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LABORATORIES

Encana Corporation

Reservoir Fluid Study

Field: Kaybob

Formation: Duvernay

Well: ECA Hz Wahigan

16-16-064-23W5

CL-70055

August 2015

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SUMMARY

Study Objective

Encana Corporation commissioned Weatherford Laboratories - Calgary to perform a PVT study using multi-rate separator samples collected from well ECA Hz 16-16-064-23W5 of the Kaybob field, Duvernay formation. The study aims to provide characterization of the fluid in situ and to measure the current physical and compositional properties associated with the fluid.

Technical Approach

The reservoir fluid study was conducted on a representative reservoir fluid in situ obtained following the Weatherford Oil System Characterization Protocol. Constant Composition Expansion and Differential Liberation tests were performed on the fluid simulating the reservoir depletion process.

Analyses Summary

The following analyses summary is provided to enhance understanding of the laboratory data and to offer additional insight relative to Weatherford's experience with laboratory and field processes. They represent our interpretation as to possible mechanisms and physical phenomena that may be occurring within the laboratory models that have been studied. These laboratory experiments are microscale representations of the field scenario; however macroscale phenomena may override behaviour exhibited in the laboratory. A more thorough development of the conclusions is presented in the Discussion section of the report.

Multirate sampling was conducted to assess the changes in fluid properties as the flowing bottomhole pressure varies with flowrates. Three sampling rates were collected and delivered to the laboratory. The details of the samples are summarized below.

Rate #	Gas Rate, e3m3/day	Production GOR, m3/m3	Meter Temperature, °C	Static Pressure, kPa
1	32	435	38	5447
2	55	283	56	5936
3	45	408	53	5647

Upon review of the production gas-oil ratios, rate 2 samples were selected to be the most representative separator gas and liquid samples for physical recombination. The physical recombination was conducted at the agreed production gas-liquid ratio = 283 m^3/m^3.

The recombined fluid exhibited a bubble point pressure of 27.21 MPa at a reservoir temperature of 109°C, lower than the reservoir pressure (56.63 MPa). This saturation pressure indicates an under-saturated oil reservoir (bubble point system). Based on these assessments, the fluid characterization was completed according to Weatherford Oil System Characterization protocol (refer to Appendix D). A standard oil PVT study was conducted on the recombined fluid; including constant composition expansion and differential liberation tests.

The salient conclusions and recommendations of the study are:

1. On the basis of detailed compositional analysis, constant composition expansion, and differential liberation tests, sufficient data were provided to effectively characterize the vapor-liquid phase behavior of ECA Hz 16-16-064-23W5 reservoir fluid from a primary depletion perspective.
2. The Weatherford Oil System Characterization protocol determined that the reservoir fluid is a bubble point system.
3. A constant composition expansion test measured a bubble point pressure = 27.21 MPa at the reservoir temperature of 109°C.
4. The differential liberation test measured the following fluid properties at saturation pressure: solution gas-oil ratio (Rs) = 697.90 m^3/m^3, formation volume factor (Bo) = 3.6916, reservoir oil density = 461.5 Kg/m^3, and reservoir oil viscosity = 0.2 mPa.s.
5. The residual oil from differential liberation exhibited 42.85 API gravity and 0.6 mPa.s viscosity.
6. A separation test is recommended to correct the differential liberation data to surface conditions for EOS modelling purposes.

RESULTS & DISCUSSION

Encana Corporation commissioned Weatherford Laboratories - Calgary to perform a PVT study using multi-rate separator samples collected from well ECA Hz 16-16-064-23W5 of the Kaybob field, Duvernay formation. Multi-rate sampling was performed and separator gas and liquid samples from three sampling rates were collected and delivered to the laboratory. Sample validations were conducted. Upon review of the production gas-oil ratios, rate 2 samples were selected to be the most representative separator gas and liquid samples for physical recombination. The physical recombination was conducted at a production gas-liquid ratio = 283 m^3/m^3. The results of the selected sample validations are included in Appendix D.

The resulting recombined fluid exhibited a bubble point pressure of 27.21 MPa at a reservoir temperature of 109°C, lower than the reservoir pressure (56.63 MPa). This saturation pressure indicates an under-saturated oil reservoir (bubble point system). The composition of the recombined fluid was determined by performing a single stage flash measuring the flash GOR and compositional analysis of the flash gas and liquid. These data are reported in Appendix A. Based on these assessments, the fluid characterization was completed according to Weatherford - Oil System characterization protocol. A standard oil PVT study was conducted on the recombined fluid.

Subsequently, constant composition expansion and differential liberation tests were conducted on the on the recombined fluid. The pertinent data are summarized below.

INITIAL RESERVOIR CONDITIONS		
Reservoir Pressure	8213 psia	56.63 MPa
Reservoir Temperature:	228.128 F	108.96 C

CONSTANT COMPOSITION EXPANSION @ 228.1 F (109.0 C)		
Saturation Pressure	3946 psia	27.21 MPa
Compressibility @ Reservoir Pressure	3.21202E-05 $psia^{-1}$	4.658647E-03 MPa^{-1}
Compressibility @ Saturation Pressure	5.10102E-05 $psia^{-1}$	7.398422E-03 MPa^{-1}

DIFFERENTIAL LIBERATION @ 228.1 F (109.0 C)		
At Saturation Pressure		
Oil Formation Volume Factor	3.6916 res.bbl/STB	3.6916 res.m^3/m^3
Solution Gas-Oil Ratio	3918.59 scf/STB	697.90 m^3/m^3
Oil Density	0.4615 g/cm^3	461.5 kg/m^3
Oil Viscosity	0.157 cp	0.2 mPa.s
At Ambient Pressure		
Residual Oil Density	0.7427 g/cm^3	742.7 kg/m^3
Residual Oil Viscosity	0.624 cp	0.6 mPa.s
At Tank Conditions		
Residual Oil Density	0.8116 g/cm^3	811.6 kg/m^3
API Gravity	42.85	42.85

SINGLE-STAGE SEPARATOR TEST		
At Saturation Pressure		
Oil Formation Volume Factor	2.7959 res.bbl/STB	2.7959 res.m^3/m^3
Solution Gas-Oil Ratio	2705.18 scf/STB	481.79 m3/m3
At Tank Conditions		
Residual Oil Density	0.7916 g/cm^3	791.6 kg/m^3
API Gravity	47.26	47.26

The compositional analysis of reservoir fluid is given in Table 1.

The PVT cell was charged with a portion of the fluid sample and a constant composition expansion experiment (CCE) was performed on the fluid. Table 2 provides the CCE results of the average compressibility of the reservoir fluid at pressures above the saturation pressure. Table 3 contains the complete CCE results with the exception of the data already presented in Table 2. Figure 1 shows the relative total volume (V/Vsat) data and Y-function.

Table 4 contains various property measurements made on the differentially liberated oil below the bubblepoint including live oil density, oil formation volume factor, and gas-oil ratios. These are shown in Figures 2 through 4, respectively.

Table 5 contains a summary of the properties of the differentially liberated gas including gas gravities, deviation factors, gas formation volume factors and gas expansion factors. The gas deviation factor (Z), gas formation volume factor and gas expansion factor, and gas gravity are shown in Figures 6 through 8, respectively.

Table 6 provides the results of the reservoir fluid viscosity measurements. This data is represented by Figures 5 and 9. Gas phase viscosity was calculated using the compositional data and the Lee, Gonzalez, Eakin correlation.

Table 7 summarizes the effluent gas compositions from each pressure stage during the differential liberation experiments. Figure 10 shows this data plotted on semi-log co-ordinates. Table 8 presents the compositional analysis of the residual oil at completion of the experiment.

Appendix B contains the material balance check performed for this experiment. It is displayed as formation volume factors so that the balance can be checked on a point by point basis. Appendix C contains the detailed compositional analyses of the liberated gases from the differential liberation test.

PROCEDURE AND EQUIPMENT

Fluids Preparation and Analysis Procedure

The following is an example of typical procedures and equipment used for fluids preparation, analysis and testing. Additional or unique procedures are outlined in the "Results and Discussion" section.

Separator oil properties were measured on duplicate samples to verify the quality of the samples. Two samples had a single stage flash performed at 60°C. Both samples were then subjected to compositional analysis to compare the samples and also to possibly detect sample contamination by extraneous hydrocarbon fluids.

Duplicate separator gas samples were analyzed for composition at 60°C. Any discrepancy between the two analyses may indicate that some components in the samples have condensed to liquid and that the samples must be thoroughly heated before use to vaporize these components.

To recombine live oil from separator oil and separator gas, the gas was first condensed into a high-pressure cylinder for high-pressure applications. By immersing the target high-pressure cylinder in liquid nitrogen, the low pressure gas could be readily transferred. The amount of pressure drop (ΔP) is calculated in terms of the amount of live oil (Voil) needed, the GOR of the oil, the live oil formation volume factor (Bo), and the volume of the gas tank (Vtank).

$$\Delta P = \frac{V_{oil}(cc) x GOR(^{cc}/_{cc})}{B_{oil} x V_{tank}(cc)}$$

Once the specified pressure drop had been achieved on the source gas in the low pressure tank, the high pressure cylinder was then heated to system temperature. To increase the pressure to operating pressure, mercury was injected into the bottom of the cylinder which acted as a confining fluid. In this manner, any pressure can be obtained (up to 70 MPa) and a constant pressure injection can be maintained.

The oil supplied was from a separator sample. The required value of the separator sample (Vsep) was calculated and added to the target cylinder. The live separator oil was pressured above the sampling pressure to ensure a single-phase fluid when transferring.

$$V_{sep} = \frac{V_{oil} x B_{sep}}{B_{oil}} \ (cc)$$

Once the gas and oil had been added together, the cylinder was isolated and thoroughly agitated at reservoir temperature to ensure a homogeneous fluid system.

The recombined sample was then pressurized to above the reservoir pressure and mixed into single phase. A single-stage flash gas-oil ratio (GOR) was measured by flashing a sample of the fluid from some pressure greater than the saturation pressure at reservoir temperature into an atmospheric separator and measuring the corresponding volumes of gas and liquid. This flash also provides parameters such as formation volume factor (Bo) and live fluid density. Although these values are measured relative to the single phase fluid pressure from which they were flashed, the CCE provides data allowing these values to be corrected to the saturation pressure. These fluids (gas and liquid) were then subjected to compositional analysis using GC analysis, as mentioned in the "Equipment" section, from which a computer generated live oil composition was determined. Compositions of these gases and oils are determined in the following manner.

Mole fractions of gases are determined by injecting the gas of interest to an evacuated sample system while maintaining a slight negative pressure (7 cm Hg vacuum). The carrier gas (helium) transports the gas into the column, the thermal conductivity detector (TCD), flame ionizing detector (FID), and integrator indicate an area associated with each component. These areas are then translated into component mole fractions by the following formula:

$$Mole\ Fraction_{(1)} = \frac{Area_{(1)} x\ Calibration\ Constant_{(1)}}{\sum_{i+1}^{N_{total}} Area_{(1)} x\ Calibration\ Constant_{(1)}}$$

The subscript i in the expression represents the ith component in the gas and the calibration constant is an empirical amount per area ratio which relates the area detected to the mole fraction that should be present in the analytical standard. If the resulting mole fractions deviate from the standard, new calibration constants are calculated knowing the mole fraction and the area detected. Thus recalibration is easy to perform and can be checked daily by running a standard sample. Recalibration is usually only necessary biweekly at most and often only monthly. When recalibrated the differences are only very slight and often affect only the non-hydrocarbons.

Mole fractions in the flashed liquid sample are determined by injecting the liquid sample into the megabore column of the HP5890 GC. Calibration is made on a component basis. However, there are many more components than with the gas, a total of 47 including the unsaturated cyclics and aromatics enumerated in the "Description of the Equipment". Calibration of this column is carried out using a quantitative standard containing C6 through C40. The main deficiency of this analytical method is related to the fraction that does not elute from the column.

Some components, especially the heavier end of an oil sample, leave some residual amount behind in the column. This non-eluted portion, if uncorrected, will indicate a smaller fraction of these components than is actually present. In order to account for any hydrocarbon that is not eluted at the final temperature, the oil analyses are corrected based on a stabilized molecular weight (C_{6+}) measured by cryoscope and a "non-elution" trial. The non-elution trial uses a GC run identical to the original oil analysis except that the liquid sample has had a measured quantity of 1-hexene added. The 1-hexene is designed to completely, or nearly completely, elute the oil sample in the GC column. Also, 1-hexene is used as the elution agent because it does not normally appear naturally in reservoir fluids thus allowing for its quick and easy identification amongst the naturally occurring oil components. After the 1-hexene eluted duplicate run has been performed the amount of original oil sample not eluted can be determined. Thus the fraction of the oil not eluted can be quantified and a correction applied to the compositional analysis. This appears in the form of a C_{30+} correction. Not only does this factor correct for the fraction of C_{30+} in the oil sample but also accounts for the fraction not eluted amongst any of the components lighter than C_{30+}.

Previous studies done by Hycal Energy Research Laboratories Ltd. (currently Weatherford) found that using a common C_{30+} mass fraction and molecular weight correction is

adequate for the majority of compositions of the same oil. For those few compositions that have undergone considerable mass transfer, this correction may be insufficient, but the error is attenuated since the corresponding gas analysis is unaffected and the GOR's for these samples are usually high.

Differential Liberation

The Differential Liberation experiment consists of two major portions: the constant composition expansion (CCE) and the actual differential liberation test (DL).

In the CCE experiment, a sample of the reservoir fluid is transferred to the PVT cell at a pressure of approximately 7000 kPa greater than the bubble point pressure. Starting at this pressure, the pressure in the cell is incrementally reduced by expanding the volume of the sample chamber, allowing time at each stage for equilibration. Gauge pressure, pump volume and gas/liquid/Hg interfaces are recorded at each stage.

The CCE test provides several pieces of information, the most important of which is the saturation pressure (bubble point) of the reservoir fluid. Secondly, it provides P-V relation data for the reservoir fluid such as relative volume and compressibility above and below the bubble point. It also allows the calculation of the Y-Function which, as indicated previously, is used as a data quality check. Since the two phase relative volume at pressures below the bubble point is generally a linear function of pressure, the Y-Function should also be linear. Subsequent to the CCE, the reservoir fluid is again pressured into single phase. Then the fluid is subjected to the following DL procedure:

1. The cell pressure is lowered to approximately 140 kPa greater than the bubble point. The volume of fluid in the PVT cell at this pressure is recorded.

2. The pressure in the PVT cell is lowered to the first designated pressure stage. Liquid and vapour phase volumes are measured using a cathetometer.

3. Keeping a constant pressure, liberated gas from the oil is displaced from the visual cell. The composition and volume of the displaced fluid are recorded.

4. Steps 2 and 3 are repeated for each designated pressure stage.

This procedure simulates the depletion of a typical oil reservoir during production.

Description of Experimental Equipment

Fluid Recombination

A cryogenic process is used to condense the sampled separator gas into a high pressure cylinder for the recombination of oil. High-pressure cylinders are used in the recombination procedure by condensing from the low pressure separator gas source to the high pressure gas source.

Compositional Analysis

Analysis of the fluids and gases in this experiment is carried out on gas chromotographs (GC). Various techniques can be used to perform compositional analysis on hydrocarbon gases and liquids.

Analysis of light hydrocarbon fluids is conducted using an HP5890 liquid injection gas chromatograph equipped with flame ionization detector (FID) operated to a maximum temperature of 300°C. Separation of individual components is performed with a 30 meter, 530 micrometer diameter “Megabore” capillary column. It is a fused silica column using methyl silicone as the stationary phase. The stationary phase is 2.6 micrometers thick and is rated for operation in the temperature range of -60^{o} to 300°C. Over this temperature range the components eluted are from C1 to C36 along with cyclopentane, methylcyclopentane, benzene, cyclohexane, methylcyclohexane, toluene, ortho-xylene, 1,2,4,-trimethylbenzene, meta- and para-xylene. That is, each of these components is retarded in its flow through the column, based on its physical properties, by the stationary phase. Thus the sample becomes segregated as it passes through the column. With prior knowledge of the amount of “retention” of a given compound, its relative magnitude can be determined by the length of time it remains in the column before it finally passing through. This is known as its retention time. For some compounds this can be lengthy so typically the temperature is gradually increased during the analysis to shorten retention times by a predefined amount.

The gas analyses are carried out on an HP5890 gas injection GC equipped with two separation columns. The first column is a combination of a 100 mesh packed column and a 100 mesh molecular sieve using high purity helium as a carrier gas. The molecular sieve is used to achieve separation of the very light gaseous components (N_2, O_2, C_1), while the packed column serves to separate ethane, propane, butanes, pentanes, and hexanes plus along with CO_2 and

H_2S. The second column is a capillary column as described previously in liquid analysis. This column is capable of achieving separation of components up to C_{12+}, along with the associated napthenese and aromatics, though these values are typically lumped into the C_{6+} fraction during analysis. Components up to C_4 are analyzed using a thermal conductivity detector (TCD) while the C_{5+} components are analyzed using an FID. The instrument has programmable air actuated multiport valves that let the flow of the sample mixture to be varied between the two columns allowing for the correct separation and analysis of the injected sample gas.

DL Apparatus

A PVT cell is used to measure the bubble point by the breakpoint of the PV curve resulting from the measure depletion of pressure from some pressure greater than the bubble point (single phase) to well below (the two-phase region). It consists of a PVT cell, source cylinders, capillary tube, collection cylinder, oven, buffers and pumps. The PVT cell is the heart of the apparatus where the fluids of interest are injected. The PVT cell has a rating of 70 MPa at about 200°C and has an internal volume of approximately 300 cm^3. Connected to the PVT cell are high-pressure source cylinders containing fluids of interest. Displacing mercury into the bottom of the source cylinder with the pump transfers a corresponding volume into the visual cell. Thus, fluids can be transferred in prescribed volumes to within 0.02 cm^3. The source cylinder is typically a 660 cm^3 316 SS high-pressure cylinder rated to 70 MPa.

The oven in which this equipment is housed is capable of operation to 200°C and is controlled to ±0.5°C. The oven has been constructed so that it is capable of 180° rotation to expedite equilibration. With mercury used as the confining fluid in the visual cell, considerable mixing and agitation are provided when the oven is inverted.

The final equipment associated with the DL apparatus are the Ruska positive displacement pumps. They are capable of injecting at pressures up to 70 MPa. Digital Sensotec gauges were used in conjunction with the positive displacement pumps to set pressure levels; these gauges are accurate to ± 40 kPa.

