATION ON INGREDIENTS * * *

| CAS # | Component | Percent |
|---|---|---|
| 7732-18-5 | Water | 80 |
| 7647-14-5 | Sodium Chloride | 20 |

Because brine water is a natural product, composition can vary greatly.

## * * * Section 4 – FIRST AID MEASURES * * *

**First Aid: Eyes**
Flush eyes with clean running water for at least fifteen (15) minutes. If irritation or redness develops from exposure, following flushing, seek medical attention.

**First Aid: Skin**
First aid is not required, normally. However, it is a good practice to wash any chemical from the skin.

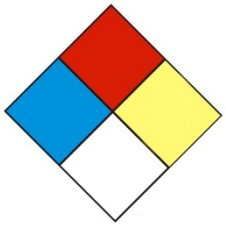
**First Aid: Ingestion (Swallowing)**
First aid is not required, normally. If spontaneous vomiting occurs, lean the victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. If symptoms develop, seek medical attention.

**First Aid: Inhalation (Breathing)**
Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

**Most important symptoms and effects**

None known or anticipated.

## * * * Section 5 – FIRE FIGHTING MEASURES * * *



**NFPA 704 Hazard Class**

**Health: 1 Flammability: 0 Instability: 0** (0=Minimal, 1=Slight, 2=Moderate, 3=Serious, 4=Severe)

**General Fire Hazards**

No fire hazards are expected.

**General Fire Hazards**

No unusual fire or explosion hazards are expected. If container is not properly cooled, it can rupture in the heat of a fire.

**Extinguishing Media**

The material is non-flammable. Use extinguishing agent suitable for the type of surrounding fire.

**Unsuitable Extinguishing Media**

None

**Fire Fighting Equipment / Instructions**

Small fires in the beginning stage may typically be extinguished using handheld portable fire extinguishers and other firefighting equipment. Isolate area around container involved in fire and keep unauthorized personnel out. Stop spill/release if it can be done safely. Move undamaged containers from the immediate hazard area if it can be done safely. Cool equipment exposed to fire with water, if it can be done safely.

**Hazardous Combustion Products**

None Anticipated. See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

## * * * Section 6 – ACCIDENTAL RELEASE MEASURES * * *

**Recovery and Neutralization**

Contain and stop the source of the spill, if safe to do so.

**Materials and Methods for Clean-Up**

Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios of this material. However, local conditions and regulations may influence or limit the choice of appropriate actions to be taken. See Section 13 for information on appropriate disposal.

**Emergency Measures**

The material is not considered hazardous. Nevertheless, evacuate nonessential personnel and secure the area. Stay upwind and uphill, if possible.

**Personal Precautions and Protective Equipment**

Stay upwind and away from the spill/release. Avoid direct contact with the material. For large spillages, notify persons downstream of the spill/release. Isolate the immediate hazard area and keep unauthorized personnel out. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

**Environmental Precautions**

Protect bodies of water by diking or absorbents, if possible. Do not flush down sewer or drainage systems. Use water sparingly to minimize environmental contamination and reduce disposal requirements. If a spill occurs on water, notify appropriate authorities and advise shipping of any hazard.

**Prevention of Secondary Hazards**

None

## * * * Section 7 – HANDLING AND STORAGE * * *

### Handling Procedures

Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8).

Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29 CFR 1910.146. Do not wear contaminated clothing or shoes.

### Storage Procedures

Keep container(s) tightly closed and properly labeled. Use and store this material in cool, dry, well ventilated areas. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

### Incompatibilities

Keep away from excessive heat to prevent rupture of container.

## * * * Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION * * *

### Component Exposure Limits

**Water (7732-18-5)**

ACGIH: Not listed

**Sodium Chloride (7647-14-5)**

ACGIH: Not listed

### Engineering Measures

If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

### Personal Protective Equipment: Respiratory

Emergencies or conditions that could result in significant airborne exposures may require the use of NIOSH approved respiratory protection. An industrial hygienist or other appropriate health and safety professional should be consulted for specific guidance under these situations.

A respiratory protection program that meets or is equivalent to OSHA 29 CFR

1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use.

**Personal Protective Equipment: Skin and Hands**

The use of skin protection is not normally required; however, good industrial hygiene practice suggests the use of gloves or other appropriate skin protection whenever working with chemicals.

**Personal Protective Equipment: Eyes**

Safety glasses or goggles that meet or exceed ANSI Z-87.1 are recommended where there is a possibility of splashing or spraying.

**Hygiene Measures**

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Promptly remove contaminated clothing and launder before reuse.

## * * * Section 9 – PHYSICAL AND CHEMICAL PROPERTIES * * *

| | | | |
|---|---|---|---|
| **Appearance:** | Clear to Brown | **Odor:** | Salty |
| **Physical State:** | Liquid | **pH:** | ND |
| **Vapor Pressure:** | < 0.36 psia @ 70°F / 21.1°C | **Vapor Density:** | > 1 |
| **Boiling Point:** | 212°F / 100°C | **Melting Point:** | 2.4°F / -16.5°C |
| **Solubility (H2O):** | Complete | **Specific Gravity:** | 1.1 @ 68°F / 20°C |
| **Evaporation Rate:** | Variable | **VOC:** | ND |
| **Octanol / H2O Coeff.:** | ND | **Flash Point:** | ND |
| **Flash Point Method:** | ND | | |
| **Lower Flammability Limit: (LFL):** | ND | **Upper Flammability Limit: (UFL):** | ND |
| **Auto Ignition:** | ND | **Burning Rate:** | ND |

## * * * Section 10 – CHEMICAL STABILITY & REACTIVITY INFORMATION * * *

**Chemical Stability**

This is a stable material.

**Hazardous Reaction Potential**

Will react with alkali and alkaline metals to form flammable hydrogen gas.

**Conditions to Avoid**

Avoid contact with alkali metals (lithium, sodium, potassium), alkaline metals (beryllium, magnesium, calcium, strontium, and barium), and metallic hydrides like lithium aluminum hydride.

**Hazardous Decomposition Products**

Not anticipated under normal conditions of use.

**Hazardous Polymerization**

Not known to occur.

## * * * Section 11 – TOXICOLOGICAL INFORMATION * * *

**Acute Toxicity**

**A: General Product Information**

Unlikely to be harmful.

**B. Component Analysis – D50/LC50**

**Water (7732-18-5)**

Oral LD50 Rat 90 g/kg

**Sodium Chloride (7647-14-5)**

Oral LD50 Rat 3 g/kg

**Potential Health Effects: Skin Corrosion Property / Stimulativeness**

May cause skin irritation with prolonged or repeated contact. Not expected to be a skin sensitizer.

**Potential Health Effects: Eye Critical Damage / Stimulativeness**

Contact with eyes may cause moderate irritation.

**Potential Health Effects: Ingestion**

Ingestion may result in nausea, vomiting, diarrhea, abdominal cramps, and dehydration (thirst).

**Potential Health Effects: Inhalation**

No information available on the mixture. However, none of the components have been classified for respiratory sensitization (or are below the concentration threshold for classification).

**Generative Cell Mutagenicity**

Not expected to cause genetic effects.

**Carcinogenicity**

**General Product Information**

Not expected to cause cancer. This substance is not listed as a carcinogen by IARC, NTP or OSHA.

**Reproductive Toxicity**

This product is not reported to have any reproductive toxicity effects.

**Specified Target Organ General Toxicity: Single Exposure**

This product is not reported to have any specific target organ general toxicity single exposure effects.

**Specified Target Organ General Toxicity: Repeated Exposure**

This product is not reported to have any specific target organ general toxicity multiple exposure effects.

**Aspiration Respiratory Organs Hazard**

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

## * * * Section 12 – ECOLOGICAL INFORMATION * * *

**Ecotoxicity**

**A: General Product Information**

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable under Federal and State regulations.

**Persistence / Degradability**

No information available

**Bioaccumulation**

No information available

**Mobility in Soil**

No information available

## * * * Section 13 – DISPOSAL CONSIDERATIONS * * *

**Waste Disposal Instructions**

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment Recommendations.

**Disposal of Contaminated Containers or Packaging**

Recover or recycle if possible. It is the responsibility of the generator to determine the toxicity and physical properties of the material generated so as to properly classify the waste and ensure disposal methods comply with applicable regulations.

