



Classification

Requested by

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Subtitle

Reservoir fluid study on separator and RFT samples
from well 15/9-11

Co-workers

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Title

RESERVOIR FLUID STUDY
FOR
STATOIL, WELL 15/9-11

STATOIL
EXPLORATION & PRODUCTION
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SUMMARY

This report presents PVT and compositional data on samples collected from 15/9-11.

Compositional analysis were performed on 5 sets of samples, two from DST No. 1, one from DST NO. 2, one from DST No. 3, and one from RFT chamber collected at 2812 m.

Constant mass and constant volume experiments were performed on one set of samples from DST No. 1.

This report also include a preparative distillation of the liquid from DST No. 1.

A qualitative comparison on the basis of GC. runs of liquids from DST No. 2 and No. 3, 15/9-11, and the liquid from 15/9-9 is also included.

Representative data of the fluid system are set up on the next page.

Summary of representative data from analysis

Reservoir fluid composition (mole %)		<u>Molecular weight</u>	<u>Density g/cm³</u>
Carbondioxide	2.86		
Nitrogene	1.52		
Methane	71.17		
Ethane	9.01		
Propane	6.47		
iso-Butane	0.98		
n-Butane	1.97		
iso-Pentane	0.65		
n-Pentane	0.74		
Hexanes	0.81	85*	0.669
Heptanes	0.98	90*	0.733
Octanes	0.93	106	0.758
Nonanes	0.52	121	0.778
Decanes+	<u>1.39</u>	202*	0.846*
	100.00		

Dew pt. pressure : 292 Barg (4234 psig)
 Density of reservoir fluid
 at 299.5 Barg and 103.5°C : 0.271 g/cm³
 Molecularweight of reservoir fluid : 27.4 g/g mol
 Gas formation volume factor
 at 299.5 Barg and 103.5°C : 233.5 SM³/M³ (1311 SCF/BBL)
 Maximum Liquid dropout : 7.6 % of DP. Vol.

Densities and molecular weights are measured values from TBP distillation.

* Calculated values (Measured values from distillation
 M10+ 200, Density 10+ 0.825)

1 INTRODUCTION

Statoil Prolab were requested by the 15/9 license to perform PVT analysis on different samples from Well 15/9-11.

Two separator sets from DST No. 1, one set from DST No. 2, two sets from DST No. 3, and one RFT sample from 2812 m.

The request was to perform a complete PVT study at 103.5°C on one set from DST No. 1, and compositional analysis on the other samples.

Due to bad sampling on the rig, only one of the 3 sets taken during DST No. 3 could be used for further analysis.

2 SAMPLE DESCRIPTION

2.1 Samples from DST No. 1.

Two sets of separator samples collected during the gas test in Perforated interval 2797 - 2807 m.

The bottles from PVT set No. 2 were marked:

Oil: 8088 - 86

Gas: A 7636 / A 4286

Validity check of the samples are summarized in table no. 1.

The bottles from PVT set No. 3 were marked:

Oil: 8088 - 51

Gas: A 7148 / A 11342

Validity check of the samples are in table no. 8.

2.2 Samples from DST No. 2

Only one set of samples was taken during DST No. 2. The set of samples was collected during the gas test in perforated interval 2432 - 2449 m.

The bottles were marked:

Oil: 9209 - 100

Gas: A 4987 / A 10915

Validity check of the samples are in table no. 14.

2.3 Samples from DST No. 3

One set of separator samples collected during DST No. 3 from perforated interval 2395 - 2415 m.

The bottles from PVT set No. 1 were marked:

Oil: 9214 - 368

Gas: A 12060 / A 12056

Validity check of the samples in table no. 17.

2.4 RFT sample from 2812 m

A 1 gal. RFT chamber (No. 40RFSAD) was collected at 2812 m.

The opening pressure of the RFT chamber was 145 Barg at ambient temperature.

The RFT chamber was pressured up to 400 Barg and kept under that pressure for 72 hours.

Approx. 600 cm³ of the content was then transferred to a high pressure oil bottle (No. 80 - 192/162).

The pressure was then released, and the remaining liquid collected.

The chamber contained approx. 250 cm³ of liquid. No water or filtrate was observed.

3 METHODS AND EQUIPMENT

3.1 Compositional analysis

Component analysis are performed using a Hewlett Packard 5880 gas chromatographic systems. For gas analysis, non hydrocarbons are determined on a poropak R 1/8" x 3 m steel column with TC detector, and hydrocarbons in chromapack Cp tm Sil 5 50 m x 0.22 mm quartz capillary column with FI detector. Oil analysis are performed on a gas chromatograph fitted with chromapack Cp tm Sil 5 25 m x 0.22 mm quartz capillary column and FI detector. Molecular weight is determined by freezing point depression of benzene, density by Paar DMA 602 frequency densiometer.