TABLE 1
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
COMPOSITIONAL ANALYSIS OF RESERVOIR FLUID

Boiling Point (C)			Mole Fraction	Mass Fraction	Calculated Properties	
-195.8	Nitrogen	N2	0.0103	0.0057	**Total Sample**	
-78.5	Carbon Dioxide	CO2	0.0061	0.0053		
-60.3	Hydrogen Sulphide	H2S	0.0000	0.0000	Molecular Weight	50.55
-161.7	Methane	C1	0.5222	0.1658		
-88.9	Ethane	C2	0.1330	0.0791		
-42.2	Propane	C3	0.0791	0.0690	**C6+ Fraction**	
-11.7	i-Butane	i-C4	0.0131	0.0150		
-0.6	n-Butane	n-C4	0.0310	0.0357	Molecular Weight	163.79
27.8	i-Pentane	i-C5	0.0099	0.0141	Mole Fraction	0.1829
36.1	n-Pentane	n-C5	0.0125	0.0178	Density (g/cc)	0.8160
36.1 - 68.9	Hexanes	C6	0.0214	0.0364		
68.9 - 98.3	Heptanes	C7	0.0192	0.0381		
98.3 - 125.6	Octanes	C8	0.0209	0.0471	**C7+ Fraction**	
125.6 - 150.6	Nonanes	C9	0.0155	0.0393		
150.6 - 173.9	Decanes	C10	0.0118	0.0331	Molecular Weight	174.51
173.9 - 196.1	Undecanes	C11	0.0104	0.0301	Mole Fraction	0.1608
196.1 - 215	Dodecanes	C12	0.0080	0.0255	Density (g/cc)	0.8265
215 - 235	Tridecanes	C13	0.0079	0.0272		
235 - 252.2	Tetradecanes	C14	0.0063	0.0239		
252.2 - 270.6	Pentadecanes	C15	0.0048	0.0195	**C12+ Fraction**	
270.6 - 287.8	Hexadecanes	C16	0.0039	0.0172		
287.8 - 291.7	Heptadecanes	C17	0.0032	0.0149	Molecular Weight	271.05
291.7 - 317.2	Octadecanes	C18	0.0030	0.0149	Mole Fraction	0.0603
317.2 - 330	Nonadecanes	C19	0.0027	0.0142	Density (g/cc)	0.8756
330 - 344.4	Eicosanes	C20	0.0022	0.0118		
344.4 - 357.2	Heneicosanes	C21	0.0019	0.0108		
357.2 - 369.4	Docosanes	C22	0.0016	0.0098		
369.4 - 380	Tricosanes	C23	0.0015	0.0093		
380 - 391.1	Tetracosanes	C24	0.0013	0.0086		
391.1 - 401.7	Pentacosanes	C25	0.0012	0.0081		
401.7 - 412.2	Hexacosanes	C26	0.0010	0.0072		
412.3 - 422.2	Heptacosanes	C27	0.0009	0.0069		
422.3 - 431.7	Octacosanes	C28	0.0008	0.0061		
431.7 - 441.1	Nonacosanes	C29	0.0007	0.0060		
Above 441.1	Tricontanes Plus	C30+	0.0073	0.0812		
48.9	Cyclopentane	C5H10	0.0007	0.0009		
72.2	Methylcyclopentane	C6H12	0.0034	0.0057		
81.1	Cyclohexane	C6H12	0.0028	0.0046		
101.1	Methylcyclohexane	C7H14	0.0074	0.0143		
80.0	Benzene	C6H6	0.0005	0.0007		
110.6	Toluene	C7H8	0.0019	0.0035		
136.1 - 138.9	Ethylbenzene & p,m-Xylene	C8H10	0.0022	0.0045		
144.4	o-Xylene	C8H10	0.0017	0.0035		
168.9	1, 2, 4-Trimethylbenzene	C9H12	0.0030	0.0071		
Total			**1.0000**	**1.0000**		

TABLE 2
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
FLUID COMPRESSIBILITY @ 228.1 °F (109.0 °C)

Pressure Range		Average
From (psia)	To (psia)	Compressibility (psi^{-1})
5544	5197	3.2120E-05
5197	4884	3.5712E-05
4884	4602	3.9210E-05
4602	4350	4.2873E-05
4350	4126	4.6156E-05
4126	4024	4.9285E-05
4024	**3946 Psat**	**5.1010E-05**

Pressure Range		Average
From (MPa)	To (MPa)	Compressibility (MPa^{-1})
38.22	35.83	4.6586E-03
35.83	33.67	5.1795E-03
33.67	31.73	5.6870E-03
31.73	29.99	6.2182E-03
29.99	28.45	6.6943E-03
28.45	27.74	7.1481E-03
27.74	**27.21 Psat**	**7.3984E-03**

Psat - Saturation Pressure

TABLE 3
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
CONSTANT COMPOSITION EXPANSION @ 228.1 °F (109.0 °C)

Pressure		Relative Volume	Y-Function	Fluid Density
(psia)	(MPa)	[1]	[2]	(g/cc)
5544	38.22	0.938146		0.4919
5197	35.83	0.948720		0.4864
4884	33.67	0.959445		0.4810
4602	31.73	0.970172		0.4757
4350	29.99	0.980768		0.4705
4126	28.45	0.991014		0.4657
4024	27.74	0.996021		0.4633
3946 Psat	**27.21**	**1.000000**		**0.4615**
3872	26.69	1.008499	2.2488	
3770	25.99	1.021057	2.2172	
3675	25.34	1.033707	2.1878	
3322	22.90	1.090372	2.0786	
3021	20.83	1.154221	1.9855	
2793	19.26	1.215586	1.9150	
2447	16.87	1.338851	1.8080	
2195	15.13	1.461143	1.7301	
1998	13.77	1.584190	1.6691	
1705	11.75	1.832782	1.5785	
1494	10.30	2.084750	1.5132	
1335	9.20	2.336109	1.4641	
1203	8.29	2.602390	1.4232	
1101	7.59	2.857146	1.3917	
1015	7.00	3.115874	1.3651	

[1] Volume at indicated pressure per volume at saturation pressure
[2] Y Function = ((Psat-P)/P)/(Relative Volume - 1)
Psat - Saturation Pressure

TABLE 4
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION OIL PROPERTIES @ 228.1°F (109.0°C)

Pressure		Oil Density	Oil Formation Volume Factor	Total Formation Volume Factor	Gas-Oil Ratio		Gas-Oil Ratio	
(psia)	(MPa)	(g/cm^3)	[1]	[2]	Solution (scf/STB)	Liberated (scf/STB)	Solution (m^3/m^3)	Liberated (m^3/m^3)
5544	38.22	0.4919	3.4632	3.4632	3918.59	0.00	697.90	0.00
5197	35.83	0.4864	3.5023	3.5023	3918.59	0.00	697.90	0.00
4884	33.67	0.4810	3.5419	3.5419	3918.59	0.00	697.90	0.00
4602	31.73	0.4757	3.5815	3.5815	3918.59	0.00	697.90	0.00
4350	29.99	0.4705	3.6206	3.6206	3918.59	0.00	697.90	0.00
4126	28.45	0.4657	3.6584	3.6584	3918.59	0.00	697.90	0.00
4024	27.74	0.4633	3.6769	3.6769	3918.59	0.00	697.90	0.00
3946 Psat	**27.21**	**0.4615**	**3.6916**	**3.6916**	**3918.59**	**0.00**	**697.90**	**0.00**
3513	24.22	0.4981	2.8739	3.8480	2718.48	1200.12	484.16	213.74
3113	21.46	0.5264	2.5265	4.1148	2159.22	1759.38	384.56	313.35
2713	18.71	0.5512	2.2764	4.4438	1816.32	2102.28	323.49	374.42
2313	15.95	0.5733	2.1122	4.9987	1537.08	2381.51	273.76	424.15
1913	13.19	0.5945	1.9743	5.8521	1319.40	2599.20	234.99	462.92
1513	10.43	0.6146	1.8317	7.2971	1085.44	2833.15	193.32	504.59
1113	7.67	0.6369	1.7196	9.8887	879.39	3039.21	156.62	541.29
713	4.92	0.6541	1.6249	15.4569	713.09	3205.51	127.00	570.90
313	2.16	0.6819	1.4757	35.4321	500.45	3418.14	89.13	608.77
13	0.09	0.7427	1.0842	525.4128	0.00	3918.59	0.00	697.90

Density of Residual Oil = 0.8116 g/cm3 (811.6 kg/m3) @ 60 F (288.7K)

[1] Barrels (Cubic meters) of oil at indicated pressure and temperature per barrel (cubic meter) of residual oil @ 60 F (288.7 K).

[2] Total barrels (cubic meters) of oil and liberated gas at the indicated pressure and temperature per barrel (cubic meter) of residual oil @ 60 F (288.7 K).

Psat - Saturation Pressure

- Tank conditions: 60 F (288.7 K) @ 13 psia (0.0896 MPa); Standard conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa).

TABLE 5
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS PROPERTIES @ 228.1°F (109.0°C)

Pressure		Gas Gravity		Gas Density (g/cm^3)	Gas Deviation Factor (-)	Gas Formation Volume Factor [1]	Gas Expansion Factor [2]
(psia)	(MPa)	Incremental (Air = 1)	Cumulative (Air = 1)				
5544	38.22						
5197	35.83						
4884	33.67						
4602	31.73						
4350	29.99						
4126	28.45						
4024	27.74						
3946 Psat	**27.21**						
3513	24.22	1.0293	1.0293	0.2751	0.8262	0.0046	219.424
3113	21.46	0.9583	1.0068	0.2302	0.8147	0.0051	197.287
2713	18.71	0.9100	0.9910	0.1913	0.8114	0.0058	172.748
2313	15.95	0.8817	0.9782	0.1575	0.8139	0.0068	146.943
1913	13.19	0.8498	0.9674	0.1232	0.8295	0.0084	119.376
1513	10.43	0.8358	0.9565	0.0936	0.8498	0.0108	92.323
1113	7.67	0.8473	0.9491	0.0679	0.8736	0.0151	66.260
713	4.92	0.8809	0.9456	0.0437	0.9041	0.0242	41.274
313	2.16	1.0862	0.9543	0.0229	0.9342	0.0558	17.928
13	0.09	1.7543	1.0565	0.0014	0.9929	0.7513	1.331

[1] Cubic feet (meters) of gas at indicated pressure and temperature per cubic feet (meter) @ standard conditions

Psat - Saturation pressure

- Standard conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)

TABLE 6
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION FLUID VISCOSITY @ 228.1°F (109.0°C)

Pressure		Oil Viscosity	Gas Viscosity	Oil - Gas
(psia)	(MPa)	(cp=mPa.s)	(cp=mPa.s)	Viscosity Ratio
4713	32.49	0.167		
4413	30.43	0.164		
4113	28.36	0.160		
3946 **Psat**	27.21	0.157		
3513	24.22	0.163	0.03068	5.33
3113	21.46	0.178	0.02563	6.95
2713	18.70	0.190	0.02216	8.58
2313	15.95	0.204	0.01966	10.39
1913	13.19	0.223	0.01762	12.65
1513	10.43	0.250	0.01612	15.51
1113	7.67	0.288	0.01494	19.25
713	4.91	0.334	0.01392	24.02
313	2.16	0.420	0.01250	33.61
13	0.09	0.624	0.01010	61.73

Psat - Saturation Pressure

TABLE 7
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
COMPOSITONAL ANALYSIS OF LIBERATED GAS @ 228.1°F (109.0°C)

Component	Differential Liberation Stage Pressure (psia/MPa)									
	3513	3113	2713	2313	1913	1513	1113	713	313	13
	24.22	21.46	18.71	15.95	13.19	10.43	7.67	4.92	2.16	0.09
N2	0.0145	0.0151	0.0150	0.0144	0.0131	0.0113	0.0093	0.0064	0.0032	0.0004
CO2	0.0067	0.0070	0.0072	0.0075	0.0078	0.0080	0.0084	0.0088	0.0085	0.0046
H2S	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
C1	0.6458	0.6666	0.6811	0.6896	0.6959	0.6919	0.6715	0.6218	0.4831	0.1822
C2	0.1374	0.1383	0.1403	0.1418	0.1465	0.1544	0.1682	0.1953	0.2328	0.2072
C3	0.0722	0.0703	0.0691	0.0681	0.0689	0.0724	0.0798	0.0986	0.1419	0.2347
i-C4	0.0114	0.0108	0.0103	0.0100	0.0098	0.0100	0.0109	0.0134	0.0204	0.0442
n-C4	0.0258	0.0245	0.0231	0.0221	0.0214	0.0217	0.0232	0.0285	0.0442	0.1027
i-C5	0.0074	0.0068	0.0062	0.0058	0.0054	0.0052	0.0054	0.0063	0.0099	0.0233
n-C5	0.0089	0.0082	0.0073	0.0070	0.0064	0.0061	0.0061	0.0071	0.0112	0.0257
C6	0.0128	0.0109	0.0095	0.0086	0.0075	0.0065	0.0062	0.0062	0.0119	0.0322
C7+	0.0571	0.0416	0.0310	0.0253	0.0174	0.0125	0.0111	0.0077	0.0329	0.1428
Total	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**

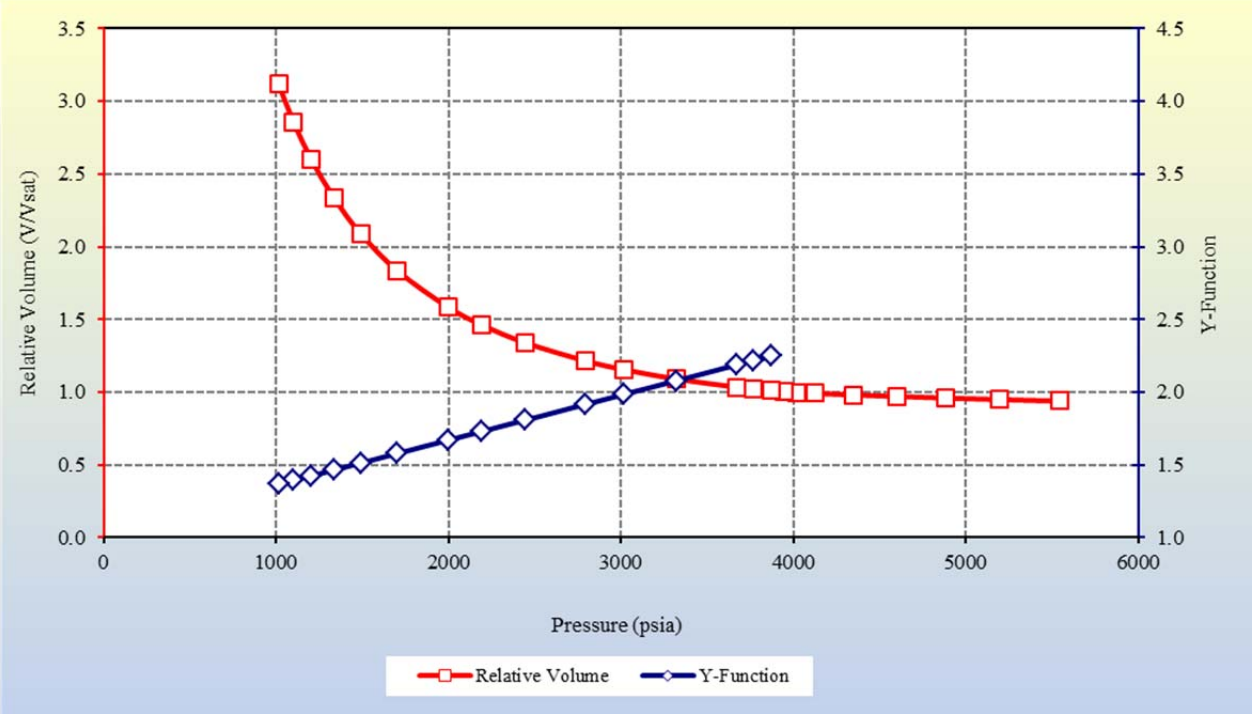
Calculated Properties of Total Sample @ Standard Conditions										
MW (g/mol)	29.81	27.76	26.36	25.54	24.61	24.21	24.54	25.51	31.46	50.81
Gravity (Air=1.0)	1.0293	0.9583	0.9100	0.8817	0.8498	0.8358	0.8473	0.8809	1.0862	1.7543

Calculated Properties of C7+ @ Standard Conditions										
MW (g/mol)	122.58	120.37	119.36	116.65	114.44	110.51	110.04	106.45	112.04	113.78
Density (g/cc)	0.7595	0.7572	0.7561	0.7529	0.7500	0.7449	0.7442	0.7394	0.7477	0.7502

TABLE 8
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
COMPOSITONAL ANALYSIS OF RESIDUAL OIL @ 228.1°F (109°C)

Boiling Point (C)			Mole Fraction	Mass Fraction	Calculated Properties	
-195.8	Nitrogen	N2	0.0000	0.0000	**Total Sample**	
-78.5	Carbon Dioxide	CO2	0.0000	0.0000		
-60.3	Hydrogen Sulphide	H2S	0.0000	0.0000	Molecular Weight	179.35
-161.7	Methane	C1	0.0000	0.0000		
-88.9	Ethane	C2	0.0000	0.0000		
-42.2	Propane	C3	0.0017	0.0004	**C6+ Fraction**	
-11.7	i-Butane	i-C4	0.0015	0.0005		
-0.6	n-Butane	n-C4	0.0072	0.0023	Molecular Weight	183.07
27.8	i-Pentane	i-C5	0.0082	0.0033	Mole Fraction	0.9680
36.1	n-Pentane	n-C5	0.0134	0.0054	Density (g/cc)	0.8301
36.1 - 68.9	Hexanes	C6	0.0505	0.0243		
68.9 - 98.3	Heptanes	C7	0.0699	0.0390		
98.3 - 125.6	Octanes	C8	0.1000	0.0637	**C7+ Fraction**	
125.6 - 150.6	Nonanes	C9	0.0824	0.0589		
150.6 - 173.9	Decanes	C10	0.0687	0.0545	Molecular Weight	188.65
173.9 - 196.1	Undecanes	C11	0.0650	0.0532	Mole Fraction	0.9156
196.1 - 215	Dodecanes	C12	0.0512	0.0459	Density (g/cc)	0.8347
215 - 235	Tridecanes	C13	0.0541	0.0528		
235 - 252.2	Tetradecanes	C14	0.0443	0.0469		
252.2 - 270.6	Pentadecanes	C15	0.0337	0.0387	**C12+ Fraction**	
270.6 - 287.8	Hexadecanes	C16	0.0289	0.0357		
287.8 - 291.7	Heptadecanes	C17	0.0243	0.0321	Molecular Weight	267.50
291.7 - 317.2	Octadecanes	C18	0.0231	0.0324	Mole Fraction	0.4265
317.2 - 330	Nonadecanes	C19	0.0209	0.0307	Density (g/cc)	0.8719
330 - 344.4	Eicosanes	C20	0.0174	0.0266		
344.4 - 357.2	Heneicosanes	C21	0.0146	0.0237		
357.2 - 369.4	Docosanes	C22	0.0126	0.0214		
369.4 - 380	Tricosanes	C23	0.0118	0.0209		
380 - 391.1	Tetracosanes	C24	0.0105	0.0194		
391.1 - 401.7	Pentacosanes	C25	0.0091	0.0176		
401.7 - 412.2	Hexacosanes	C26	0.0081	0.0162		
412.3 - 422.2	Heptacosanes	C27	0.0073	0.0152		
422.3 - 431.7	Octacosanes	C28	0.0066	0.0143		
431.7 - 441.1	Nonacosanes	C29	0.0058	0.0131		
Above 441.1	Tricontanes Plus	C30+	0.0421	0.1324		
48.9	Cyclopentane	C5H10	0.0018	0.0007		
72.2	Methylcyclopentane	C6H12	0.0102	0.0048		
81.1	Cyclohexane	C6H12	0.0106	0.0050		
101.1	Methylcyclohexane	C7H14	0.0324	0.0177		
80.0	Benzene	C6H6	0.0015	0.0007		
110.6	Toluene	C7H8	0.0090	0.0046		
136.1 - 138.9	Ethylbenzene & p,m-Xylene	C8H10	0.0119	0.0071		
144.4	o-Xylene	C8H10	0.0094	0.0056		
168.9	1, 2, 4-Trimethylbenzene	C9H12	0.0182	0.0122		
Total			**1.0000**	**1.0000**		