This material, if discarded as produced, is not a RCRA "listed" hazardous waste, and is not believed to exhibit characteristics of hazardous waste. Consult state and local regulations regarding the proper disposal of this material. Do not dispose of brine water by draining onto the ground. This will result in soil and groundwater contamination. Waste arising from spillage or tank cleaning should be disposed of in accordance with applicable regulations.

Container contents should be completely used and containers should be emptied prior to discard. Container rinsate should not be considered a RCRA hazardous waste but must be disposed of with care and in full compliance with federal, state and local regulations. Larger empty containers, such as drums, should be returned to the distributor or to a qualified drum reconditioner. To assure proper disposal of smaller empty containers, consult with state and local regulations and disposal authorities.

## * * * Section 14 – TRANSPORTATION INFORMATION * * *

**DOT Information**

**Shipping Description:** Not Regulated

**UN #:** Not Regulated

## * * * Section 15 – REGULATORY INFORMATION * * *

**CERCLA/SARA – Section 302 Extremely Hazardous Substances and TPQs (in pounds):**
This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372,

**CERCLA/SARA – Section 313 and 40 CFR 372):**
This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

**EPA (CERCLA) Reportable Quantity (in pounds):**
This material does not contain any chemicals with CERCLA Reportable Quantities.

**State Regulations**

**Component Analysis**

The following components appear on one or more of the following state hazardous substances list.

**California Proposition 65:**
This material does not contain any chemicals that are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

**National Chemical Inventories:**
All components are either listed on the US TSCA Inventory, or are not regulated under TSCA.

**U.S. Export control classification Number:** EAR99.

## * * * Section 16 – OTHER INFORMATION * * *

**NFPA® Hazard Rating**

| | |
|---|---|
| Health | 1 |
| Fire | 0 |
| Reactivity | 0 |

| | | | |
|---|---|---|---|
| **HMIS® Hazard Rating** | Health | 1 | Slight |
| | Fire | 0 | Minimal |
| | Physical | 0 | Minimal |

**Key/Legend**

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act: ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NJTSR = New Jersey Trade Secret Registry.

**Literature References**

None

**Other Information**

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**Date of Preparation: January 28, 2014**

**Date of Last Revision: March 4, 2014**

End of Sheet

# Attachment O

## Emissions Summary Sheet

## Attachment O: G70-A Emissions Summary Sheet

### Emission Points Data Summary Sheet

Table 1: Emissions Data

| Emission Point ID No. *(Must match Emission Units Table & Plot Plan)* | Emission Point Type[1] | Emission Unit Vented Through This Point *(Must match Emission Units Table & Plot Plan)* | | Air Pollution Control Device *(Must match Emission Units Table & Plot Plan)* | | All Regulated Pollutants - Chemical Name/CAS[3] *(Speciate VOCs & HAPS)* | Maximum Potential Uncontrolled Emissions [4] | | Maximum Potential Controlled Emissions [5] | | Emission Form or Phase *(At exit conditions, Solid, Liquid or Gas/Vapor)* | Est. Method Used [6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ID No. | Source | ID No. | Device Type | | lb/hr | ton/yr | lb/hr | ton/yr | | |
| EP-H001, EP-H002, EP-H003, EP-H004, EP-H005, EP-H006, EP-H007, EP-H008, EP-H009, EP-H010 | Vertical Stack | H001, H002, H003, H004, H005, H006, H007, H008, H009, H010 | Gas Production Unit Heater | N/A | | CO (630080) | 1.01 | 4.43 | 1.01 | 4.43 | Gas/Vapor /Solid (for PM) | MB AP-42 |
| | | | | | | NOx (10102439) | 1.20 | 5.27 | 1.20 | 5.27 | | |
| | | | | | | CO2 Equivalent N2O (10024972), CO2 (124389), CH4 (74828) | 1451.97 | 6359.64 | 1451.97 | 6359.64 | | |
| | | | | | | SO2 (7446095) | 0.01 | 0.03 | 0.01 | 0.03 | | |
| | | | | | | PM, PM10, PM2.5 | 0.09 | 0.40 | 0.09 | 0.40 | | |
| | | | | | | Hexane (110543) | 0.02 | 0.09 | 0.02 | 0.09 | | |
| | | | | | | Total VOCs | 0.07 | 0.29 | 0.07 | 0.29 | | |
| F001 | n/a | F001 | Fugitives | N/A | | Benzene (71432) | 0.00 | 0.01 | 0.00 | 0.01 | Gas/Vapor | MB |
| | | | | | | Toluene (108883) | 0.02 | 0.08 | 0.02 | 0.08 | | |
| | | | | | | Ethyl benzene (100414) | 0.03 | 0.14 | 0.03 | 0.14 | | |
| | | | | | | Hexane (110543) | 0.20 | 0.87 | 0.20 | 0.87 | | |
| | | | | | | o,m,p-xylenes (95476,108383,106423) | 0.07 | 0.32 | 0.07 | 0.32 | | |
| | | | | | | CO2 Equivalent CO2 (124389)), CH4 | 80.94 | 354.50 | 80.94 | 354.50 | | |
| | | | | | | VOCs | 3.79 | 16.59 | 3.79 | 16.59 | | |
| | | | | | | TAPs (benzene) | 0.00 | 0.01 | 0.00 | 0.01 | | |
| EP-L001, EP-L002 | n/a | L001, L002 | Loading (Condensate), Loading (Water) | N/A | | VOCs | 6.28 | 5.51 | 6.28 | 5.51 | Gas/Vapor | MB |
| | | | | | | hexane (110543) | 0.01 | 0.01 | 0.01 | 0.01 | | |
| | | | | | | CO2 Equivalent CO2 (124389), CH4 | 3.23 | 12.36 | 3.23 | 12.36 | | |
| EP-HR001 | n/a | HR001 | Haul Truck | N/A | | PM, PM10, PM2.5 | 1.33 | 8.37 | 0.66 | 4.19 | Solid | MB |
| EP-EC001 | n/a | TANKCOND001-010, TANKPW001-002, and EC001 | Condensate Tanks, PW Tanks, and Enclosed Combustor | N/A | Enclosed Combustor | CO (630080) | 0.00 | 0.00 | 0.44 | 1.94 | Gas/Vapor/ Solid (for PM) | MB |
| | | | | | | NOx (10102439) | 0.00 | 0.00 | 0.53 | 2.31 | | |
| | | | | | | CO2 Equivalent N2O (10024972), CO2 (124389), CH4 | 1761.44 | 7715.13 | 2679.58 | 11736.54 | | |
| | | | | | | PM, PM10, PM2.5 | 0.00 | 0.00 | 0.04 | 0.18 | | |
| | | | | | | Benzene (71432) | 0.21 | 0.91 | 0.00 | 0.02 | | |
| | | | | | | Toluene (108883) | 0.46 | 2.00 | 0.01 | 0.04 | | |
| | | | | | | ethyl benzene (100414) | 0.27 | 1.18 | 0.01 | 0.02 | | |
| | | | | | | hexane (110543) | 5.58 | 24.45 | 0.11 | 0.49 | | |
| | | | | | | o,m,p-xylenes (95476,108383,106423) | 0.49 | 2.13 | 0.01 | 0.04 | | |
| | | | | | | VOCs | 280.21 | 1227.31 | 5.60 | 24.55 | | |
| EP-PCV | valve | PCV | Pneumatic CV | N/A | | hexane (110543) | 0.01 | 0.06 | 0.01 | 0.06 | Gas/Vapor | MB |
| | | | | | | CO2 Equivalent CO2 (124389)), CH4 | 9.03 | 39.56 | 9.03 | 39.56 | | |
| | | | | | | VOCs | 0.11 | 0.50 | 0.11 | 0.50 | | |
| EP-ENG001 | Vertical Stack | ENG001 | Compressor Engine | N/A | | CO (630080) | 5.64 | 24.72 | 5.64 | 24.72 | Gas/Vapor/ Solid (for PM) | MB |
| | | | | | | NOx (10102439) | 0.32 | 1.38 | 0.32 | 1.38 | | |
| | | | | | | CO2 Equivalent N2O (10024972), CO2 (124389), CH4 (74828) | 27.78 | 121.66 | 27.78 | 121.66 | | |
| | | | | | | PM, PM10, PM2.5 | 0.00 | 0.01 | 0.00 | 0.01 | | |
| | | | | | | TAPs Formaldehyde (50000) | 0.00 | 0.02 | 0.00 | 0.02 | | |
| | | | | | | Total VOCs | 0.01 | 0.03 | 0.01 | 0.03 | | |

# Attachment C/O: G70-A Emissions Summary Sheet

## Fugitive Emissions Data Summary Sheet

| FUGITIVE EMISSIONS SUMMARY | All Regulated Pollutants Chemical Name/CAS [1] | Maximum Potential Uncontrolled Emissions [2] | | Maximum Potential Controlled Emissions [3] | | Est. Method Used [4] |
|---|---|---|---|---|---|---|
| | | lb/hr | ton/yr | lb/hr | ton/yr | |
| Haul Road/Road Dust Emissions<br>Paved Haul Roads | n/a | | | | | |
| Unpaved Haul Roads | PM, PM10, PM2.5 | 1.3291 | 8.3718 | 0.6645 | 4.1859 | MB |
| Loading/Unloading Operations | VOCs | 6.2848 | 5.5080 | 6.2848 | 5.5080 | MB |
| | toluene (108883) | 0.0009 | 0.0008 | 0.0009 | 0.0008 | |
| | ethyl benzene (100414) | 0.0010 | 0.0009 | 0.0010 | 0.0009 | |
| | hexane (110543) | 0.0086 | 0.0075 | 0.0086 | 0.0075 | |
| | o,m,p-xylenes (95476,108383,106423) | 0.0022 | 0.0019 | 0.0022 | 0.0019 | |
| | CO2 Equivalent<br>CO2 (124389), CH4 | 3.2288 | 12.3613 | 3.2288 | 12.3613 | |
| | benzene (71432) | 0.0002 | 0.0002 | 0.0002 | 0.0002 | |
| | TAPs (benzene) | 0.0002 | 0.0002 | 0.0002 | 0.0002 | |
| Equipment Leaks (Components) | Benzene (71432) | Does not apply | 0.0103 | Does not apply | 0.0103 | MB |
| | Toluene (108883) | | 0.0788 | | 0.0788 | |
| | Ethyl benzene (100414) | | 0.1384 | | 0.1384 | |
| | Hexane (110543) | | 0.8741 | | 0.8741 | |
| | o,m,p-xylenes (95476,108383,106423) | | 0.3209 | | 0.3209 | |
| | CO2 Equivalent<br>CO2 (124389)), CH4 | | 354.4988 | | 354.4988 | |
| | VOCs | | 16.5870 | | 16.5870 | |
| | TAPs (benzene) | | 0.0103 | | 0.0103 | |
| Equipment Leaks (PCVs) | toluene (108883) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MB |
| | ethyl benzene (100414) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| | hexane (110543) | 0.0136 | 0.0596 | 0.0136 | 0.0596 | |
| | o,m,p-xylenes (95476,108383,106423) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| | CO2 Equivalent<br>CO2 (124389)), CH4 | 9.0327 | 39.5633 | 9.0327 | 39.5633 | |
| | VOCs | 0.1145 | 0.5015 | 0.1145 | 0.5015 | |
| | TAPs (benzene) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |

[1] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. LIST Acids, CO, $CS_2$, VOCs, $H_2S$, Inorganics, Lead, Organics, $O_3$, NO, $NO_2$, $SO_2$, $SO_3$, all applicable Greenhouse Gases (including $CO_2$ and methane), etc. DO NOT LIST $H_2$, $H_2O$, $N_2$, $O_2$, and Noble Gases.

[2] Give rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[3] Give rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[4] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

# Attachment P

## Other Supporting Documentation
## (Engine EPA's Certificate of Conformity and Technical Information)

# UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
## 2013 MODEL YEAR
## CERTIFICATE OF CONFORMITY
## WITH THE CLEAN AIR ACT OF 1990

**OFFICE OF TRANSPORTATION AND AIR QUALITY**
**ANN ARBOR, MICHIGAN 48105**

**Certificate Issued To:** **Kubota Corporation**
(U.S. Manufacturer or Importer)

**Certificate Number: DKBXS.9622HP-002**

**Effective Date:** 11/20/2012

**Expiration Date:** 12/31/2013

**Byron J. Bunker, Division Director**
**Compliance Division**

**Issue Date:** 11/20/2012

**Revision Date:** N/A

**Manufacturer:** Kubota Corporation
**Engine Family:** DKBXS.9622HP
**Certificate Number:** DKBXS.9622HP-002
**Useful Life :** 1000 Hours / 5 Years
**Engine Class :** Nonhandheld-Class II
**Fuel :** Natural Gas (CNG/LNG)
**Emission Standards :** NMHC + NOx ( g/kW-hr ) : 8
CO ( g/kW-hr ) : 610

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. section 7547), 40 CFR Part 1054, 40 CFR Part 1068 and 40 CFR Part 60 (stationary only and combined stationary and mobile), and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued for the following small nonroad engine family, more fully described in the documentation required by 40 CFR Part 1054 and produced in the stated model year.

This certificate of conformity covers only those new small nonroad engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 1054 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 1054. This certificate of conformity does not cover small nonroad engines imported prior to the effective date of the certificate.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068.20 and 1068, Subpart E and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 1054. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 1054, 40 CFR Part 1068.

This certificate does not cover small nonroad engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

# TECHNICAL INFORMATION

# DG972-SAEH-S1

NATURAL GAS FUEL ENGINE

July, 2006

KUBOTA Corporation

# CONTENTS



Specifications and dimensions are subject to change without prior notice.