FIGURE 1
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
CONSTANT COMPOSITION EXPANSION @ 228.1°F (109.0°C)



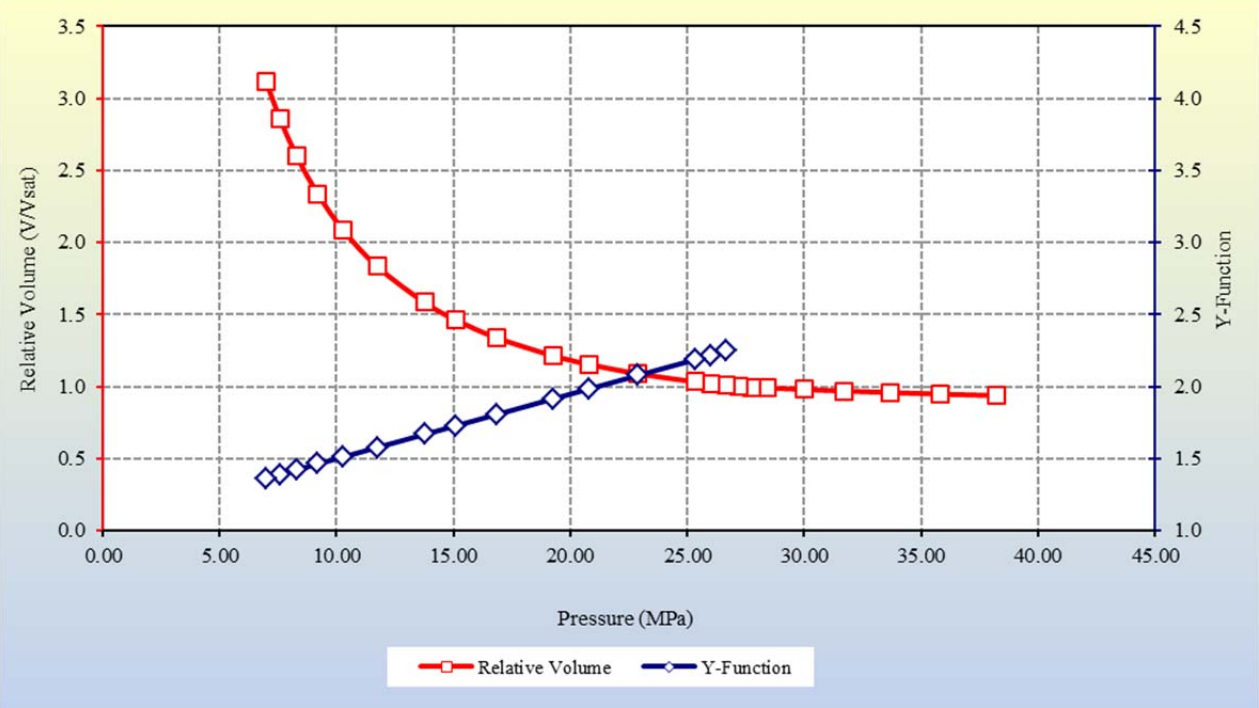
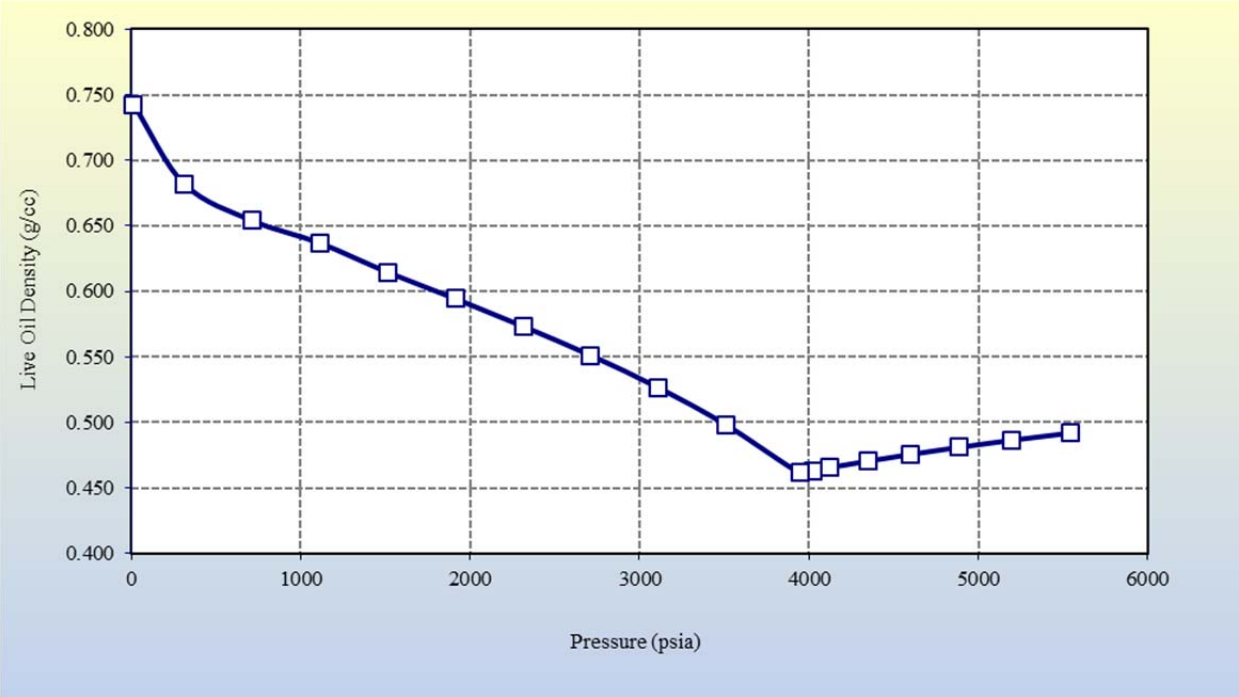


FIGURE 2
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION OIL DENSITY @ 228.1°F (109.0°C)



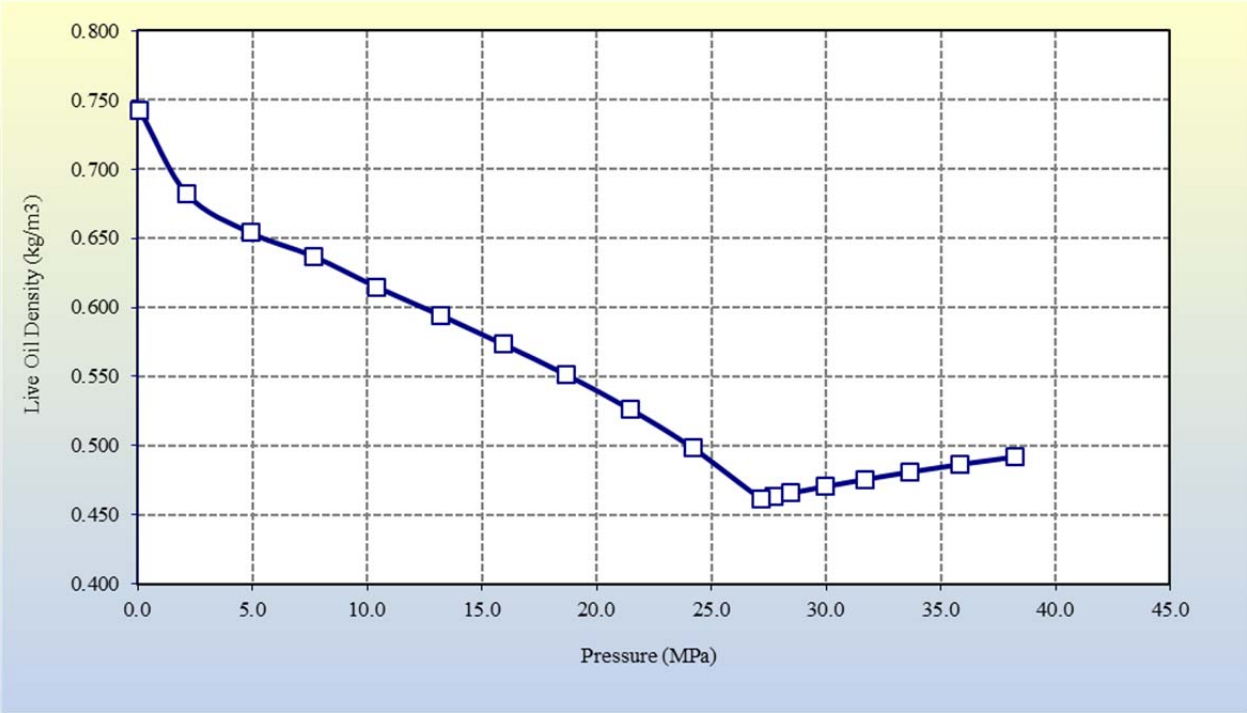
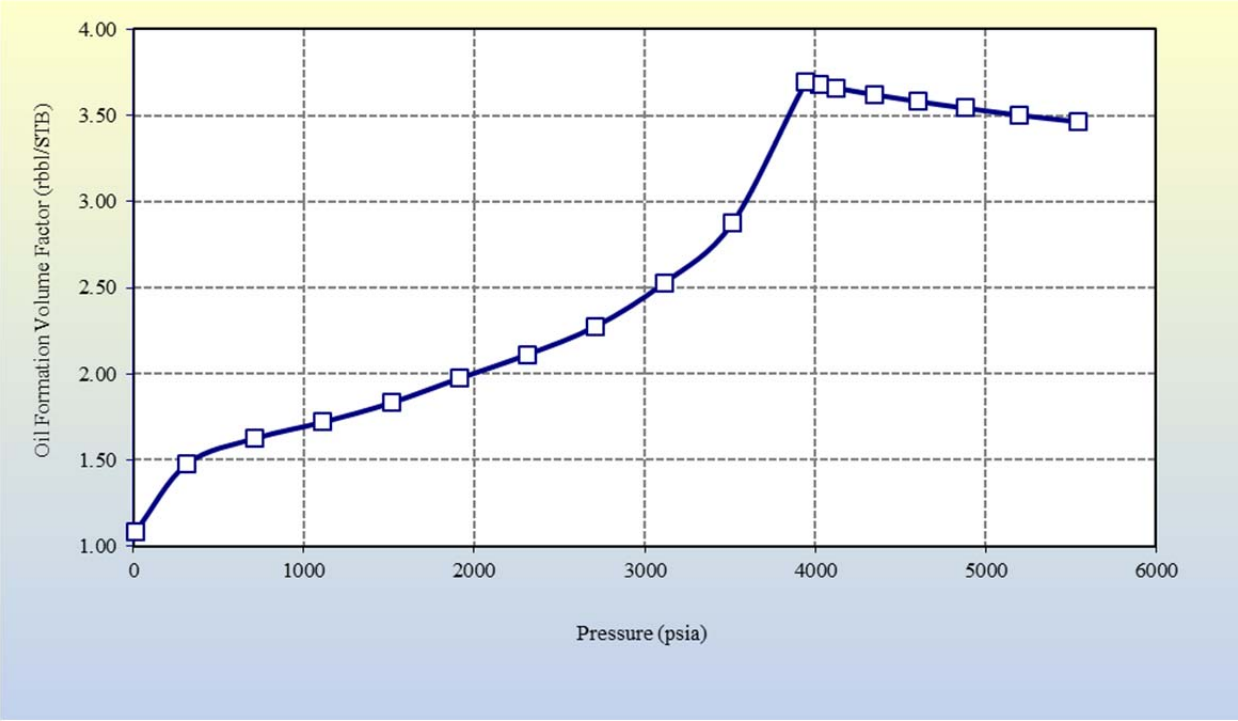


FIGURE 3
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION OIL FORMATION VOLUME FACTOR @ 228.1°F (109.0°C)



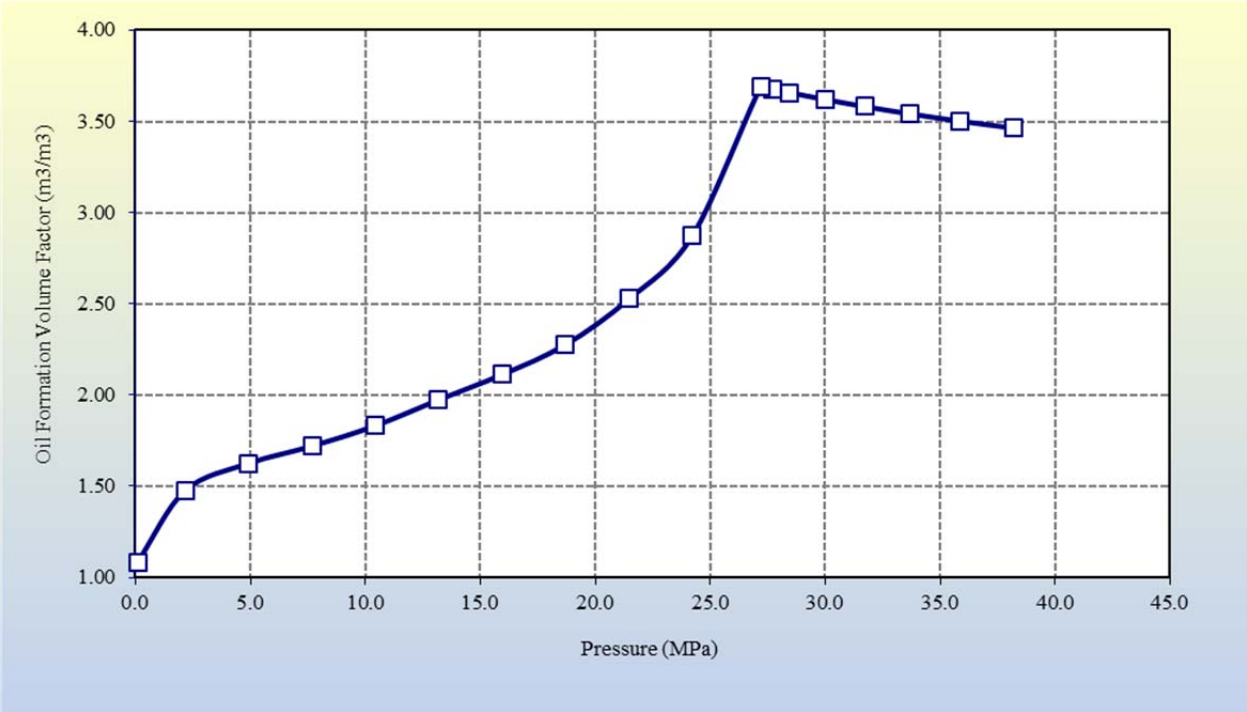
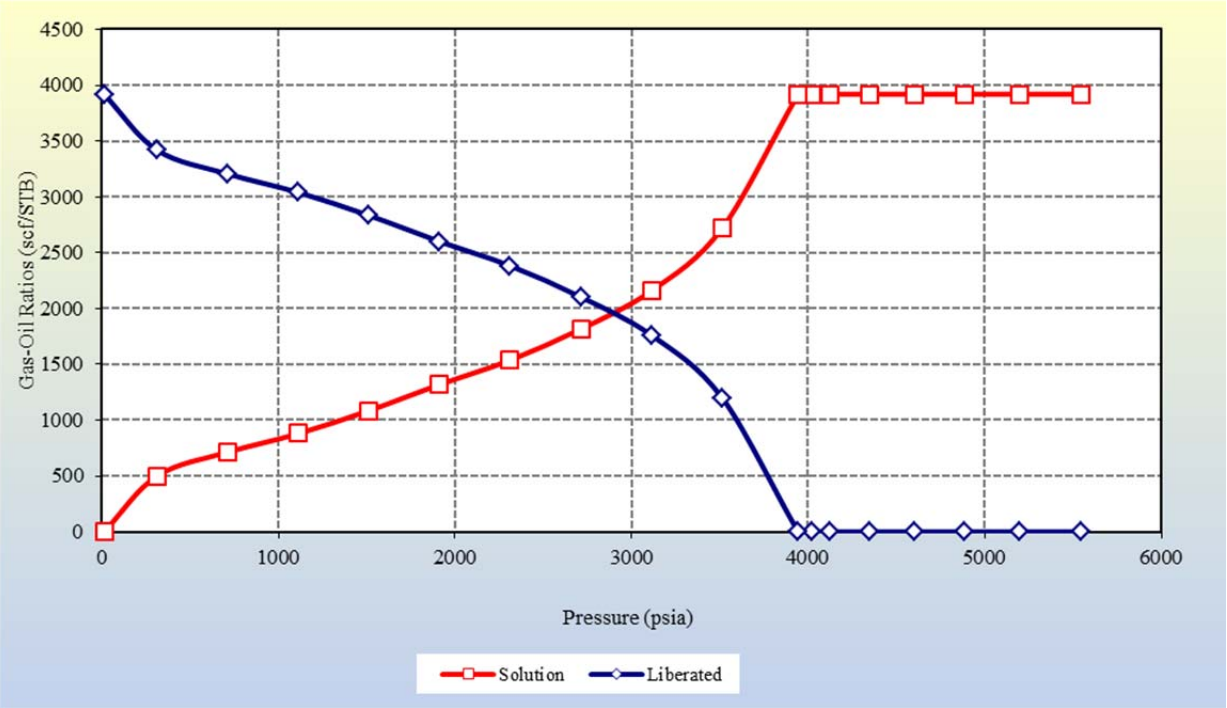


FIGURE 4
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS-OIL RATIOS @ 228.1°F (109.0°C)