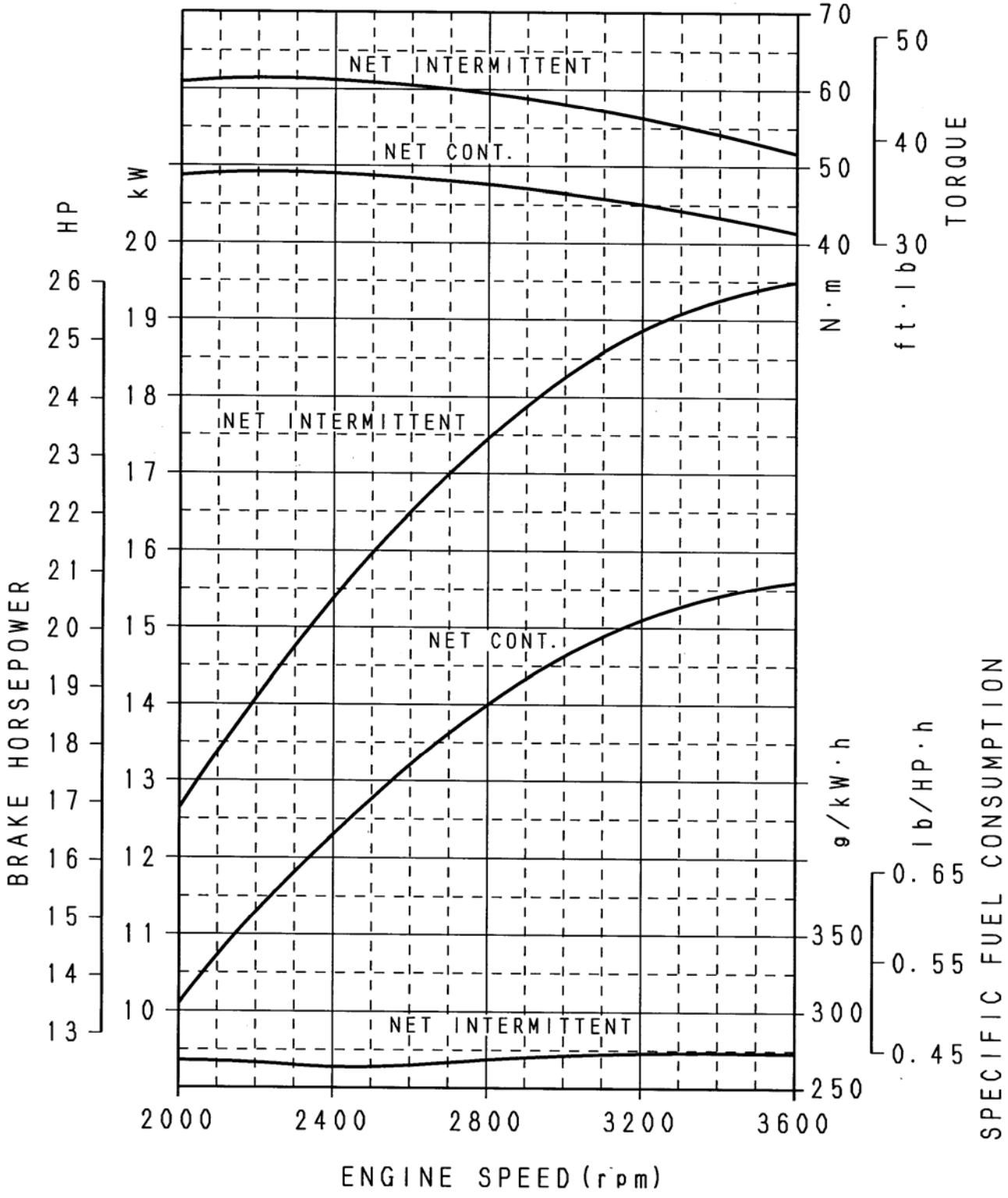
# 1. GENERAL SPECIFICATIONS

| ITEM | UNIT | SPECIFICATIONS |
|---|---|---|
| Engine model | | DG972-SAEH-S1 |
| Type | | Vertical, In line,<br>4cycle Natural Gas engine |
| Cooling system | | Water cooling with water pump |
| Number of cylinders | | 3 |
| Cylinder bore | mm(in) | 74.5 (2.93) |
| Stroke | mm(in) | 73.6 (2.90) |
| Total displacement | L(cu. in) | 0.962 (58.7) |
| High idle | rpm | 3850 |
| Low idle | rpm | 1500 |
| Horsepower | kW(HP) | 19.5(26.1) |
| Max. torque<br>(SAE J1349) | Nm(ft-lb)<br>/rpm | 61.2 (45.2)/2400 |
| Compression ratio | | 9.2 |
| Firing order | | 1-2-3 |
| Ignition timing | | B.T.D.C.15˚/1000rpm B.T.D.C.28˚/3600rpm |
| Ignition system | | Distributor-less Solid State type |
| Fuel | | Natural Gas only |
| Direction of rotation | | Counter-clockwise from flywheel side |
| Starting system | | Electric starting with cell starter |
| Starter output | V-kW | 12-1.0 |
| Alternator output | V-W | 12-480 (Standard) |
| Lubricating system | | Forced lubricating by trochoid pump |
| Lubricating oil | | Quality better than SH class |
| Lube. oil capacity | L(US gal) | 3.4 (0.90) |
| Coolant capacity | L(US gal) | 1.22 (0.32) |
| Governor type | | Centrifugal flyweight mechanical type governor |
| Dimensions (LxBxH) | mm(in) | 526x415x503 (20.7x16.3x19.8) |
| Dry weight | kg(lb) | Approx. 95.4(210) |
| Application | | Stationary only |

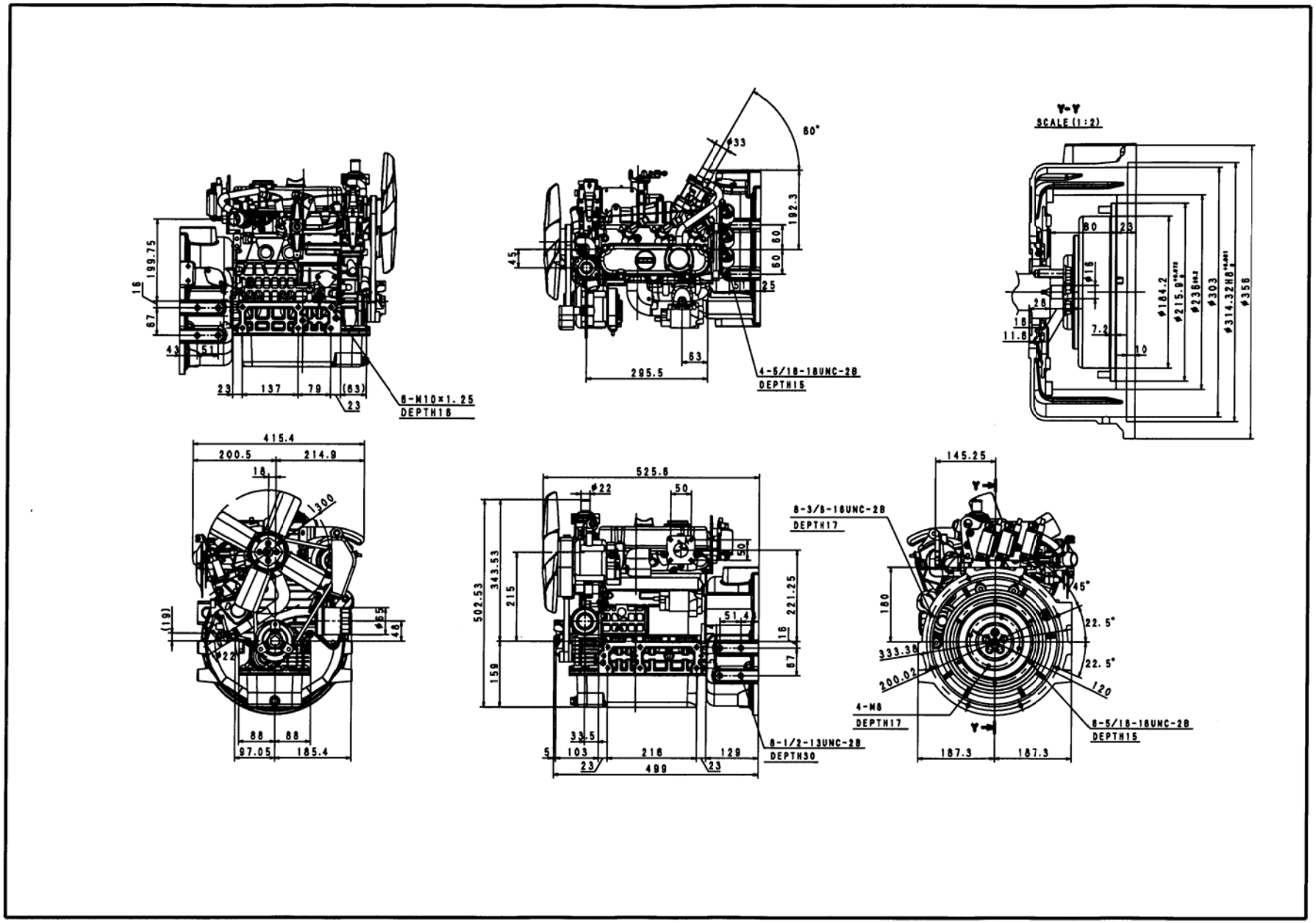
## 2. PERFORMANCE CURVES

# DG972 PERFORMANCE CURVES

Higher calorific value : 11000kcal/$m^3$ (1236BTU/$ft^3$)



# 3. DIMENSIONS



# 4. TECHNICAL DATA

| ITEM | | SPECIFICATIONS |
|---|---|---|
| Engine model | | DG972-SAEH-S1 |
| Brake horse power | | See attached sheet 4-1) |
| Top Clearance | | 1.35 to 1.65mm (0.05315 to 0.06496in) |
| Compression pressure | | 1.32MPa (192psi) |
| Fuel consumption | | See attached sheet 4-2) |
| Lube. oil consumption | | Max.0.67g/kWh (0.5g/HPh) at rated load |
| Lube. oil pressure | | at idling speed: more than 69kPa (more than 9.95psi) |
| | | at rated speed: 196 to 441kPa (28.44 to 63.99psi) |
| Noise level | | See attached sheet 4-3) |
| Combustion air requirements | | See attached sheet (Refer to 25deg.C and 1000hPa) 4-4) |
| Cooling air requirements | | |
| Combustion and cooling air requirements | | |
| Exhaust gas volume | | See attached sheet (Refer to 25deg.C and 1000hPa) 4-5) |
| Cold starting limits | | -15deg.C (5deg.F) |
| Heat rejection | | See attached sheet 4-6) |
| Angles of tilt | Front or Rear down | 30° (Less than 10min. continuous operation) |
| | | 20° (Continuous operation) |
| | Left or Right side down | 30° (Less than 10min. continuous operation) |
| | | 20° (Continuous operation) |
| Valve timing | | [Inlet valve] Open: TDC –20° Close: BDT +45° |
| | | [Exhaust valve] Open: BDC –50° Close: TDC +15° |
| Cooling fan data | | See attached sheet 4-7) |
| Center of gravity | | See attached sheet 4-8) |
| Unbalanced forces of engines | | See attached sheet 4-9) |
| Mass elastic system | | See attached sheet 4-10) |
| Thermostat specifications | | Opening temperature: 71±1.5deg.C (159.8±2.7deg.F) |
| | | Fully opened temperature: 85deg.C (185deg.F) [at Thermostat lift:8mm (0.31in)] |

# 4-1) BRAKE HORSE POWER

### SAE J1349

| Engine speed | rpm | 2000 | 2400 | 2800 | 3200 | 3600 |
|---|---|---|---|---|---|---|
| Net intermittent | kW | 12.6 | 15.4 | 17.4 | 18.9 | 19.5 |
| | HP | 16.9 | 20.6 | 23.3 | 25.3 | 26.1 |
| | PS | 17.1 | 20.9 | 23.7 | 25.7 | 26.5 |
| Net continuous | kW | 10.1 | 12.3 | 13.9 | 15.1 | 15.6 |
| | HP | 13.5 | 16.5 | 18.7 | 20.3 | 20.9 |
| | PS | 13.7 | 16.8 | 18.9 | 20.6 | 21.2 |

Note

1. Conversion rates 1kW=1.35962PS=1.34048HP
   1PS=0.7355kW=0.985925HP
   1HP=0.7457kW=1.01428PS
2. Fuel detail Japanese standard gas
   higher calorific value : 11000kcal/$m^3$ (1236BTU/$ft^3$)
   supply pressure : 0.98 – 2.45kPa (7.35 – 18.38mmHg)

# 4-2) FUEL CONSUMPTION

### Specific at net intermittent (SAE J1349)

| Engine speed | rpm | 2000 | 2400 | 2800 | 3200 | 3600 |
|---|---|---|---|---|---|---|
| Brake horse power | kW | 12.6 | 15.4 | 17.4 | 18.9 | 19.5 |
| | HP | 16.9 | 20.6 | 23.3 | 25.3 | 26.1 |
| | PS | 17.1 | 20.9 | 23.7 | 25.7 | 26.5 |
| Fuel consumption | g/kWh | 269 | 264 | 269 | 273 | 273 |
| | g/HPh | 200 | 197 | 200 | 204 | 204 |
| | g/PSh | 198 | 194 | 198 | 201 | 201 |
| | lb/HPh | 0.442 | 0.434 | 0.442 | 0.449 | 0.449 |

Note

1. Conversion rates 1kW=1.35962PS=1.34048HP 1kg=2.20462lb (1g=0.00220462lb)
   1PS=0.7355kW=0.985925HP 1lb=0.45359kg
   1HP=0.7457kW=1.01428PS
2. Fuel detail Japanese standard gas
   higher calorific value : 11000kcal/$m^3$ (1236BTU/$ft^3$)
   supply pressure : 0.98 – 2.45kPa (7.35 – 18.38mmHg)

# 4-3) NOISE LEVEL

| Load × rpm | Unit | Sound pressure at 1m(3.3ft) |
|---|---|---|
| 0/4 × 3850 | dB(A) | 90.0 |
| 4/4 × 3850<br>15.6kW (20.9HP) | dB(A) | 92.0 |
| 0/4 × 1500 | dB(A) | 72.0 |

These data show the average noise level at four points.

Note

1. Measurement conditions : With radiator, cooling fan, air cleaner and muffler.

# 4-4) AIR REQUIREMENTS

## 1. Combustion air requirements (Refer to 25deg.C and 1000hPa)

| rpm | 2000 | 2400 | 2800 | 3200 | 3600 |
|---|---|---|---|---|---|
| L/sec | 12.35 | 14.81 | 17.28 | 19.75 | 22.22 |
| $m^3/h$ | 44.44 | 53.33 | 62.22 | 71.11 | 80.00 |
| $in^3/sec$ | 753 | 904 | 1055 | 1205 | 1356 |
| $ft^3/min$ | 26.13 | 31.35 | 36.58 | 41.80 | 47.03 |

Combustion air requirements calculating formula

$Q_1=Vh \bullet N \bullet C \bullet \eta \bullet 10^{-3}$

$Q_1$: Amount of intake air ($m^3$/min)
Vh: Total displacement (L)
N: Engine speed (rpm)
C: Coefficient=0.5
η: Intake efficiency
Natural Gas: 0.77

## 2. Cooling air requirements (Refer to 25deg.C and 1000hPa)

| rpm | 2000 | 2400 | 2800 | 3200 | 3600 |
|---|---|---|---|---|---|
| L/sec | 571.2 | 737.2 | 824.7 | 833.9 | 764.7 |
| $m^3/h$ | 2056 | 2654 | 2969 | 3002 | 2753 |
| $in^3/sec$ | 34859 | 44984 | 50327 | 50888 | 46667 |
| $ft^3/min$ | 1210.2 | 1561.8 | 1747.3 | 1766.7 | 1620.2 |

Above data is decided by following conditions.

1. Using the standard radiator.
2. Engine is run as open unit.

## 3. Combustion and cooling air requirements (Refer to 25deg.C and 1000hPa)

| rpm | 2000 | 2400 | 2800 | 3200 | 3600 |
|---|---|---|---|---|---|
| L/sec | 583.5 | 752.0 | 842.0 | 853.7 | 786.9 |
| $m^3/h$ | 2100.4 | 2707.3 | 3031.2 | 3073.1 | 2833.0 |
| $in^3/sec$ | 35612 | 45888 | 51382 | 52093 | 48023 |
| $ft^3/min$ | 1236.3 | 1593.2 | 1783.9 | 1808.5 | 1667.2 |

Note

1. Cooling fan and fan pulley specifications(Cooling fan Part No. 15881-74112)

| Item | |
|---|---|
| Fan diameter | 300mm (11.81in) |
| No. of blade and type of shape | 4, S type |
| Diameter of fan driving pulley | 100mm (3.94in) |
| Diameter of fan pulley | 84mm (3.31in) |

2. Conversion rates

$1L=61.0237in^3=0.035315ft^3$
$1ft^3=28.3168L$
$1L/sec=3.6m^3/h=2.1189ft^3/min$

# 4-5) EXHAUST GAS VOLUME

**Refer to 25deg.C and 1000hPa**

| rpm | 2000 | 2400 | 2800 | 3200 | 3600 |
|---|---|---|---|---|---|
| L/sec | 35.46 | 42.55 | 49.65 | 56.74 | 63.83 |
| $m^3/h$ | 127.67 | 153.19 | 178.73 | 204.26 | 229.80 |
| $in^3/sec$ | 2164 | 2597 | 3030 | 3462 | 3895 |
| $ft^3/min$ | 75.05 | 90.06 | 105.07 | 120.08 | 135.09 |

Note

1. Conversion rates $1L=61.0237in^3=0.035315ft^3$
   $1ft^3=28.3168L$
   $1L/sec=3.6m^3/h=127.133ft^3/hr$

# 4-6) HEAT REJECTION TO COOLING WATER

## 1. Specific at net intermittent (SAE J1349)

| Engine speed | rpm | 2000 | 2400 | 2800 | 3200 | 3600 |
|---|---|---|---|---|---|---|
| Brake horse power | kW | 12.6 | 15.4 | 17.4 | 18.9 | 19.5 |
| | HP | 16.9 | 20.6 | 23.3 | 25.3 | 26.1 |
| | PS | 17.1 | 20.9 | 23.7 | 25.7 | 26.5 |
| Fuel consumption | g/kWh | 269 | 264 | 269 | 273 | 273 |
| | g/HPh | 200 | 197 | 200 | 204 | 204 |
| | g/PSh | 198 | 194 | 198 | 201 | 201 |
| | lb/HPh | 0.442 | 0.434 | 0.442 | 0.449 | 0.449 |
| Heat rejection to cooling water | MJ/h | 29.05 | 31.52 | 38.79 | 45.13 | 51.82 |
| | kcal/h | 6940 | 7529 | 9267 | 10781 | 12379 |
| | BTU/h | 12491 | 13551 | 16679 | 19404 | 22281 |