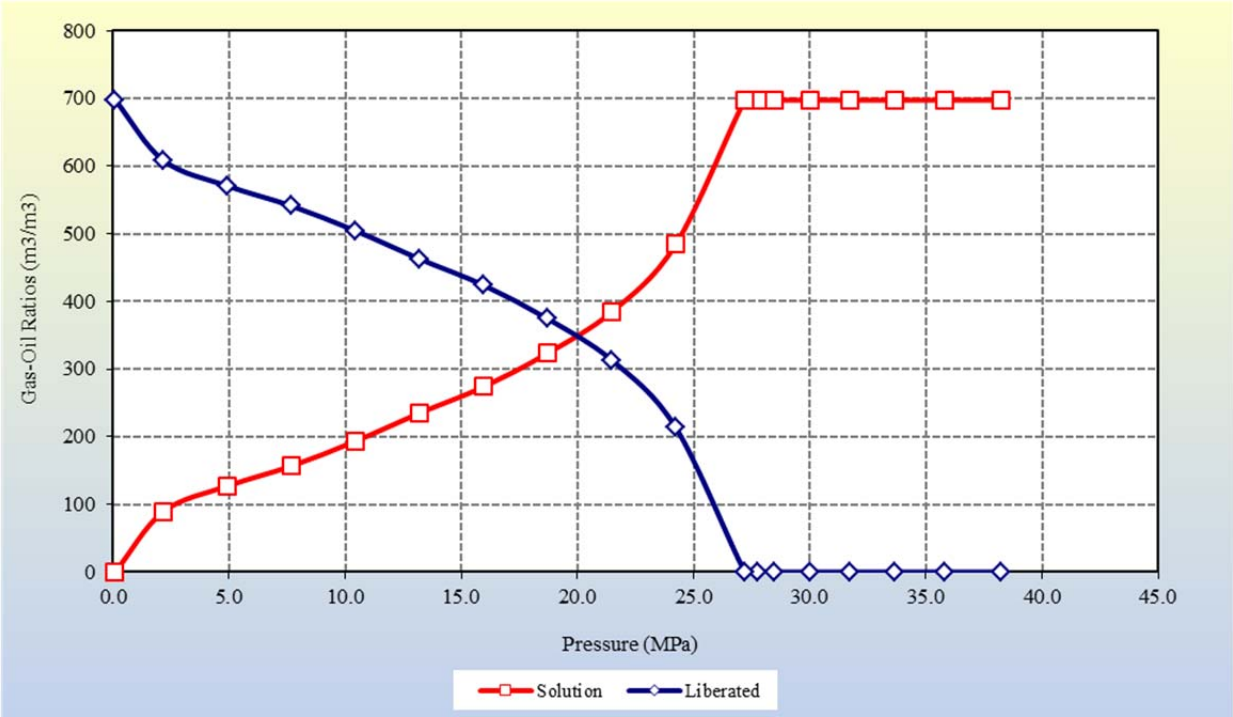
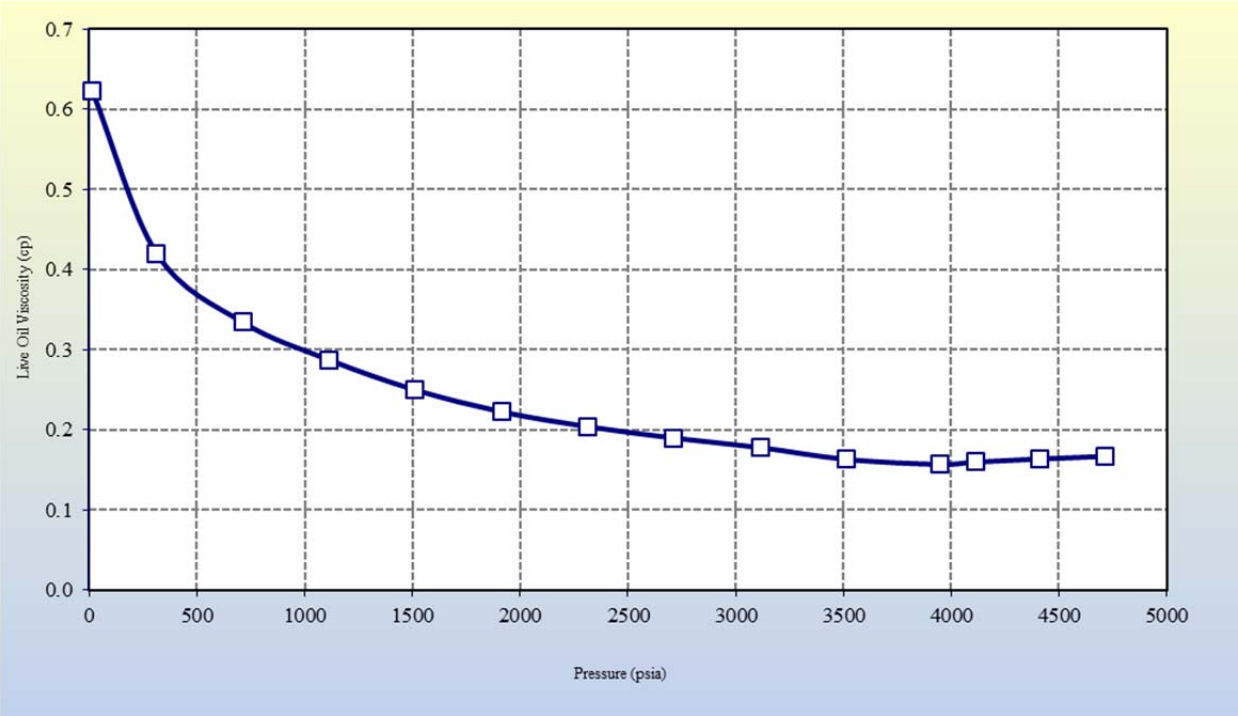


FIGURE 5
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION OIL VISCOSITY @ 228.1°F (109.0°C)



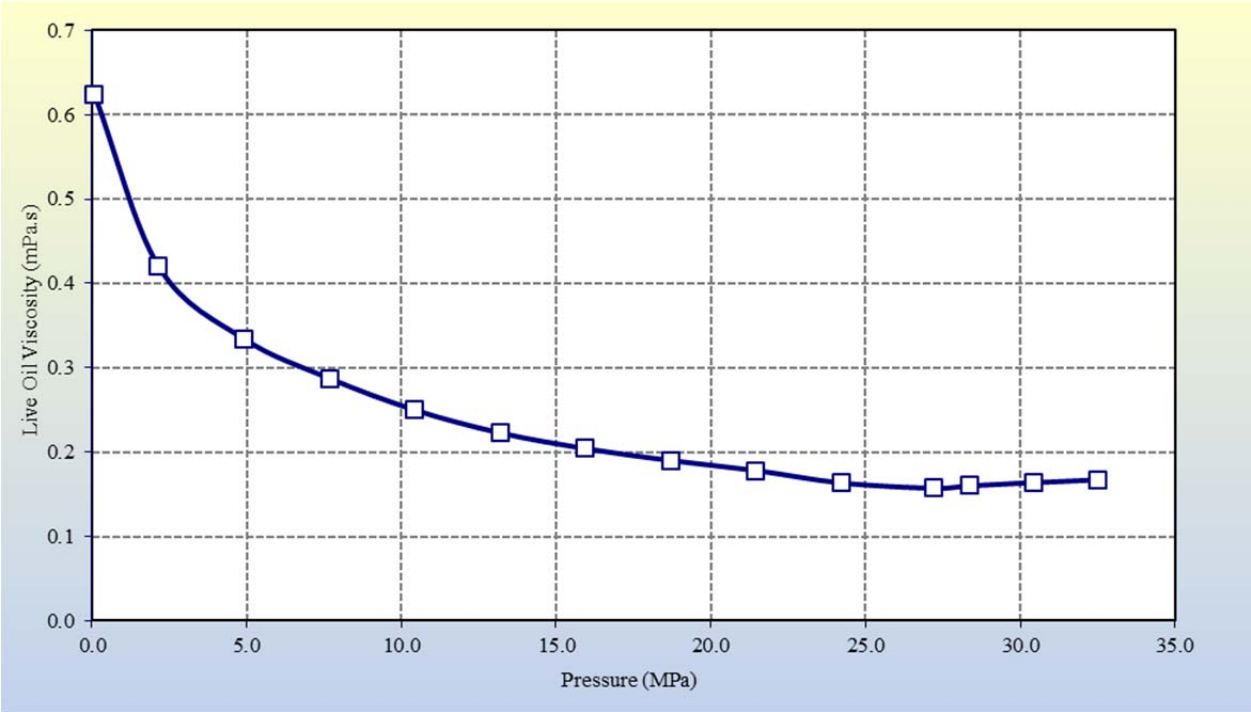
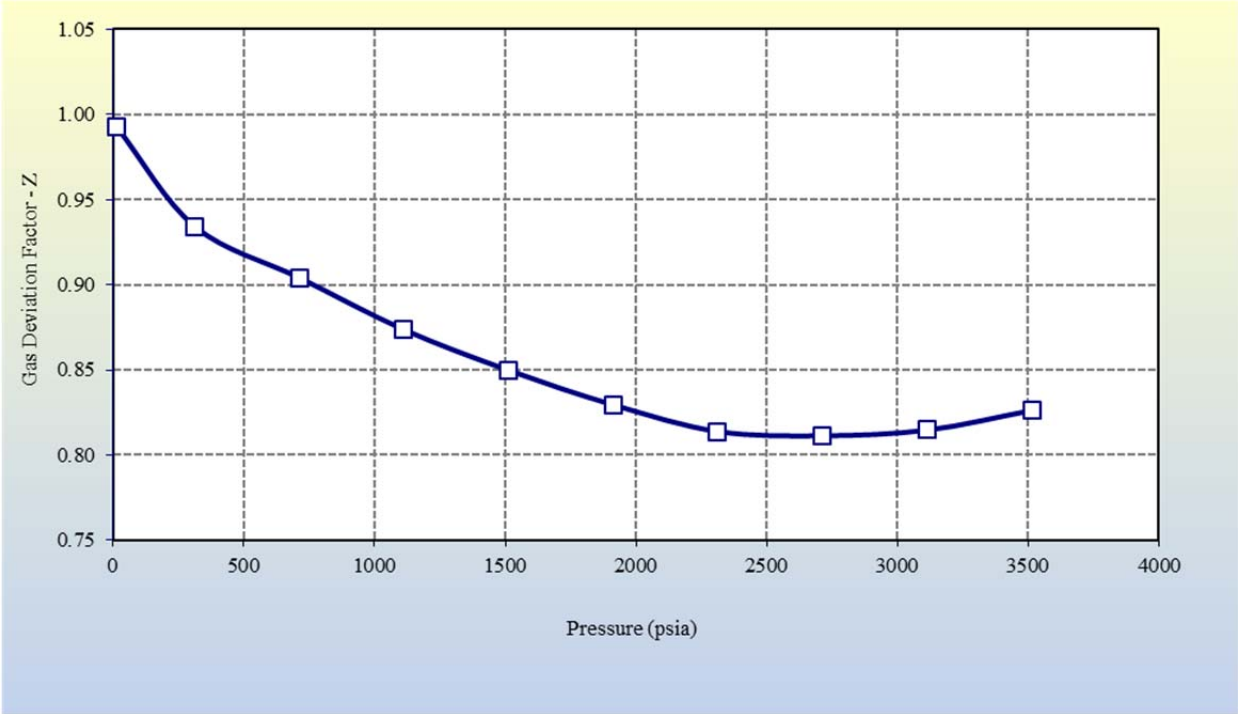


FIGURE 6
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS DEVIATION FACTOR @ 228.1°F (109.0°C)



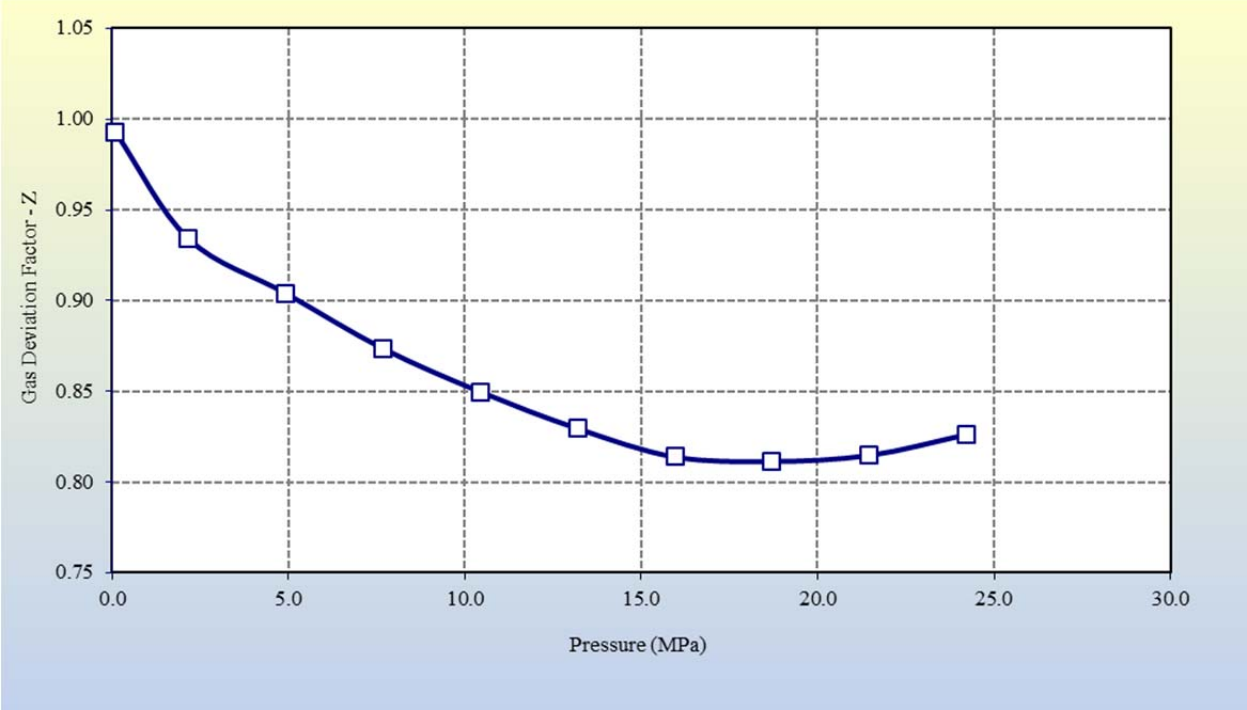
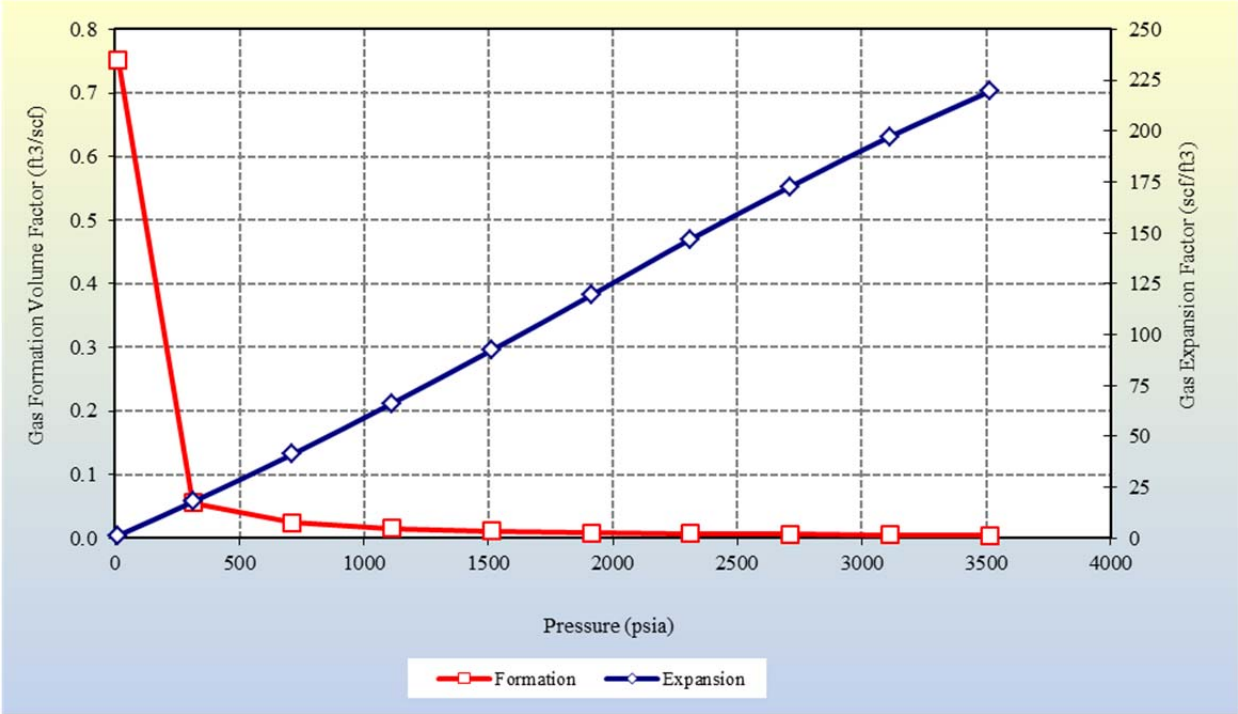


FIGURE 7
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS VOLUME FACTORS @ 228.1°F (109.0°C)



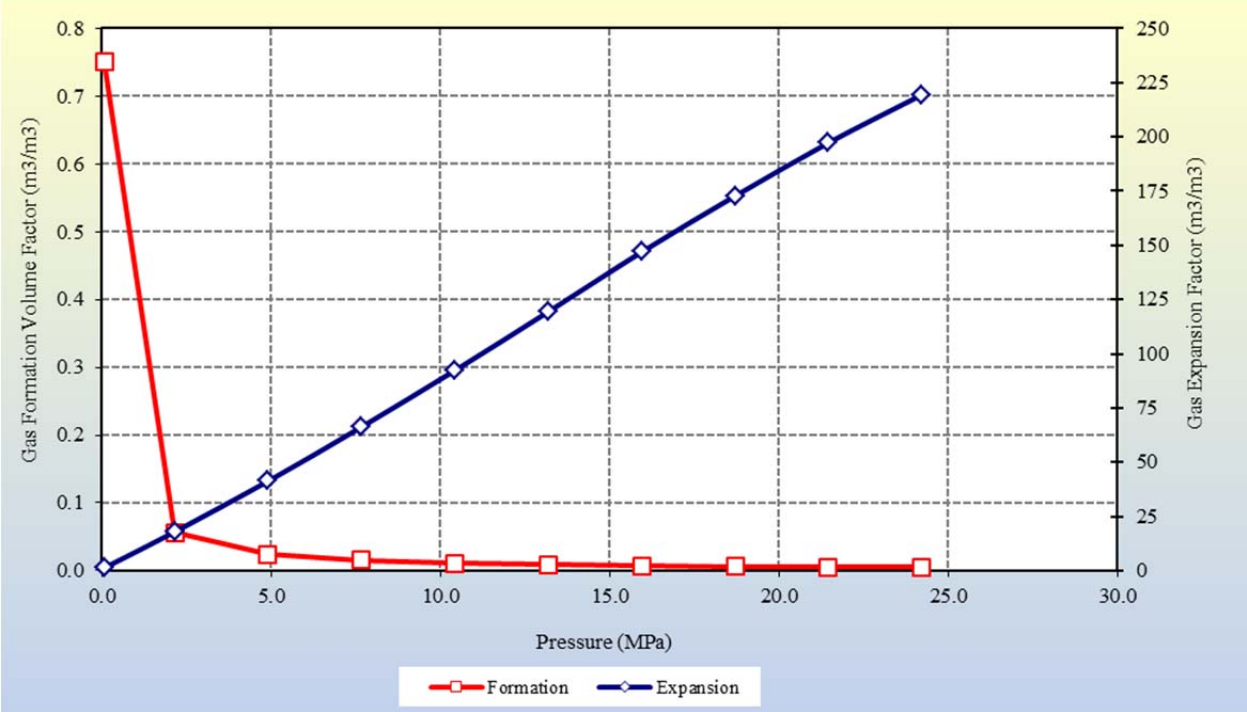
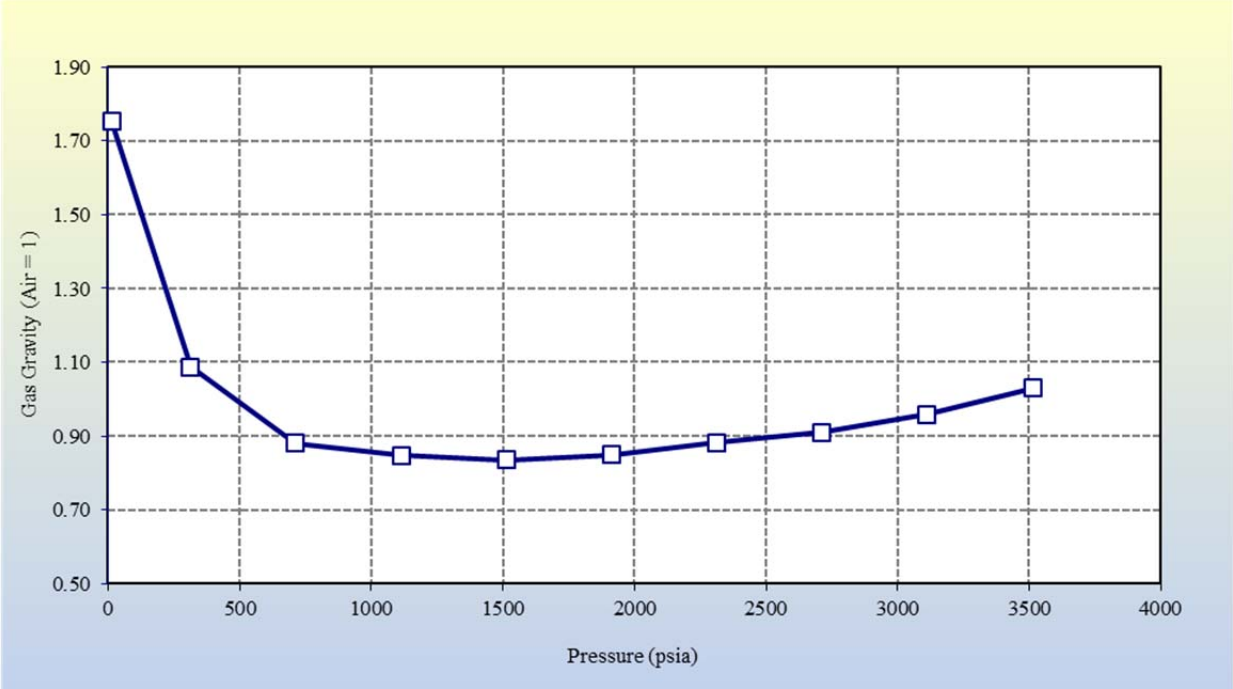


FIGURE 8
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS GRAVITY @ 228.1°F (109.0°C)



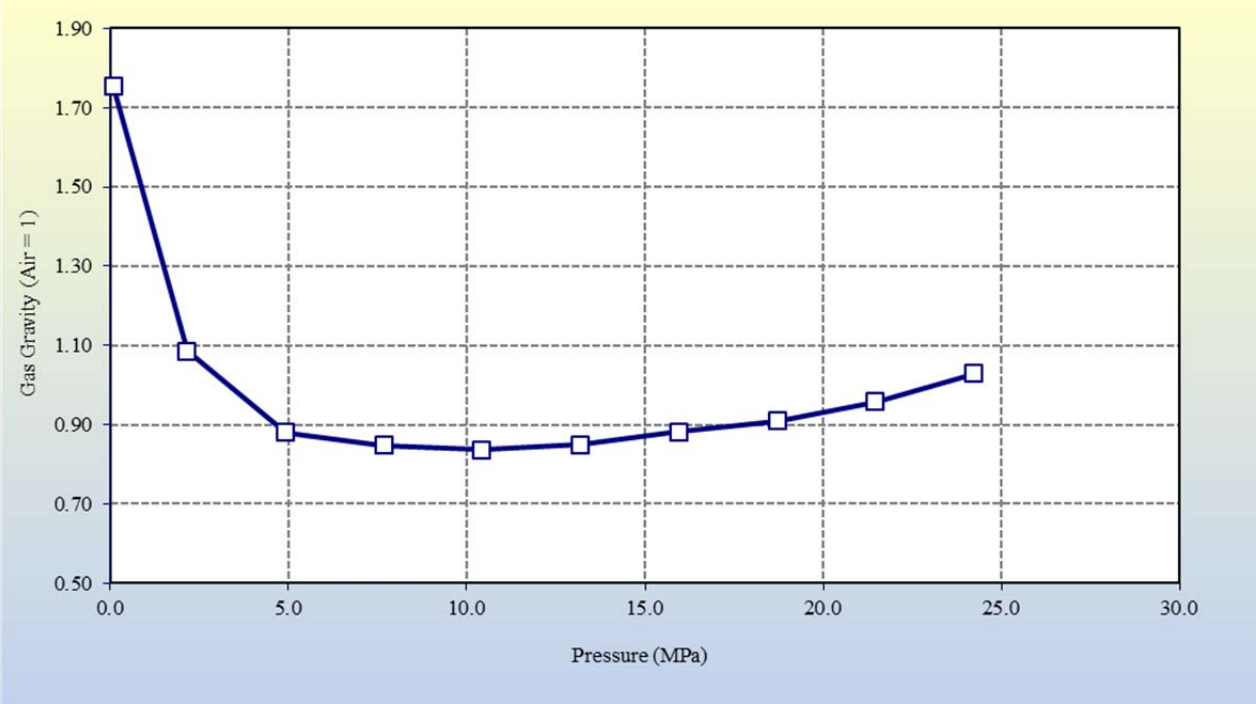
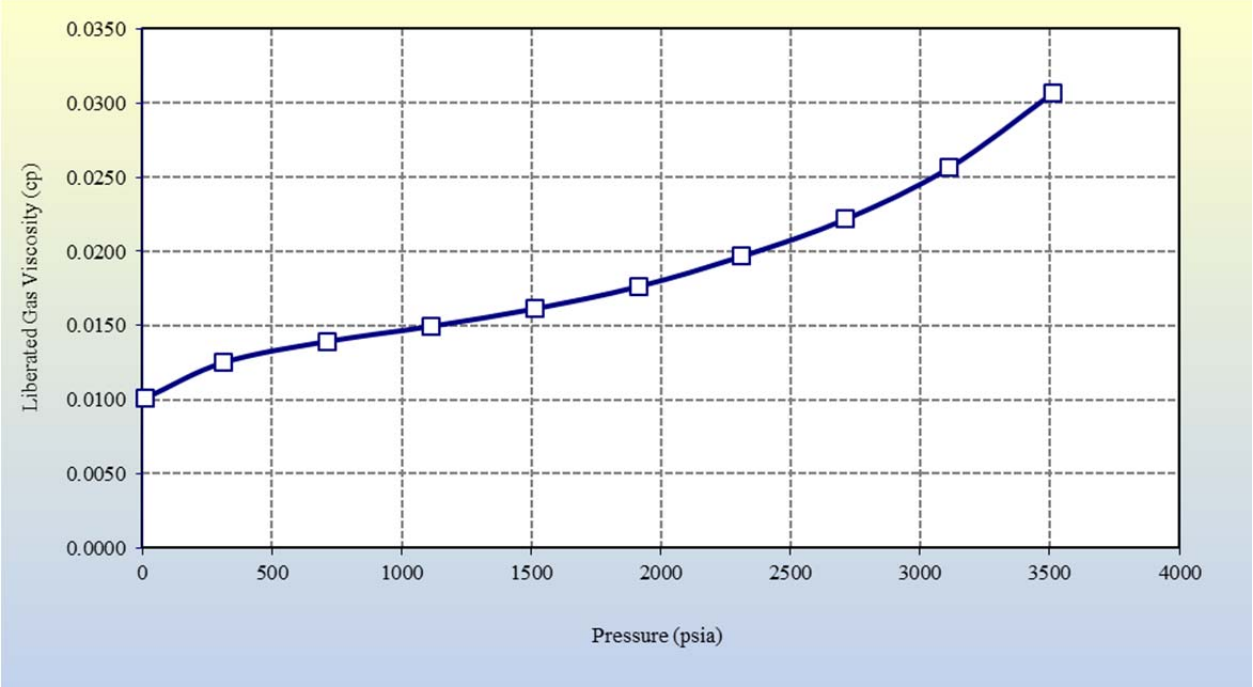


FIGURE 9
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS VISCOSITY @ 228.1°F (109.0°C)



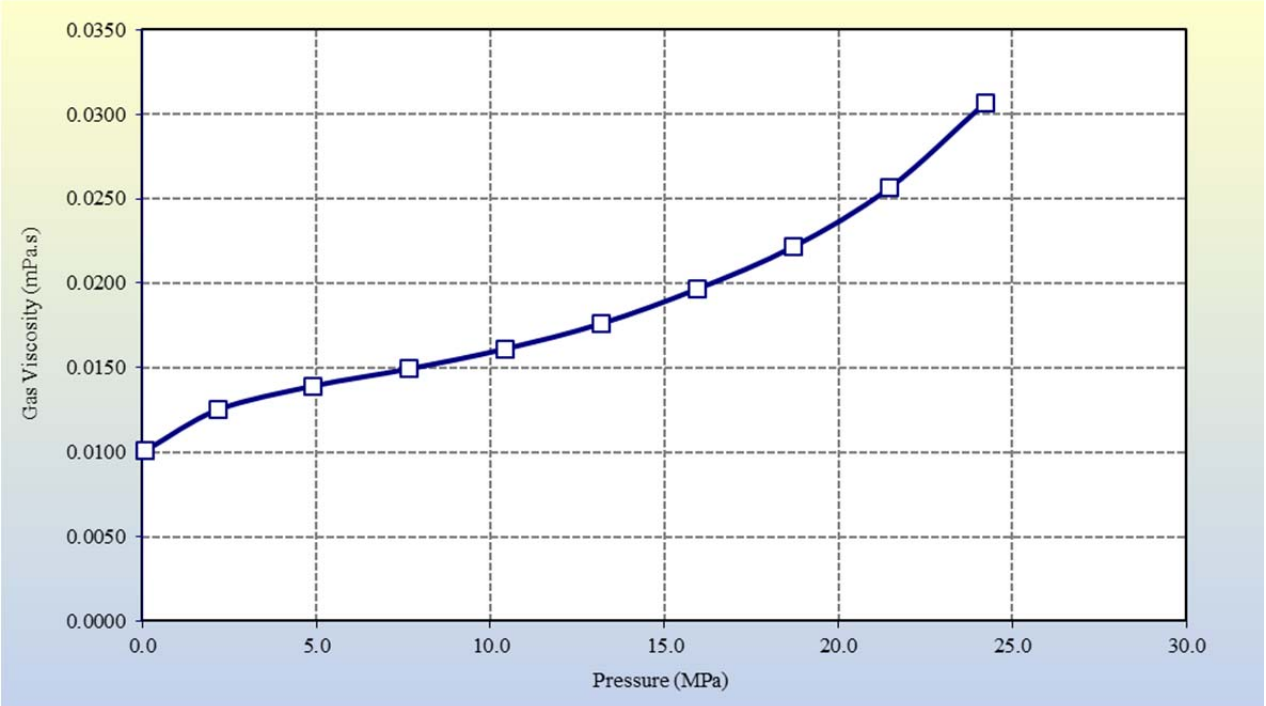
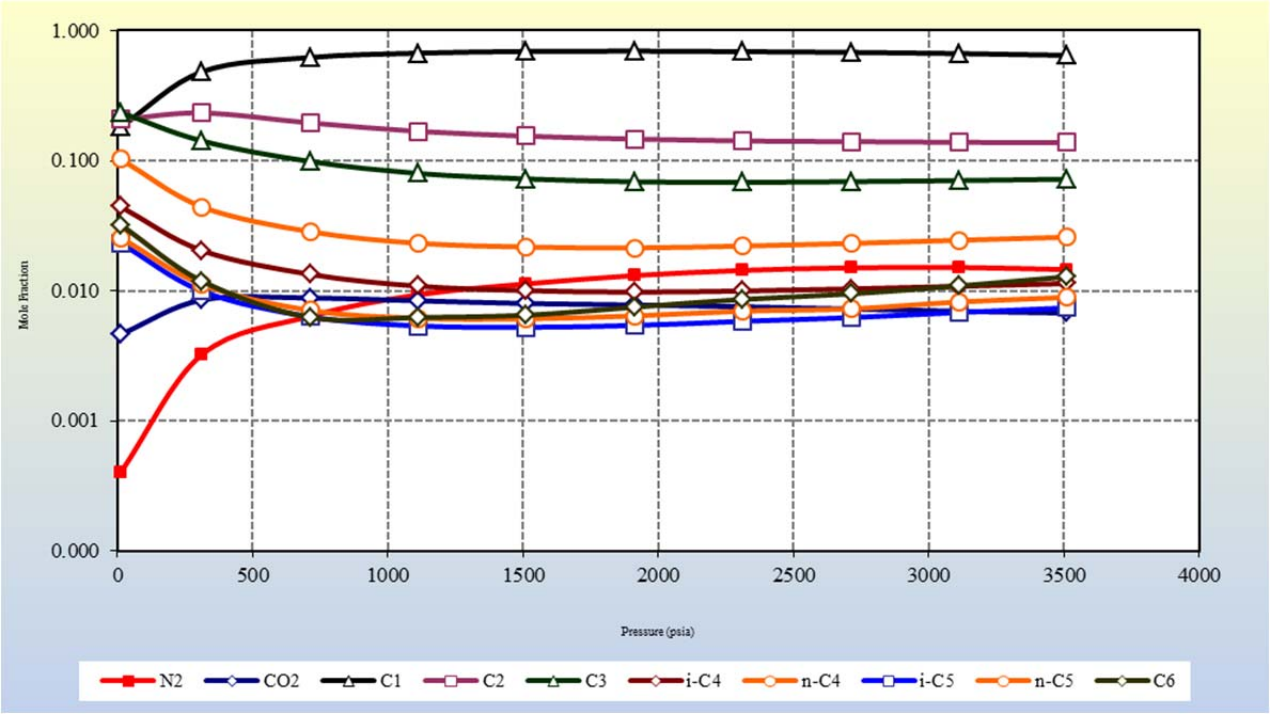
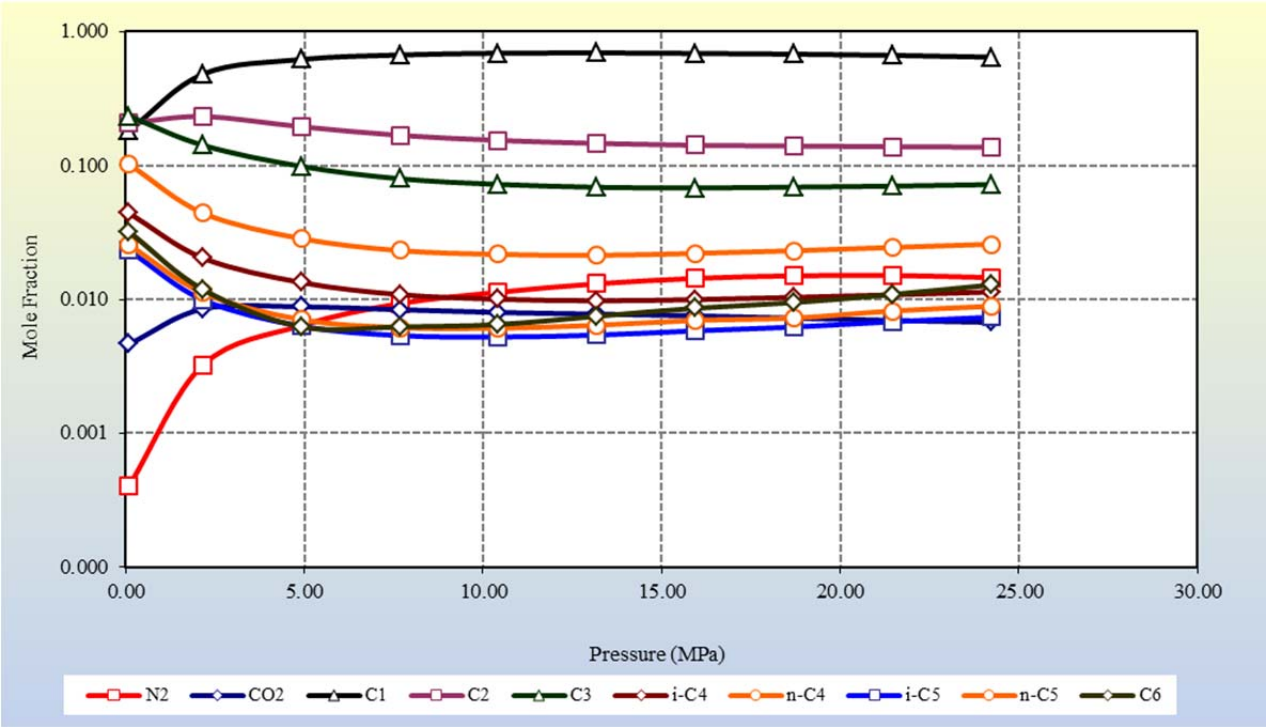