Note

Heat rejection to cooling water calculating formula

Ho=Hu•Ne•be•i

Ho: Heat rejection to cooling water

Hu: Fuel low calorific value

Japanese standard gas; 49.4MJ/kg, 11800kcal/h, 212391BTU/lb

Ne: Brake horse power

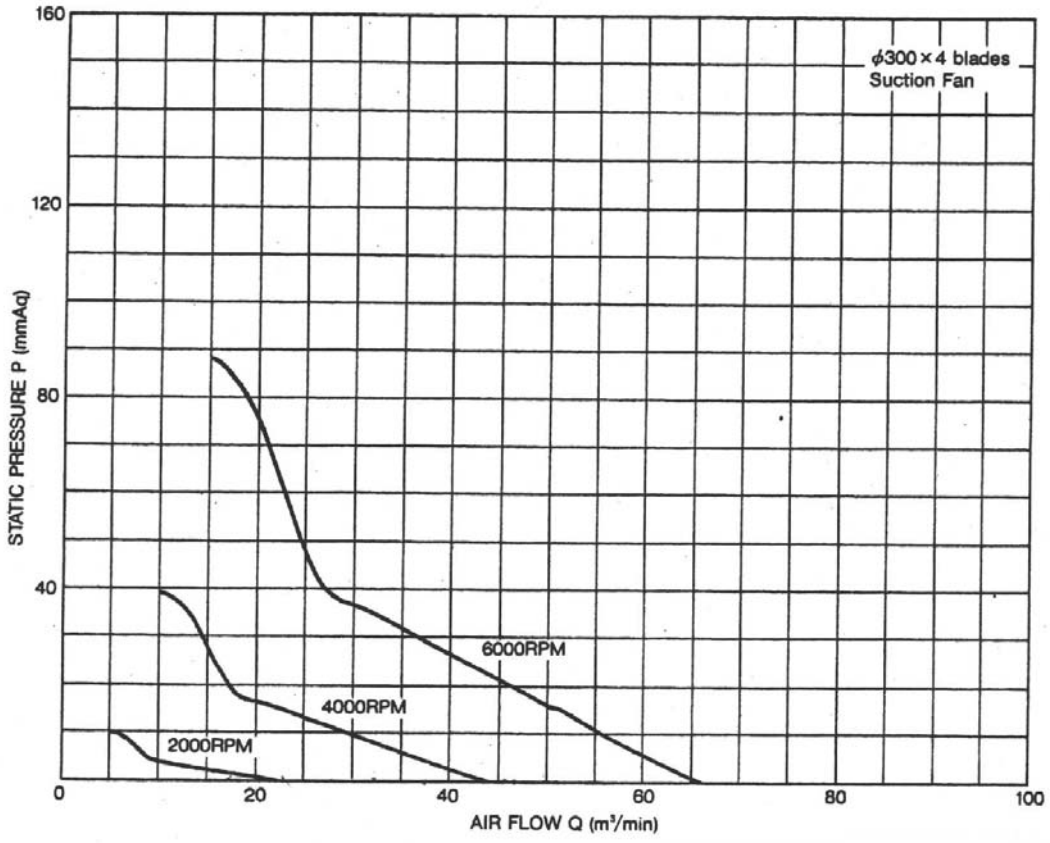
Be: Specific fuel consumption

i: Dispersion ratio to cooling water

# 4-7) COOLING FAN DATA

## 1. Performance curves <P-Q>

- Part No. 15881-74110 (Applicable for DG972)



# 4-8) CENTER OF GRAVITY

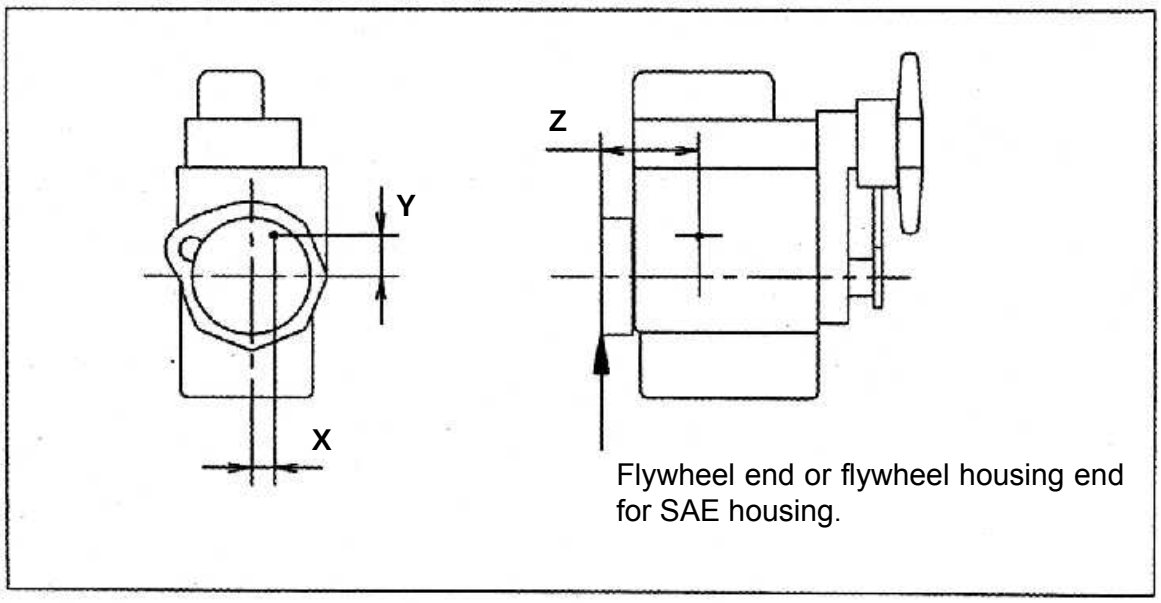
## 1. With standard flywheel and rear-end plate

| Model | Dry weight kg (lb) | Center of gravity | | |
|---|---|---|---|---|
| | | X mm (in) | Y mm (in) | Z mm (in) |
| WG/DF972 | 72.0 (159) | -25.5 (-1.00) | 73.3 (2.89) | 179.5 (7.07) |

## 2. With SAE flywheel and flywheel housing

| Model | Dry weight kg (lb) | Center of gravity | | |
|---|---|---|---|---|
| | | X mm (in) | Y mm (in) | Z mm (in) |
| DG972 -SAEH-S1 | 95.4 (210) | -10.0 (0.39) | 28.0 (1.10) | 207.0 (8.15) |

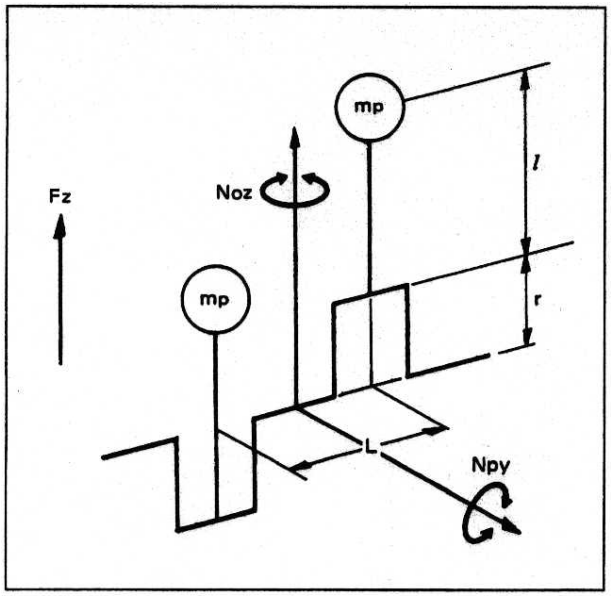
Note
Cooling water and lubricating oil weight is not included in above engine weight.




Flywheel end or flywheel housing end for SAE housing.