FIGURE 10
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
LIBERATED GAS COMPOSITION PROFILE @ 228.1°F (109.0°C)





Appendix A

RECOMBINED FLUID COMPOSITION

TABLE A1
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
COMPOSITIONAL ANALYSIS OF RESERVOIR FLUID

Boiling Point (C)	Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties	
-195.8	Nitrogen	N_2	0.0103	0.0057	**Total Sample**	
-78.5	Carbon Dioxide	CO_2	0.0061	0.0053		
-60.3	Hydrogen Sulphide	H_2S	0.0000	0.0000	Molecular Weight	50.55
-161.7	Methane	C_1	0.5222	0.1658	Density (g/cc)	0.5581
-88.9	Ethane	C_2	0.1330	0.0791		
-42.2	Propane	C_3	0.0791	0.0690	**C_{6+} Fraction**	
-11.7	i-Butane	i-C_4	0.0131	0.0150		
-0.6	n-Butane	n-C_4	0.0310	0.0357	Molecular Weight	163.79
27.8	i-Pentane	i-C_5	0.0099	0.0141	Mole Fraction	0.1829
36.1	n-Pentane	n-C_5	0.0125	0.0178	Density (g/cc)	0.8160
36.1 - 68.9	Hexanes	C_6	0.0214	0.0364		
68.9 - 98.3	Heptanes	C_7	0.0192	0.0381	**C_{7+} Fraction**	
98.3 - 125.6	Octanes	C_8	0.0209	0.0471		
125.6 - 150.6	Nonanes	C_9	0.0155	0.0393	Molecular Weight	174.51
150.6 - 173.9	Decanes	C_{10}	0.0118	0.0331	Mole Fraction	0.1608
173.9 - 196.1	Undecanes	C_{11}	0.0104	0.0301	Density (g/cc)	0.8265
196.1 - 215	Dodecanes	C_{12}	0.0080	0.0255		
215 - 235	Tridecanes	C_{13}	0.0079	0.0272	**C_{12+} Fraction**	
235 - 252.2	Tetradecanes	C_{14}	0.0063	0.0239		
252.2 - 270.6	Pentadecanes	C_{15}	0.0048	0.0195	Molecular Weight	271.05
270.6 - 287.8	Hexadecanes	C_{16}	0.0039	0.0172	Mole Fraction	0.0603
287.8 - 291.7	Heptadecanes	C_{17}	0.0032	0.0149	Density (g/cc)	0.8756
291.7 - 317.2	Octadecanes	C_{18}	0.0030	0.0149		
317.2 - 330	Nonadecanes	C_{19}	0.0027	0.0142	**C_{30+} Fraction**	
330 - 344.4	Eicosanes	C_{20}	0.0022	0.0118		
344.4 - 357.2	Heneicosanes	C_{21}	0.0019	0.0108	Molecular Weight	563.56
357.2 - 369.4	Docosanes	C_{22}	0.0016	0.0098	Mole Fraction	0.0073
369.4 - 380	Tricosanes	C_{23}	0.0015	0.0093	Density (g/cc)	0.9819
380 - 391.1	Tetracosanes	C_{24}	0.0013	0.0086		
391.1 - 401.7	Pentacosanes	C_{25}	0.0012	0.0081		
401.7 - 412.2	Hexacosanes	C_{26}	0.0010	0.0072	**Recombination Parameters**	
412.3 - 422.2	Heptacosanes	C_{27}	0.0009	0.0069		
422.3 - 431.7	Octacosanes	C_{28}	0.0008	0.0061	Gas-Oil Ratio (cc/cc)	481.79
431.7 - 441.1	Nonacosanes	C_{29}	0.0007	0.0060	Dead Oil Density (g/cc)	0.7916
Above 441.1	Tricontanes Plus	C_{30+}	0.0073	0.0812	Dead Oil MW (g/mol)	152.88
	NAPHTHENES					
48.9	Cyclopentane	C_5H_{10}	0.0007	0.0009		
72.2	Methylcyclopentane	C_6H_{12}	0.0034	0.0057		
81.1	Cyclohexane	C_6H_{12}	0.0028	0.0046		
101.1	Methylcyclohexane	C_7H_{14}	0.0074	0.0143		
	AROMATICS					
80.0	Benzene	C_6H_6	0.0005	0.0007		
110.6	Toluene	C_7H_8	0.0019	0.0035		
136.1 - 138.9	Ethylbenzene & p,m-Xyle	C_8H_{10}	0.0022	0.0045		
144.4	o-Xylene	C_8H_{10}	0.0017	0.0035		
168.9	1, 2, 4-Trimethylbenzene	C_9H_{12}	0.0030	0.0071		
Total			**1.0000**	**1.0000**		

Note: Physical Properties calculated based GPA 2145-00 physical constants

TABLE A2
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
COMPOSITIONAL ANALYSIS OF FLASHED OIL

Boiling Point (C)	Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties	
-195.8	Nitrogen	N_2	0.0000	0.0000	**Total Sample**	
-78.5	Carbon Dioxide	CO_2	0.0000	0.0000		
-60.3	Hydrogen Sulphide	H_2S	0.0000	0.0000	Molecular Weight	152.88
-161.7	Methane	C_1	0.0000	0.0000	Density (g/cc)	0.8020
-88.9	Ethane	C_2	0.0000	0.0000		
-42.2	Propane	C_3	0.0217	0.0063	**C_{6+} Fraction**	
-11.7	i-Butane	i-C_4	0.0100	0.0038		
-0.6	n-Butane	n-C_4	0.0369	0.0140	Molecular Weight	166.31
27.8	i-Pentane	i-C_5	0.0246	0.0116	Mole Fraction	0.8708
36.1	n-Pentane	n-C_5	0.0360	0.0170	Density (g/cc)	0.8184
36.1 - 68.9	Hexanes	C_6	0.0873	0.0492		
68.9 - 98.3	Heptanes	C_7	0.0868	0.0569	**C_{7+} Fraction**	
98.3 - 125.6	Octanes	C_8	0.1016	0.0759		
125.6 - 150.6	Nonanes	C_9	0.0758	0.0636	Molecular Weight	175.70
150.6 - 173.9	Decanes	C_{10}	0.0580	0.0540	Mole Fraction	0.7801
173.9 - 196.1	Undecanes	C_{11}	0.0511	0.0491	Density (g/cc)	0.8274
196.1 - 215	Dodecanes	C_{12}	0.0394	0.0415		
215 - 235	Tridecanes	C_{13}	0.0387	0.0443	**C_{12+} Fraction**	
235 - 252.2	Tetradecanes	C_{14}	0.0313	0.0389		
252.2 - 270.6	Pentadecanes	C_{15}	0.0236	0.0319	Molecular Weight	271.05
270.6 - 287.8	Hexadecanes	C_{16}	0.0193	0.0280	Mole Fraction	0.2971
287.8 - 291.7	Heptadecanes	C_{17}	0.0157	0.0244	Density (g/cc)	0.8756
291.7 - 317.2	Octadecanes	C_{18}	0.0148	0.0244		
317.2 - 330	Nonadecanes	C_{19}	0.0135	0.0232	**C_{30+} Fraction**	
330 - 344.4	Eicosanes	C_{20}	0.0107	0.0193		
344.4 - 357.2	Heneicosanes	C_{21}	0.0093	0.0176	Molecular Weight	563.56
357.2 - 369.4	Docosanes	C_{22}	0.0080	0.0159	Mole Fraction	0.0359
369.4 - 380	Tricosanes	C_{23}	0.0073	0.0152	Density (g/cc)	0.9819
380 - 391.1	Tetracosanes	C_{24}	0.0065	0.0140		
391.1 - 401.7	Pentacosanes	C_{25}	0.0058	0.0131		
401.7 - 412.2	Hexacosanes	C_{26}	0.0050	0.0117		
412.3 - 422.2	Heptacosanes	C_{27}	0.0046	0.0113		
422.3 - 431.7	Octacosanes	C_{28}	0.0039	0.0099		
431.7 - 441.1	Nonacosanes	C_{29}	0.0037	0.0097		
Above 441.1	Tricontanes Plus	C_{30+}	0.0359	0.1324		
	NAPHTHENES					
48.9	Cyclopentane	C_5H_{10}	0.0034	0.0015		
72.2	Methylcyclopentane	C_6H_{12}	0.0148	0.0081		
81.1	Cyclohexane	C_6H_{12}	0.0136	0.0075		
101.1	Methylcyclohexane	C_7H_{14}	0.0363	0.0233		
	AROMATICS					
80.0	Benzene	C_6H_6	0.0021	0.0011		
110.6	Toluene	C_7H_8	0.0094	0.0057		
136.1 - 138.9	Ethylbenzene & p,m-Xyle	C_8H_{10}	0.0106	0.0074		
144.4	o-Xylene	C_8H_{10}	0.0082	0.0057		
168.9	1, 2, 4-Trimethylbenzene	C_9H_{12}	0.0147	0.0116		
Total			**1.0000**	**1.0000**		

Note: Physical Properties calculated based GPA 2145-00 physical constants

TABLE A3
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
COMPOSITIONAL ANALYSIS OF FLASHED GAS

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0129	0.0130		
Carbon Dioxide	CO_2	0.0077	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.6551	0.6602		
Ethane	C_2	0.1669	0.1682		
Propane	C_3	0.0937	0.0944	61.164	343.403
i-Butane	i-C_4	0.0138	0.0139	10.736	60.279
n-Butane	n-C_4	0.0296	0.0298	22.111	124.140
i-Pentane	i-C_5	0.0062	0.0062	5.350	30.040
n-Pentane	n-C_5	0.0065	0.0065	5.567	31.254
Hexanes	C_6	0.0046	0.0046	4.478	25.139
Heptanes	C_7	0.0026	0.0027	2.895	16.257
Octanes	C_8	0.0004	0.0004	0.438	2.460
Nonanes	C_9	0.0001	0.0001	0.185	1.037
Decanes	C_{10}	0.0000	0.0000	0.014	0.078
Undecane	C_{11}	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C_{12+}	0.0000	0.0000	0.000	0.000
Total		**1.0000**	**1.0000**	**112.937**	**634.087**
Propanes Plus	C_{3+}	0.1574	0.1586	112.937	634.087
Butanes Plus	C_{4+}	0.0638	0.0643	51.774	290.684
	C_{5+}	0.0204	0.0205	18.927	106.264

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	24.50 kg/kmol	24.50 lb/lb-mol	Ppc	660.9 psia	4.56 MPa
Specific Gravity	0.8457 (Air = 1)	0.8457 (Air = 1)	Tpc	436.6 R	242.6 K
MW of C7+	0.31 kg/kmol	0.31 lb/lbmol	Ppc*	658.7 psia	4.54 MPa
Density of C7+	0.7266 g/cc	726.6 kg/m3	Tpc*	435.2 R	241.8 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,424.0 Btu/scf	53.16 MJ/m3	Dry	1,296.4 Btu/scf	48.39 MJ/m3
Wet	1,399.2 Btu/scf	52.23 MJ/m3	Wet	1,273.8 Btu/scf	47.55 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)

GC No.: A150716

Appendix B

DIFFERENTIAL LIBERATION-MATERIAL BALANCE

TABLE B1
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION @ 228.1°F (109.0°C)-MATERIAL BALANCE

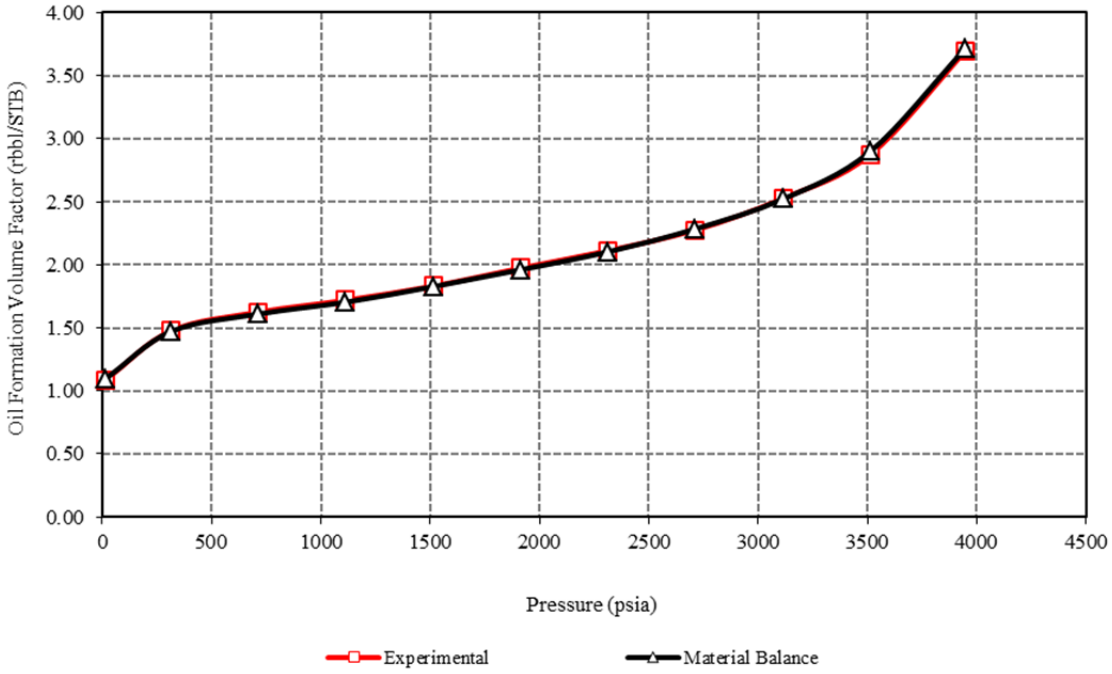
Pressure (psia)	Pressure (MPa)	Measured Oil FVF [1]	Calculated Oil FVF [1]	Absolute Relative Error (%)
3946 Psat	**27.21**	**3.6916**	**3.7124**	**0.5597**
3513	24.22	2.8739	2.8996	0.8859
3113	21.46	2.5265	2.5217	0.1931
2713	18.71	2.2764	2.2852	0.3867
2313	15.95	2.1122	2.1034	0.4196
1913	13.19	1.9743	1.9607	0.6930
1513	10.43	1.8317	1.8272	0.2457
1113	7.67	1.7196	1.7035	0.9433
713	4.92	1.6249	1.6101	0.9211
313	2.16	1.4757	1.4706	0.3490
13	0.09	1.0842	1.0928	0.7904

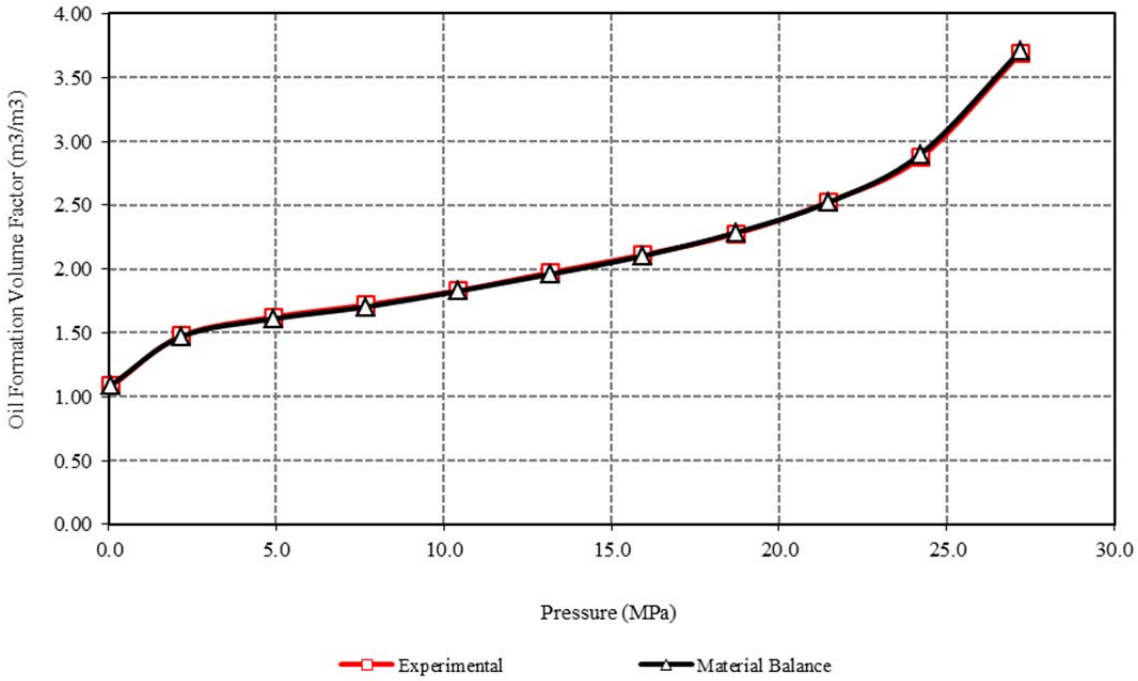
[1] (res bbl/STB) (res m3/m3)

Psat - Saturation Pressure

- Tank conditions: 60 F (288.7 K) @ 13 psia (0.09 MPa)

FIGURE B1
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION @ 228.1°F (109.0°C)-MATERIAL BALANCE





Appendix C

DIFFERENTIAL LIBERATION -LIBERATED GAS COMPOSITIONS

TABLE C1
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 3513 PSIA (24.22 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0145	0.0146		
Carbon Dioxide	CO_2	0.0067	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.6458	0.6502		
Ethane	C_2	0.1374	0.1384		
Propane	C_3	0.0722	0.0726	47.118	264.547
i-Butane	i-C_4	0.0114	0.0114	8.817	49.504
n-Butane	n-C_4	0.0258	0.0260	19.323	108.489
i-Pentane	i-C_5	0.0074	0.0074	6.410	35.991
n-Pentane	n-C_5	0.0089	0.0089	7.638	42.884
Hexanes	C_6	0.0128	0.0129	12.511	70.246
Heptanes	C_7	0.0132	0.0132	14.409	80.898
Octanes	C_8	0.0152	0.0153	18.504	103.891
Nonanes	C_9	0.0081	0.0082	10.861	60.981
Decanes	C_{10}	0.0053	0.0053	7.705	43.262
Undecane	C_{11}	0.0033	0.0034	5.280	29.646
Dodecanes Plus	C_{12+}	0.0119	0.0120	20.264	113.772
Total		**1.0000**	**1.0000**	**178.842**	**1004.110**
Propanes Plus	C_{3+}	0.1955	0.1968	178.842	1004.110
Butanes Plus	C_{4+}	0.1233	0.1242	131.724	739.564
	C_{5+}	0.0861	0.0867	103.584	581.571