# 4-9) UNBALANCED FORCES OF ENGINES

## 1. Base data




FZ: Unbalanced inertia force
Npy, Noz: Unbalanced inertia couple
mp: Reciprocating mass
r: Crank radius
l: Center distance of connecting rod
L: Cylinder distance
ω: Angular velocity

| ω=2πn/60 | n: Engine speed(rpm) |
|---|---|

| l=0.098m<br>r=0.0368m<br>L=0.080m | Cylinder bore (mm) | mp (kg) |
|---|---|---|
| | 74.5 | 0.37/9.80665 |

## 2. Unbalanced inertia force and couple

($x\omega^2$)

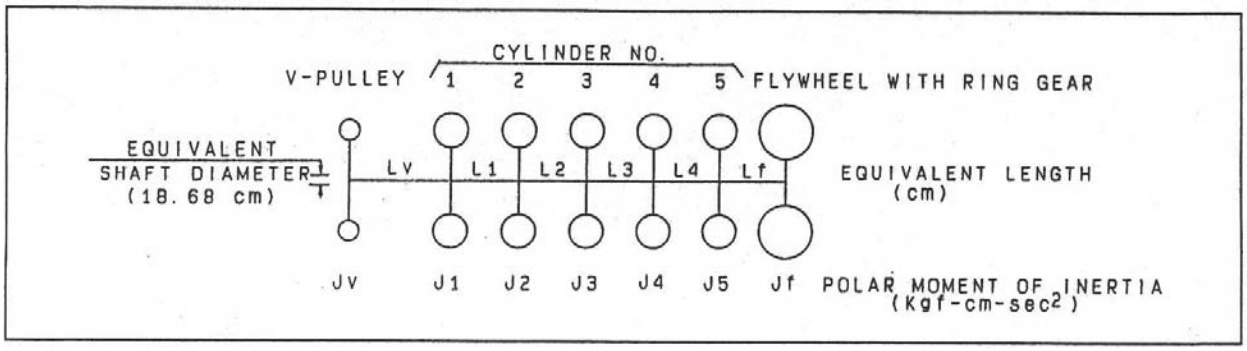
| Model | No. of Cylinder | Cylinder Bore | Order | Fz | Npy | Noz |
|---|---|---|---|---|---|---|
| WG/DF/DG 972 | 3 | 74.5mm | 1 | 0 | 0.000096 | 0.000096 |
| | | | 2 | 0 | 0.000072 | 0 |

### ▼An example of calculation

| Calculation condition | $\omega^2$ | Fz, Npy, Noz | | |
|---|---|---|---|---|
| | | | Order | Calculation |
| Engine model DG972<br>Engine speed 3600(rpm) | $[2 \times \pi \times 3600/60]^2$ =142122 | Fz | 1 | 0 |
| | | | 2 | 0 |
| | | Npy | 1 | 0.000096 × 142122=13.6kg |
| | | | 2 | 0.000072 × 142122=10.2kg |
| | | Noz | 1 | 0.000096 × 142122=13.6kg |
| | | | 2 | 0 |

# 4-10) MASS ELASTIC SYSTEM

## Equivalent torsional vibration data




| MODEL | EQUIVALENT LENGTH (cm) | | | | POLAR MOMENT OF INERTIA (kgfcm-sec$^2$) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LV | L1 | L2 | Lf | JV | J1 | J2 | J3 | Jf |
| DG972 -SAEH-S1 | 35082 | 4528 | 4528 | 2824 | 0.013 | 0.026 | 0.026 | 0.026 | 1.281 |

Note: Flywheel E8052-25110, V-Pulley 16861-74280

# 5. FUEL SYSTEM AND FUEL DIAGRAM

- **All fuel connections added to this engine must be installed by qualified personnel utilizing recognized procedures and standards.**
- **These non-KUBOTA installed parts, such as hoses, shutoff solenoid valve should be approved for Natural gas use.**
- **An approved, listed fuel filter and shutoff solenoid valve must be installed between the gas tank and Kubota regulator.**
- **Two fuel cut solenoids must be installed in series before the regulator on the fuel supply line for safety (backup) purpose.**

## 1. Tightening torque and leak check

1) The joint must be installed to the gas entrance of the regulator by screw with O-ring. Screw is tightened to the specified torque using a driver, and leak check must be performed as shown in the below table.
2) The connector on the gas mixer may be mounted on any position since it is not sealed. The lock nut may be loosened using a wrench. The connector may be changed to any specified angle. The lock nut should be tightened to the specified torque using a wrench as shown in the below table.

**[ TIGHTENING TORQUE AND LEAK CHECK ]**

| | | | Tightening torque | | | Leak check pressure |
|---|---|---|---|---|---|---|
| | Qty. | Size | Nm | kgfm | ft-lb | |
| SCREW | 2 | M4 | 1.9 to 2.9 | 0.2 to 0.3 | 1.5 to 2.2 | Soap solution or its equivalent |
| LOCK NUT | 1 | M16 × 1 | 19.6 to 39.2 | 2.0 to 4.0 | 14.5 to 28.9 | |

## 2. Setting of the regulator

1) Install the regulator in **UPRIGHT** position, it must be installed within 4G vibration level. If not, it may not supply necessary fuel to the engine.
2) **DO NOT** connect any extension hose to the air vent pipe of the regulator. This may cause an improper supply of fuel to the engine.

## 3. Caution for FUEL SYSTEM

The standard engine is equipped with $\phi$6.6 jet for the fuel calorific gas value of 11000kcal/$m^3$ (1236BTU/$ft^3$).
When the engine is operated with the different calorific gas, it is necessary to select the correct jet of the mixer.
In that case, refer to the manual **[ Adjustment for Natural Gas Engine DG972 ]**.

Japanese standard gas higher calorific value : 11000kcal/$m^3$ (1236BTU/$ft^3$)
supply pressure : 0.98 – 2.45kPa (7.35 – 18.38mmHg)

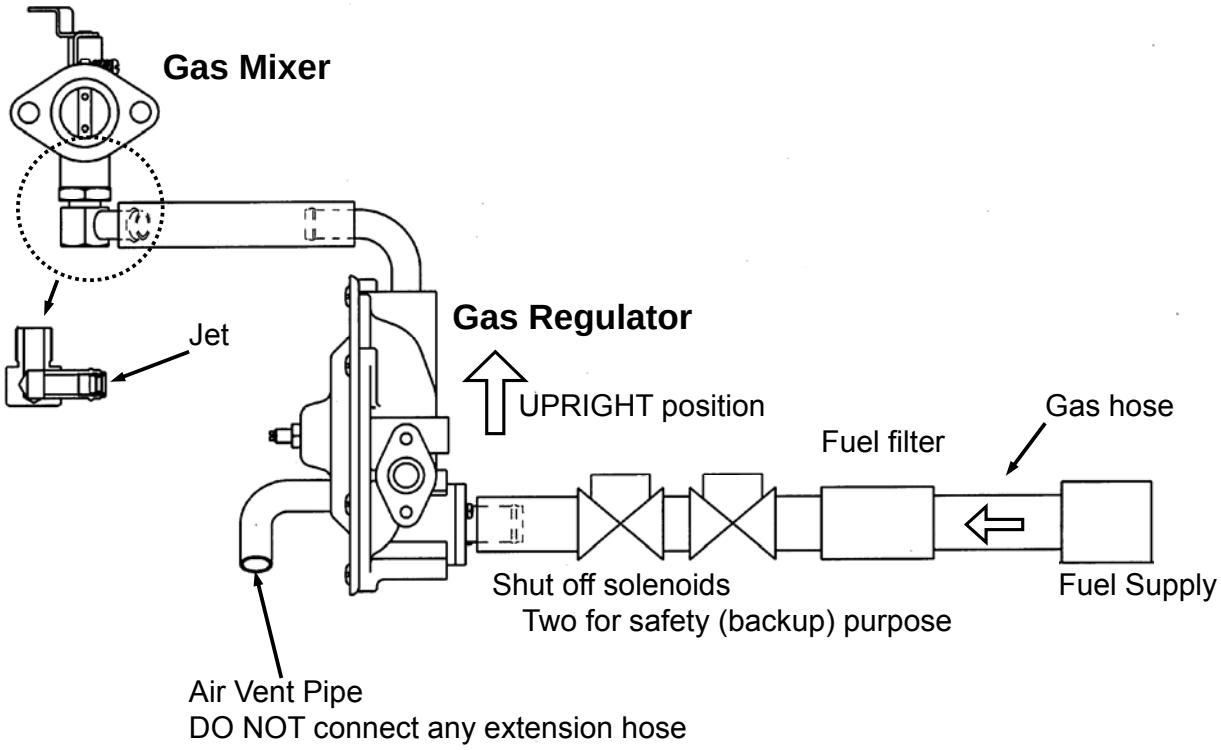
Equipments Vacuum Meter : Not KUBOTA supplied
Adjustable Jet : Service Tool

## 4. Application Check Item

The items as shown below must be managed for all engines, and these items must be informed to KUBOTA with Application Check results.
Refer to the attached sheet **[ Application Check Sheet for DG972 ]**.