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	29.81 kg/kmol	29.81 lb/lb-mol	Ppc	640.8 psia	4.42 MPa
Specific Gravity	1.0293 (Air = 1)	1.0293 (Air = 1)	Tpc	466.9 R	259.4 K
MW of C7+	122.58 kg/kmol	122.58 lb/lbmol	Ppc*	639.1 psia	4.41 MPa
Density of C7+	0.7595 g/cc	759.5 kg/m3	Tpc*	465.6 R	258.6 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,713.6 Btu/scf	63.96 MJ/m3	Dry	1,567.5 Btu/scf	58.51 MJ/m3
Wet	1,683.8 Btu/scf	62.85 MJ/m3	Wet	1,540.2 Btu/scf	57.49 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150782

TABLE C2
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 3113 PSIA (21.46 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0151	0.0152		
Carbon Dioxide	CO_2	0.0070	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.6666	0.6712		
Ethane	C_2	0.1383	0.1393		
Propane	C_3	0.0703	0.0708	45.899	257.698
i-Butane	i-C_4	0.0108	0.0109	8.392	47.116
n-Butane	n-C_4	0.0245	0.0246	18.303	102.760
i-Pentane	i-C_5	0.0068	0.0069	5.921	33.241
n-Pentane	n-C_5	0.0082	0.0083	7.050	39.585
Hexanes	C_6	0.0109	0.0110	10.637	59.723
Heptanes	C_7	0.0104	0.0104	11.343	63.686
Octanes	C_8	0.0112	0.0113	13.611	76.417
Nonanes	C_9	0.0065	0.0066	8.706	48.877
Decanes	C_{10}	0.0042	0.0042	6.135	34.443
Undecane	C_{11}	0.0026	0.0026	4.069	22.846
Dodecanes Plus	C_{12+}	0.0067	0.0067	11.388	63.937
Total		**1.0000**	**1.0000**	**151.452**	**850.328**
Propanes Plus	C_{3+}	0.1730	0.1742	151.452	850.328
Butanes Plus	C_{4+}	0.1027	0.1035	105.553	592.630
	C_{5+}	0.0675	0.0679	78.859	442.755

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	27.76 kg/kmol	27.76 lb/lb-mol	Ppc	647.0 psia	4.46 MPa
Specific Gravity	0.9583 (Air = 1)	0.9583 (Air = 1)	Tpc	452.3 R	251.3 K
MW of C7+	120.37 kg/kmol	120.37 lb/lbmol	Ppc*	645.1 psia	4.45 MPa
Density of C7+	0.7572 g/cc	757.2 kg/m3	Tpc*	451.0 R	250.5 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,599.0 Btu/scf	59.69 MJ/m3	Dry	1,460.5 Btu/scf	54.52 MJ/m3
Wet	1,571.2 Btu/scf	58.65 MJ/m3	Wet	1,435.1 Btu/scf	53.57 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150783

TABLE C3
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 2713 PSIA (18.71 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0150	0.0151		
Carbon Dioxide	CO_2	0.0072	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.6811	0.6861		
Ethane	C_2	0.1403	0.1413		
Propane	C_3	0.0691	0.0696	45.094	253.183
i-Butane	i-C_4	0.0103	0.0104	8.028	45.075
n-Butane	n-C_4	0.0231	0.0233	17.286	97.050
i-Pentane	i-C_5	0.0062	0.0063	5.404	30.340
n-Pentane	n-C_5	0.0073	0.0073	6.238	35.024
Hexanes	C_6	0.0095	0.0095	9.245	51.904
Heptanes	C_7	0.0081	0.0081	8.858	49.732
Octanes	C_8	0.0081	0.0081	9.783	54.925
Nonanes	C_9	0.0052	0.0053	7.012	39.371
Decanes	C_{10}	0.0034	0.0035	5.017	28.169
Undecane	C_{11}	0.0018	0.0019	2.911	16.343
Dodecanes Plus	C_{12+}	0.0043	0.0043	7.285	40.903
Total		**1.0000**	**1.0000**	**132.161**	**742.019**
Propanes Plus	C_{3+}	0.1564	0.1575	132.161	742.019
Butanes Plus	C_{4+}	0.0874	0.0880	87.067	488.836
	C_{5+}	0.0539	0.0543	61.753	346.711

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	26.36 kg/kmol	26.36 lb/lb-mol	Ppc	651.6 psia	4.49 MPa
Specific Gravity	0.9100 (Air = 1)	0.9100 (Air = 1)	Tpc	442.3 R	245.7 K
MW of C7+	119.36 kg/kmol	119.36 lb/lbmol	Ppc*	649.5 psia	4.48 MPa
Density of C7+	0.7561 g/cc	756.1 kg/m3	Tpc*	440.9 R	244.9 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,521.8 Btu/scf	56.81 MJ/m3	Dry	1,388.3 Btu/scf	51.82 MJ/m3
Wet	1,495.4 Btu/scf	55.82 MJ/m3	Wet	1,364.2 Btu/scf	50.92 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150785

TABLE C4
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 2313 PSIA (15.95 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0144	0.0145		
Carbon Dioxide	CO_2	0.0075	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.6896	0.6948		
Ethane	C_2	0.1418	0.1428		
Propane	C_3	0.0681	0.0686	44.459	249.614
i-Butane	i-C_4	0.0100	0.0100	7.735	43.431
n-Butane	n-C_4	0.0221	0.0222	16.508	92.686
i-Pentane	i-C_5	0.0058	0.0059	5.060	28.407
n-Pentane	n-C_5	0.0070	0.0070	5.989	33.625
Hexanes	C_6	0.0086	0.0087	8.386	47.085
Heptanes	C_7	0.0074	0.0074	8.072	45.323
Octanes	C_8	0.0072	0.0073	8.763	49.198
Nonanes	C_9	0.0041	0.0042	5.544	31.129
Decanes	C_{10}	0.0025	0.0025	3.678	20.650
Undecane	C_{11}	0.0014	0.0014	2.249	12.624
Dodecanes Plus	C_{12+}	0.0026	0.0027	4.472	25.107
Total		**1.0000**	**1.0000**	**120.915**	**678.878**
Propanes Plus	C_{3+}	0.1468	0.1479	120.915	678.878
Butanes Plus	C_{4+}	0.0787	0.0793	76.456	429.264
	C_{5+}	0.0467	0.0470	52.212	293.147

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	25.54 kg/kmol	25.54 lb/lb-mol	Ppc	654.3 psia	4.51 MPa
Specific Gravity	0.8817 (Air = 1)	0.8817 (Air = 1)	Tpc	436.7 R	242.6 K
MW of C7+	116.65 kg/kmol	116.65 lb/lbmol	Ppc*	652.2 psia	4.50 MPa
Density of C7+	0.7529 g/cc	752.9 kg/m3	Tpc*	435.2 R	241.8 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,478.2 Btu/scf	55.18 MJ/m3	Dry	1,347.4 Btu/scf	50.30 MJ/m3
Wet	1,452.4 Btu/scf	54.22 MJ/m3	Wet	1,324.0 Btu/scf	49.42 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150786

TABLE C5
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 1913 PSIA (13.19 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0131	0.0132		
Carbon Dioxide	CO_2	0.0078	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.6959	0.7014		
Ethane	C_2	0.1465	0.1476		
Propane	C_3	0.0689	0.0694	44.973	252.503
i-Butane	i-C_4	0.0098	0.0098	7.579	42.550
n-Butane	n-C_4	0.0214	0.0215	15.980	89.720
i-Pentane	i-C_5	0.0054	0.0055	4.701	26.395
n-Pentane	n-C_5	0.0064	0.0065	5.514	30.960
Hexanes	C_6	0.0075	0.0075	7.306	41.019
Heptanes	C_7	0.0059	0.0059	6.444	36.179
Octanes	C_8	0.0049	0.0050	5.988	33.622
Nonanes	C_9	0.0027	0.0027	3.581	20.106
Decanes	C_{10}	0.0015	0.0016	2.257	12.673
Undecane	C_{11}	0.0009	0.0009	1.376	7.723
Dodecanes Plus	C_{12+}	0.0015	0.0015	2.517	14.132
Total		**1.0000**	**1.0000**	**108.217**	**607.584**
Propanes Plus	C_{3+}	0.1367	0.1378	108.217	607.584
Butanes Plus	C_{4+}	0.0678	0.0684	63.243	355.080
	C_{5+}	0.0367	0.0370	39.685	222.810

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	24.61 kg/kmol	24.61 lb/lb-mol	Ppc	657.9 psia	4.54 MPa
Specific Gravity	0.8498 (Air = 1)	0.8498 (Air = 1)	Tpc	430.8 R	239.3 K
MW of C7+	114.44 kg/kmol	114.44 lb/lbmol	Ppc*	655.6 psia	4.52 MPa
Density of C7+	0.7500 g/cc	750.0 kg/m3	Tpc*	429.4 R	238.5 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,429.9 Btu/scf	53.38 MJ/m3	Dry	1,302.2 Btu/scf	48.61 MJ/m3
Wet	1,405.0 Btu/scf	52.45 MJ/m3	Wet	1,279.5 Btu/scf	47.76 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150787

TABLE C6
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 1513 PSIA (10.43 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0113	0.0114		
Carbon Dioxide	CO_2	0.0080	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.6919	0.6975		
Ethane	C_2	0.1544	0.1556		
Propane	C_3	0.0724	0.0730	47.263	265.359
i-Butane	i-C_4	0.0100	0.0101	7.781	43.686
n-Butane	n-C_4	0.0217	0.0219	16.229	91.119
i-Pentane	i-C_5	0.0052	0.0053	4.550	25.544
n-Pentane	n-C_5	0.0061	0.0061	5.228	29.355
Hexanes	C_6	0.0065	0.0066	6.343	35.613
Heptanes	C_7	0.0052	0.0052	5.665	31.807
Octanes	C_8	0.0037	0.0037	4.454	25.008
Nonanes	C_9	0.0017	0.0017	2.260	12.690
Decanes	C_{10}	0.0008	0.0008	1.181	6.630
Undecane	C_{11}	0.0007	0.0007	1.077	6.045
Dodecanes Plus	C_{12+}	0.0005	0.0005	0.885	4.971
Total		**1.0000**	**1.0000**	**102.916**	**577.825**
Propanes Plus	C_{3+}	0.1345	0.1355	102.916	577.825
Butanes Plus	C_{4+}	0.0621	0.0626	55.653	312.466
	C_{5+}	0.0304	0.0306	31.643	177.662

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	24.21 kg/kmol	24.21 lb/lb-mol	Ppc	660.2 psia	4.55 MPa
Specific Gravity	0.8358 (Air = 1)	0.8358 (Air = 1)	Tpc	429.7 R	238.7 K
MW of C7+	110.51 kg/kmol	110.51 lb/lbmol	Ppc*	657.9 psia	4.54 MPa
Density of C7+	0.7449 g/cc	744.9 kg/m3	Tpc*	428.2 R	237.9 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,410.6 Btu/scf	52.66 MJ/m3	Dry	1,284.0 Btu/scf	47.93 MJ/m3
Wet	1,386.1 Btu/scf	51.74 MJ/m3	Wet	1,261.7 Btu/scf	47.10 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150788

TABLE C7
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 1113 PSIA (7.67 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0093	0.0094		
Carbon Dioxide	CO_2	0.0084	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.6715	0.6772		
Ethane	C_2	0.1682	0.1696		
Propane	C_3	0.0798	0.0805	52.098	292.503
i-Butane	i-C_4	0.0109	0.0109	8.424	47.299
n-Butane	n-C_4	0.0232	0.0234	17.338	97.344
i-Pentane	i-C_5	0.0054	0.0054	4.662	26.176
n-Pentane	n-C_5	0.0061	0.0062	5.285	29.674
Hexanes	C_6	0.0062	0.0063	6.078	34.124
Heptanes	C_7	0.0049	0.0049	5.310	29.815
Octanes	C_8	0.0029	0.0029	3.541	19.883
Nonanes	C_9	0.0014	0.0014	1.895	10.637
Decanes	C_{10}	0.0009	0.0009	1.364	7.657
Undecane	C_{11}	0.0007	0.0007	1.043	5.854
Dodecanes Plus	C_{12+}	0.0003	0.0003	0.488	2.742
Total		**1.0000**	**1.0000**	**107.526**	**603.707**
Propanes Plus	C_{3+}	0.1426	0.1438	107.526	603.707
Butanes Plus	C_{4+}	0.0628	0.0634	55.429	311.204
	C_{5+}	0.0288	0.0290	29.666	166.561

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	24.54 kg/kmol	24.54 lb/lb-mol	Ppc	661.1 psia	4.56 MPa
Specific Gravity	0.8473 (Air = 1)	0.8473 (Air = 1)	Tpc	435.1 R	241.7 K
MW of C7+	110.04 kg/kmol	110.04 lb/lbmol	Ppc*	658.7 psia	4.54 MPa
Density of C7+	0.7442 g/cc	744.2 kg/m3	Tpc*	433.5 R	240.8 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,430.9 Btu/scf	53.41 MJ/m3	Dry	1,302.9 Btu/scf	48.63 MJ/m3
Wet	1,406.0 Btu/scf	52.48 MJ/m3	Wet	1,280.2 Btu/scf	47.79 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150789

TABLE C8
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 713 PSIA (4.92 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0064	0.0064		
Carbon Dioxide	CO_2	0.0088	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.6218	0.6273		
Ethane	C_2	0.1953	0.1971		
Propane	C_3	0.0986	0.0995	64.394	361.538
i-Butane	i-C_4	0.0134	0.0135	10.381	58.283
n-Butane	n-C_4	0.0285	0.0287	21.304	119.610
i-Pentane	i-C_5	0.0063	0.0064	5.481	30.772
n-Pentane	n-C_5	0.0071	0.0071	6.062	34.033
Hexanes	C_6	0.0062	0.0063	6.083	34.153
Heptanes	C_7	0.0038	0.0038	4.163	23.376
Octanes	C_8	0.0023	0.0024	2.833	15.908
Nonanes	C_9	0.0009	0.0009	1.157	6.495
Decanes	C_{10}	0.0003	0.0003	0.467	2.621
Undecane	C_{11}	0.0002	0.0002	0.248	1.393
Dodecanes Plus	C_{12+}	0.0002	0.0002	0.333	1.870
Total		**1.0000**	**1.0000**	**122.905**	**690.053**
Propanes Plus	C_{3+}	0.1677	0.1692	122.905	690.053
Butanes Plus	C_{4+}	0.0691	0.0697	58.512	328.515
	C_{5+}	0.0273	0.0275	26.827	150.622

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	25.51 kg/kmol	25.51 lb/lb-mol	Ppc	661.7 psia	4.56 MPa
Specific Gravity	0.8809 (Air = 1)	0.8809 (Air = 1)	Tpc	448.9 R	249.4 K
MW of C7+	106.45 kg/kmol	106.45 lb/lbmol	Ppc*	659.3 psia	4.55 MPa
Density of C7+	0.7394 g/cc	739.4 kg/m3	Tpc*	447.3 R	248.5 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,486.9 Btu/scf	55.50 MJ/m3	Dry	1,354.9 Btu/scf	50.58 MJ/m3
Wet	1,461.0 Btu/scf	54.53 MJ/m3	Wet	1,331.4 Btu/scf	49.70 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150791

TABLE C9
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 313 PSIA (2.16 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0032	0.0033		
Carbon Dioxide	CO_2	0.0085	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.4831	0.4872		
Ethane	C_2	0.2328	0.2348		
Propane	C_3	0.1419	0.1431	92.685	520.382
i-Butane	i-C_4	0.0204	0.0206	15.824	88.844
n-Butane	n-C_4	0.0442	0.0445	33.047	185.540
i-Pentane	i-C_5	0.0099	0.0100	8.626	48.429
n-Pentane	n-C_5	0.0112	0.0113	9.623	54.028
Hexanes	C_6	0.0119	0.0120	11.574	64.982
Heptanes	C_7	0.0108	0.0109	11.789	66.189
Octanes	C_8	0.0111	0.0112	13.508	75.839
Nonanes	C_9	0.0054	0.0055	7.272	40.828
Decanes	C_{10}	0.0028	0.0028	4.088	22.954
Undecane	C_{11}	0.0014	0.0014	2.149	12.068
Dodecanes Plus	C_{12+}	0.0014	0.0015	2.458	13.799
Total		**1.0000**	**1.0000**	**212.642**	**1193.882**
Propanes Plus	C_{3+}	0.2724	0.2747	212.642	1193.882
Butanes Plus	C_{4+}	0.1305	0.1316	119.957	673.499
	C_{5+}	0.0659	0.0665	71.086	399.115

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	31.46 kg/kmol	31.46 lb/lb-mol	Ppc	648.1 psia	4.47 MPa
Specific Gravity	1.0862 (Air = 1)	1.0862 (Air = 1)	Tpc	505.1 R	280.6 K
MW of C7+	112.04 kg/kmol	112.04 lb/lbmol	Ppc*	646.0 psia	4.45 MPa
Density of C7+	0.7477 g/cc	747.7 kg/m3	Tpc*	503.5 R	279.7 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,812.0 Btu/scf	67.64 MJ/m3	Dry	1,658.8 Btu/scf	61.92 MJ/m3
Wet	1,780.5 Btu/scf	66.46 MJ/m3	Wet	1,629.9 Btu/scf	60.84 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150792

TABLE C10
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – RECOMBINED SAMPLE
RESERVOIR FLUID STUDY
DIFFERENTIAL LIBERATION GAS @ 13 PSIA (0.09 MPa)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0004	0.0004		
Carbon Dioxide	CO_2	0.0046	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.1822	0.1830		
Ethane	C_2	0.2072	0.2082		
Propane	C_3	0.2347	0.2358	153.294	860.673
i-Butane	i-C_4	0.0442	0.0444	34.322	192.701
n-Butane	n-C_4	0.1027	0.1032	76.839	431.412
i-Pentane	i-C_5	0.0233	0.0234	20.218	113.514
n-Pentane	n-C_5	0.0257	0.0258	22.053	123.819
Hexanes	C_6	0.0322	0.0323	31.406	176.329
Heptanes	C_7	0.0398	0.0399	43.526	244.377
Octanes	C_8	0.0491	0.0493	59.665	334.987
Nonanes	C_9	0.0258	0.0259	34.494	193.665
Decanes	C_{10}	0.0141	0.0141	20.510	115.154
Undecane	C_{11}	0.0068	0.0069	10.783	60.540
Dodecanes Plus	C_{12+}	0.0073	0.0073	12.330	69.226
Total		**1.0000**	**1.0000**	**519.439**	**2916.396**
Propanes Plus	C_{3+}	0.6056	0.6084	519.439	2916.396
Butanes Plus	C_{4+}	0.3708	0.3726	366.145	2055.723
	C_{5+}	0.2239	0.2249	254.984	1431.611