1) The diameter of the jet (with the intake vacuum curve)
2) The calorific value of the gas
3) The supply pressure of gas
4) The serial number of the engine

## 5. Fuel diagram



NATURAL GAS ENGINE

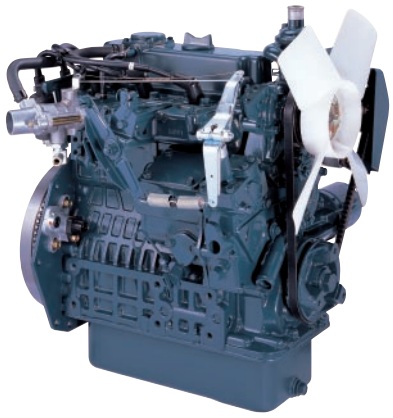
## KUBOTA DG SERIES (3-cylinder)

# DG972-E2

2 EPA Tier

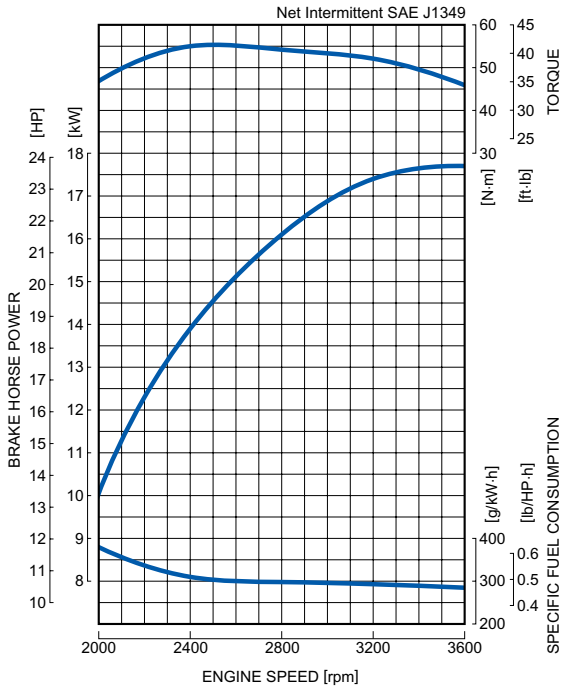
## RATED POWER

**17.6kW@3600rpm**



Photograph may show non-standard equipment.

## PERFORMANCE CURVE




## FEATURES and BENEFITS

### New Engine Series

- The Kubota DG Series offers a new solution to the increasing needs for natural gas engine. The diesel engine based Kubota DG Series gives users the same foot-print, reliability and durability of D902, WG972, and DF972 acknowledged as the world's top quality small industrial engines.
- Kubota offers SAE Flywheel Housing and Rear End Plate specifications for the DG972 engine. These options offer users flexible Power Take Off (PTO) choices.
- The Kubota DG Series is designed to endure use outdoors under severe environment. This series is equipped with a bypass breather tube to avoid freezing below zero.

### Emission

- Kubota DG Series complies with EPA Tier 2 Emissions Regulations. EPA regulation is one of the most stringent emissions regulations in the world.

### Best Fuel System

- Specialized for Natural Gas use, the DG972 engine eliminated the carburetor, regulator and a fuel filter parts, which are only necessary for Gasoline or LPG use. Also, Kubota adopts the best jet set and the ignition timing that provides the best engine performance in severe conditions.

### Ease maintenance cost and time

- Mechanical governor system will contribute to lower maintenance cost and prevents users from having to deal with complicated electric maintenance. Moreover, water resistant spark plug caps are adopted for outdoor use.

# DG972-E2

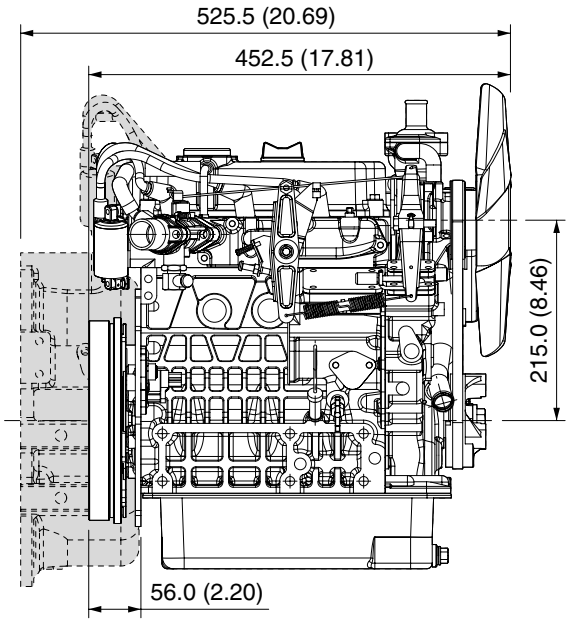
KUBOTA DG SERIES

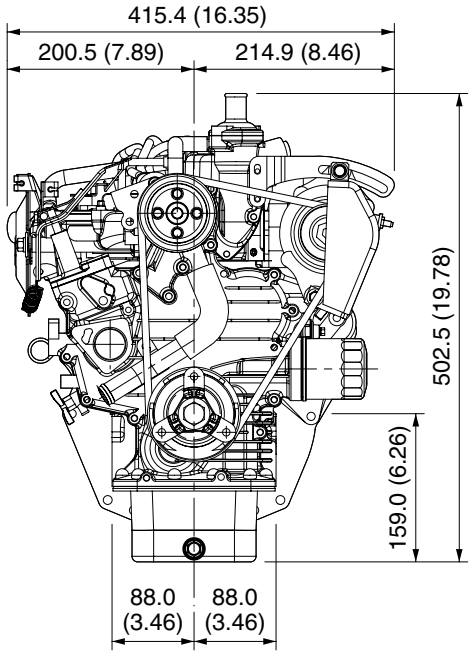
## GENERAL SPECIFICATION

| Model | | DG972-E2 |
|---|---|---|
| Emission Regulation | | Tier 2 |
| Type | | Vertical 4-cycle Liquid Cooled Natural Gas |
| Number of Cylinders | | 3 |
| Bore | mm (in) | 74.5 (2.93) |
| Stroke | mm (in) | 73.6 (2.9) |
| Displacement | L (cu.in) | 0.962 (58.70) |
| Fuel | | Natural Gas |
| Intake System | | Naturally Aspirated |
| Maximum Speed | rpm | 3600 |
| Output: Net Intermittent | kW | 17.6 |
| | hp | 23.6 |
| | ps | 23.9 |
| Direction of Rotation | | Counterclockwise Viewed on Flywheel |
| Oil Pan Capacity | L (gal) | 3.7 (0.98) |
| Starter Capacity | V-kW | 12-1.0 |
| Alternator Capacity | V-A | 12-40 |
| Length | mm (in) | 525.5 (20.69)*1 / 452.5 (17.81)*2 |
| Width | mm (in) | 415.4 (16.35) |
| Height (1) | mm (in) | 502.5 (19.78) |
| Height (2) | mm (in) | 159.0 (6.26) |
| Dry Weight | kg (lb) | 72.0 (158.7)*1 / 95.4 (210.3)*2 |

*Specification is subject to change without notice.
*Output: Net Intermittent SAE J1349
*Dry weight is according to Kubota's standard specification.
When specification varies, the weight will vary accordingly.
*1 with SAE Flywheel and Housing
*2 with Rear End Plate

## DIMENSIONS




Kubota

Your Driving Force
KUBOTA ENGINE

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