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	50.81 kg/kmol	50.81 lb/lb-mol	Ppc	587.3 psia	4.05 MPa
Specific Gravity	1.7543 (Air = 1)	1.7543 (Air = 1)	Tpc	666.2 R	370.1 K
MW of C7+	113.78 kg/kmol	113.78 lb/lbmol	Ppc*	586.4 psia	4.04 MPa
Density of C7+	0.7502 g/cc	750.2 kg/m3	Tpc*	665.2 R	369.6 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	2,863.4 Btu/scf	106.88 MJ/m3	Dry	2,642.0 Btu/scf	98.62 MJ/m3
Wet	2,813.6 Btu/scf	105.02 MJ/m3	Wet	2,596.0 Btu/scf	96.90 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC No.: A150793

Appendix D

SELECTED SEPARATOR SAMPLES VALIDATION

TABLE D1
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – SAMPLE HY0068
RESERVOIR FLUID STUDY
SEPARATOR GAS - SAMPLE COLLECTION DATA

Project File:	CL-70055	
Company:	ENCANA CORPORATION	
Pool:	DUVERNAY	
Field:	KAYBOB	
Well Location:	16-16-64-23W5	
Fluid Sample:	HY0068	
Sample Description:	SEP GAS-RATE 2	
Sampling Company:	WFT	
Name of Sampler:	BS	
Sampling Date:	16-Oct-14	
Sampling Point:	SEPARATOR	
Sampling Temperature:	132.8 F	56 C
Sampling Pressure:	861 psia	5.94 MPa
Reservoir Temperature:	228.1 F	108.9 C
Reservoir Pressure:	8213.0 psia	56.63 MPa
Initial Reservoir Pressure (Pi)	N/A psia	N/A MPa
Depth of Reported Pi	N/A mMD	N/A mss

TABLE D2
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – SAMPLE HY0068
RESERVOIR FLUID STUDY
COMPOSITIONAL ANALYSIS OF SEPARATOR GAS

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0132	0.0132		
Carbon Dioxide	CO_2	0.0057	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.7435	0.7478		
Ethane	C_2	0.1467	0.1476		
Propane	C_3	0.0605	0.0609	39.517	221.867
i-Butane	i-C_4	0.0075	0.0076	5.848	32.835
n-Butane	n-C_4	0.0144	0.0145	10.796	60.613
i-Pentane	i-C_5	0.0028	0.0029	2.472	13.880
n-Pentane	n-C_5	0.0028	0.0028	2.386	13.396
Hexanes	C_6	0.0015	0.0015	1.467	8.239
Heptanes	C_7	0.0009	0.0009	0.966	5.423
Octanes	C_8	0.0003	0.0003	0.382	2.144
Nonanes	C_9	0.0001	0.0001	0.108	0.608
Decanes	C_{10}	0.0000	0.0000	0.020	0.112
Undecane	C_{11}	0.0000	0.0000	0.001	0.003
Dodecanes Plus	C_{12+}	0.0000	0.0000	0.000	0.000
Total		**1.0000**	**1.0000**	**63.963**	**359.120**
Propanes Plus	C_{3+}	0.0909	0.0914	63.963	359.120
Butanes Plus	C_{4+}	0.0304	0.0306	24.446	137.253
Pentanes Plus	C_{5+}	0.0084	0.0085	7.802	43.805

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	21.57 kg/kmol	21.57 lb/lb-mol	Ppc	666.1 psia	4.59 MPa
Specific Gravity	0.7447 (Air = 1)	0.7447 (Air = 1)	Tpc	406.1 R	225.6 K
MW of C7+	100.66 kg/kmol	100.66 lb/lbmol	Ppc*	664.3 psia	4.58 MPa
Density of C7+	0.7308 g/cc	730.8 kg/m3	Tpc*	404.9 R	225.0 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,271.3 Btu/scf	47.45 MJ/m3	Dry	1,153.8 Btu/scf	43.07 MJ/m3
Wet	1,249.2 Btu/scf	46.63 MJ/m3	Wet	1,133.7 Btu/scf	42.32 MJ/m3

* - Corrected for Acid Gas Content

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC ID: A141398 ID: 20182

TABLE D3
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – SAMPLE Z83124
RESERVOIR FLUID STUDY
SEPARATOR LIQUID- SAMPLE COLLECTION DATA

Project File:	CL-70055			
Company:	ENCANA CORPORATION			
Pool:	DUVERNAY			
Field:	KAYBOB			
Well Location:	16-16-64-23W5			
Fluid Sample:	Z83124			
Sample Description:	LIVE SEP OIL-RATE 2			
Sampling Company:	WFT			
Name of Sampler:	BS			
Sampling Date:	16-Oct-14			
Sampling Point:	SEPARATOR			
Sampling Temperature:	132.8	F	56	C
Sampling Pressure:	861	psia	5.94	MPa
Reservoir Temperature:	228.1	F	108.9	C
Reservoir Pressure:	2813.0	psia	56.63	MPa
Initial Reservoir Pressure (Pi)	N/A	psia	N/A	MPa
Depth of Reported Pi	N/A	mMD	N/A	mss

TABLE D4
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – SAMPLE Z83124
RESERVOIR FLUID STUDY
SEPARATOR LIQUID- SAMPLE VALIDATION DATA

INITIAL RESERVOIR CONDITIONS

Reservoir Pressure	8213	psia	56.63	MPa
Reservoir Temperature:	228.1	F	108.9	C

SINGLE-STAGE SEPARATOR TEST @ 1,546 psia (10.66 MPa) AND 140.0 F (333.2 K)

At Separator Test Conditions				
Oil Formation Volume Factor	1.3449	res.bbl/STB	1.3449	$res.m^3/m^3$
Solution Gas-Oil Ratio	534.70	scf/STB	95.23	m^3/m^3
Oil Density	0.6868	g/cm^3	686.8	kg/m^3
At Tank Conditions				
Residual Oil Density	0.7863	g/cm^3	786.3	kg/m^3
API Gravity	48.46		48.46	

SINGLE-STAGE SEPARATOR TEST - MATERIAL BALANCE CHECK

Oil FVF @ 1546 psia (10.66 MPa) (Measured)	1.3449	res.bbl/STB ($res.m^3/m^3$)
Oil FVF @ 1546 psia (10.66 MPa) (Calculated)	1.3439	res.bbl/STB ($res.m^3/m^3$)
Absolute Relative Error	0.0725	(%)

TABLE D5
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – SAMPLE Z83124
RESERVOIR FLUID STUDY
COMPOSITIONAL ANALYSIS OF SEPARATOR FLUID

Boiling Point (C)	Component Name	Chemical Symbol	Mole Fraction	Mass Fraction
-195.8	Nitrogen	N_2	0.0009	0.0003
-78.5	Carbon Dioxide	CO_2	0.0019	0.0009
-60.3	Hydrogen Sulphide	H_2S	0.0000	0.0000
-161.7	Methane	C_1	0.1461	0.0243
-88.9	Ethane	C_2	0.1063	0.0331
-42.2	Propane	C_3	0.1110	0.0507
-11.7	i-Butane	i-C_4	0.0276	0.0166
-0.6	n-Butane	n-C_4	0.0742	0.0447
27.8	i-Pentane	i-C_5	0.0337	0.0252
36.1	n-Pentane	n-C_5	0.0426	0.0319
36.1 - 68.9	Hexanes	C_6	0.0509	0.0454
68.9 - 98.3	Heptanes	C_7	0.0485	0.0504
98.3 - 125.6	Octanes	C_8	0.0536	0.0635
125.6 - 150.6	Nonanes	C_9	0.0392	0.0521
150.6 - 173.9	Decanes	C_{10}	0.0290	0.0427
173.9 - 196.1	Undecanes	C_{11}	0.0258	0.0392
196.1 - 215	Dodecanes	C_{12}	0.0203	0.0338
215 - 235	Tridecanes	C_{13}	0.0193	0.0351
235 - 252.2	Tetradecanes	C_{14}	0.0153	0.0300
252.2 - 270.6	Pentadecanes	C_{15}	0.0112	0.0240
270.6 - 287.8	Hexadecanes	C_{16}	0.0092	0.0210
287.8 - 291.7	Heptadecanes	C_{17}	0.0078	0.0190
291.7 - 317.2	Octadecanes	C_{18}	0.0074	0.0193
317.2 - 330	Nonadecanes	C_{19}	0.0065	0.0176
330 - 344.4	Eicosanes	C_{20}	0.0052	0.0149
344.4 - 357.2	Heneicosanes	C_{21}	0.0046	0.0139
357.2 - 369.4	Docosanes	C_{22}	0.0040	0.0125
369.4 - 380	Tricosanes	C_{23}	0.0035	0.0117
380 - 391.1	Tetracosanes	C_{24}	0.0031	0.0106
391.1 - 401.7	Pentacosanes	C_{25}	0.0028	0.0099
401.7 - 412.2	Hexacosanes	C_{26}	0.0024	0.0089
412.3 - 422.2	Heptacosanes	C_{27}	0.0021	0.0083
422.3 - 431.7	Octacosanes	C_{28}	0.0019	0.0075
431.7 - 441.1	Nonacosanes	C_{29}	0.0017	0.0069
Above 441.1	Tricontanes Plus	C_{30+}	0.0193	0.1128
	NAPHTHENES			
48.9	Cyclopentane	C_5H_{10}	0.0021	0.0015
72.2	Methylcyclopentane	C_6H_{12}	0.0089	0.0077
81.1	Cyclohexane	C_6H_{12}	0.0077	0.0067
101.1	Methylcyclohexane	C_7H_{14}	0.0194	0.0198
	AROMATICS			
80.0	Benzene	C_6H_6	0.0013	0.0010
110.6	Toluene	C_7H_8	0.0053	0.0050
136.1 - 138.9	Ethylbenzene & p,m-Xyle	C_8H_{10}	0.0049	0.0054
144.4	o-Xylene	C_8H_{10}	0.0042	0.0046
168.9	1, 2, 4-Trimethylbenzene	C_9H_{12}	0.0075	0.0093
Total			**1.0000**	**1.0000**

Total Sample

Molecular Weight	96.52

C_{6+} Fraction

Molecular Weight	163.58
Mole Fraction	0.4536
Density (g/cc)	0.8166

C_{7+} Fraction

Molecular Weight	173.59
Mole Fraction	0.3849
Density (g/cc)	0.8267

C_{12+} Fraction

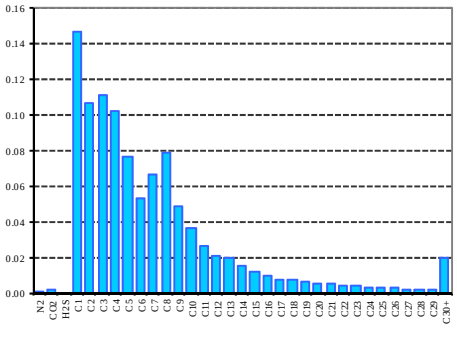
Molecular Weight	273.42
Mole Fraction	0.1475
Density (g/cc)	0.8776

C_{30+} Fraction

Molecular Weight	563.56
Mole Fraction	0.0193
Density (g/cc)	0.9819

Recombination Parameters

Gas-Oil Ratio (cc/cc)	95.23
Dead Oil Density (g/cc)	0.7863
Dead Oil MW (g/mol)	141.89

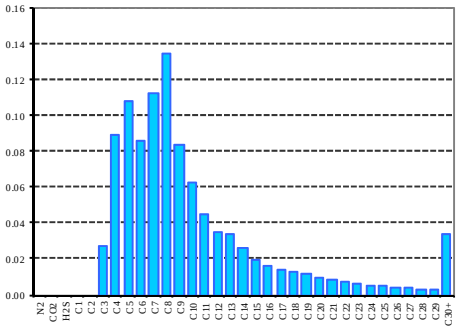


Note: Physical properties are calculated based on GPA 2145-00 physical constants ID.: 8701-3381

TABLE D6
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – SAMPLE Z83124
RESERVOIR FLUID STUDY
COMPOSITIONAL ANALYSIS OF FLASHED OIL

Boiling Point (C)	Component Name	Chemical Symbol	Mole Fraction	Mass Fraction
-195.8	Nitrogen	N_2	0.0000	0.0000
-78.5	Carbon Dioxide	CO_2	0.0000	0.0000
-60.3	Hydrogen Sulphide	H_2S	0.0000	0.0000
-161.7	Methane	C_1	0.0000	0.0000
-88.9	Ethane	C_2	0.0000	0.0000
-42.2	Propane	C_3	0.0271	0.0084
-11.7	i-Butane	i-C_4	0.0191	0.0078
-0.6	n-Butane	n-C_4	0.0693	0.0284
27.8	i-Pentane	i-C_5	0.0456	0.0232
36.1	n-Pentane	n-C_5	0.0617	0.0314
36.1 - 68.9	Hexanes	C_6	0.0818	0.0497
68.9 - 98.3	Heptanes	C_7	0.0820	0.0579
98.3 - 125.6	Octanes	C_8	0.0923	0.0743
125.6 - 150.6	Nonanes	C_9	0.0676	0.0611
150.6 - 173.9	Decanes	C_{10}	0.0500	0.0501
173.9 - 196.1	Undecanes	C_{11}	0.0445	0.0461
196.1 - 215	Dodecanes	C_{12}	0.0350	0.0397
215 - 235	Tridecanes	C_{13}	0.0334	0.0412
235 - 252.2	Tetradecanes	C_{14}	0.0263	0.0353
252.2 - 270.6	Pentadecanes	C_{15}	0.0194	0.0282
270.6 - 287.8	Hexadecanes	C_{16}	0.0158	0.0247
287.8 - 291.7	Heptadecanes	C_{17}	0.0134	0.0223
291.7 - 317.2	Octadecanes	C_{18}	0.0128	0.0227
317.2 - 330	Nonadecanes	C_{19}	0.0112	0.0207
330 - 344.4	Eicosanes	C_{20}	0.0090	0.0175
344.4 - 357.2	Heneicosanes	C_{21}	0.0080	0.0163
357.2 - 369.4	Docosanes	C_{22}	0.0069	0.0147
369.4 - 380	Tricosanes	C_{23}	0.0061	0.0137
380 - 391.1	Tetracosanes	C_{24}	0.0053	0.0124
391.1 - 401.7	Pentacosanes	C_{25}	0.0048	0.0117
401.7 - 412.2	Hexacosanes	C_{26}	0.0041	0.0104
412.3 - 422.2	Heptacosanes	C_{27}	0.0037	0.0097
422.3 - 431.7	Octacosanes	C_{28}	0.0032	0.0089
431.7 - 441.1	Nonacosanes	C_{29}	0.0029	0.0081
Above 441.1	Tricontanes Plus	C_{30+}	0.0333	0.1324
	NAPHTHENES			
48.9	Cyclopentane	C_5H_{10}	0.0037	0.0018
72.2	Methylcyclopentane	C_6H_{12}	0.0147	0.0087
81.1	Cyclohexane	C_6H_{12}	0.0132	0.0078
101.1	Methylcyclohexane	C_7H_{14}	0.0331	0.0229
	AROMATICS			
80.0	Benzene	C_6H_6	0.0022	0.0012
110.6	Toluene	C_7H_8	0.0091	0.0059
136.1 - 138.9	Ethylbenzene & p,m-Xyle	C_8H_{10}	0.0084	0.0063
144.4	o-Xylene	C_8H_{10}	0.0072	0.0054
168.9	1, 2, 4-Trimethylbenzene	C_9H_{12}	0.0129	0.0109
Total			**1.0000**	**1.0000**

Calculated Properties	
Total Sample	
Molecular Weight	141.89
Density (g/cc)	0.7878
C_{6+} Fraction	
Molecular Weight	164.45
Mole Fraction	0.7772
Density (g/cc)	0.8174
C_{7+} Fraction	
Molecular Weight	174.21
Mole Fraction	0.6917
Density (g/cc)	0.8270
C_{12+} Fraction	
Molecular Weight	273.42
Mole Fraction	0.2546
Density (g/cc)	0.8776
C_{30+} Fraction	
Molecular Weight	563.56
Mole Fraction	0.0333
Density (g/cc)	0.9819



Note: Physical properties are calculated based on GPA 2145-00 physical constants GC ID: B140962

TABLE D7
ENCANA CORPORATION
WELL ECA HZ WAHIGAN 16-16-064-23W5 – SAMPLE Z83124
RESERVOIR FLUID STUDY
COMPOSITIONAL ANALYSIS OF FLASHED GAS

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N_2	0.0021	0.0021		
Carbon Dioxide	CO_2	0.0045	0.0000		
Hydrogen Sulphide	H_2S	0.0000	0.0000		
Methane	C_1	0.3474	0.3490		
Ethane	C_2	0.2528	0.2540		
Propane	C_3	0.2265	0.2276	147.939	830.604
i-Butane	i-C_4	0.0394	0.0395	30.550	171.522
n-Butane	n-C_4	0.0809	0.0813	60.545	339.932
i-Pentane	i-C_5	0.0173	0.0174	15.027	84.370
n-Pentane	n-C_5	0.0164	0.0164	14.054	78.909
Hexanes	C_6	0.0083	0.0083	8.113	45.549
Heptanes	C_7	0.0034	0.0034	3.720	20.888
Octanes	C_8	0.0009	0.0009	1.064	5.972
Nonanes	C_9	0.0001	0.0001	0.122	0.684
Decanes	C_{10}	0.0000	0.0000	0.012	0.067
Undecane	C_{11}	0.0000	0.0000	0.000	0.003
Dodecanes Plus	C_{12+}	0.0000	0.0000	0.000	0.000
Total		**1.0000**	**1.0000**	**281.146**	**1578.499**
Propanes Plus	C_{3+}	0.3932	0.3949	281.146	1578.499
Butanes Plus	C_{4+}	0.1666	0.1674	133.208	747.896
Pentanes Plus	C_{5+}	0.0463	0.0465	42.113	236.441

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	33.99 kg/kmol	33.99 lb/lb-mol	Ppc	643.6 psia	4.44 MPa
Specific Gravity	1.1736 (Air = 1)	1.1736 (Air = 1)	Tpc	542.9 R	301.6 K
MW of C7+	98.80 kg/kmol	98.80 lb/lbmol	Ppc*	642.6 psia	4.43 MPa
Density of C7+	0.7276 g/cc	727.6 kg/m3	Tpc*	541.9 R	301.1 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,959.4 Btu/scf	73.14 MJ/m3	Dry	1,795.5 Btu/scf	67.02 MJ/m3
Wet	1,925.3 Btu/scf	71.87 MJ/m3	Wet	1,764.3 Btu/scf	65.85 MJ/m3

* - Corrected for Acid Gas Content

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa) GC ID: A141412

Appendix E

WFT OIL SYSTEM CHARACTERIZATION PROTOCOL

Oil Characterization Protocol