3.2 PVT analysis

PVT analysis are performed on our Elf designed gas condensate cell produced by ACB, NANNTES. This is a cell of the sloane type and does offer a liquid readability down to 0.1 cm³. Total volume of cell is 3.5 dm³.

Separator gas was charged to this cell, and separator liquid added in order to yield the corrected separator GOR. The GOR's were taken from the sampling sheets, this because the test report was not available at this time.

$$GOR_{\text{corr.}} = GOR_{\text{sep.}} \sqrt{\frac{\gamma_{\text{rig}} \cdot Z_{\text{rig}}}{\gamma_{\text{lab}} \cdot Z_{\text{lab}}}}$$

A constant mass pressure volume relationship and a constant volume depletion were performed.

Single flash of the RFT sample was performed in a RUSKA Flash Separator. The gas was samples in a RUSKA Gasometer.

3.3 Preparative distillation

To confirm GC analysis and also to determine physical properties of C₆ - C₁₀ cuts a preparative distillation is run on a Fisher HMS 500 mini distillation still. The fractions are collected according to the boiling point ranges of the various hydrocarbongroups.

The composition of the gas and the light-end fractions of the crude is determined by capillary gas-chromatography.

Density and molecular weight of each cut and of the crude oil were measured by a density measuring cell, and by freezing point depression respectively.

4 RESULTS

4.1 Results from DST No. 1

4.1.1 Set No. 2

Results of single flash of separator oil are given in table 2. Table 3 contains hydrocarbon analysis of separator products and calculated reservoir fluid composition. Table 4 presents results of a single flash of the recombined reservoir fluid from the condensate cell.

The dew point is determined to 292 Barg and the max. liquid drop out to 7.6 % from the constant mass pressure volume relationship. (see table 5 and fig. 1).

Results from the constant volume depletion are given in table 6 and 7.

Stage No. 1 and 2 contained enough liquid to measure molweight. The other values of molecular weight and density are calculated on the basis of the total composition from the gas chromatografic analysis. The liquid drop out curve from this experiment is presented in fig. 1 (table 7).

The variation in composition with pressure is plotted in fig. 2-15.

4.1.2 Set No. 3

Table 9 contains results from single flash of separator oil. Hydrocarbon analysis of separator products and calculated reservoir fluid composition are given in table no. 10.

4.2 Results from DST No. 2

Table 16 contains results from single flash of separator oil. Hydrocarbon analysis of separator products and calculated reservoir fluid composition are given in table 17.

4.3 Results from DST No. 3

Table 19 contains results from single flash of separator oil. Hydrocarbon analysis of separator products and calculated reservoir fluid composition are given in table 20.

4.4 Results from the RFT sample (2812 m)

The hydrocarbon analysis of the oil and gas from the single flash, and the recombined reservoir fluid are presented in table 11.

4.5 Results from TBP distillation

Table no. 12 contains the weight %, density and molecular weight of the collected liquid fractions. The composition of the gas and the light-end of the crude oil is in table no. 13.

Table 14 gives a comparison of the composition of the crude oil from C_1 to C_{10+} , analysed by GC and TBP distillation respectively.

5 DISCUSSION

5.1 DST No. 1 and RFT from 2812 m

If we compare the composition from the RFT sample with the separator samples, they are equal. This might be a good indication that the results is representative for the reservoir fluid composition. One should also notice the good agreement between the composition obtained from the single flash of the recombined fluid (table 4), and the recombination of the separator fluids (table 3).

The CO₂ content in this formation is higher than what was found in the Heimdal formation of 15/9-9 and 11, but lower than for eg. 15/9-7.

The C₂ and C₃ content is lower than what was found in Heimdal of 15/9-9 and 11, but higher than 15/9-7.

The C₁₀₊ content is higher than in the Heimdal formation of 15/9-9 and 11.

5.2 DST No. 2 and No. 3

The liquid samples from 15/9-11, DST No. 2 and No. 3, and 15/9-9, DST No. 2 and No. 3 have been analysed on a 25 m fused silica WCOT column, with resolution from C₂ to C₄₀.

If we compare these samples they seem to be identical.

The reservoir composition of 15/9-11 DST No. 3 is equal to the composition of 15/9-9.

15/9-11 DST No. 2 however is heavier than DST No. 3.

Looking at separator gas from the Heimdal formation of 15/9-9 with comparable separator conditions, it is likely to believe that this separator gas has a too low C₁ content.

If this assumption is correct, the reservoir fluid composition reported from DST No. 2 is too heavy.

6 CONCLUSION

6.1 DST No. 1 and RFT from 2812 m

The very good agreement in composition obtained from the RFT - sampler and the separator samples gives us the reason to believe that the results given in the report are representative for the reservoir fluid system.

6.2 DST No. 2 and No. 3

Taking into account the results obtained from 15/9-9 and the assumptions mentioned in the discussion it is likely to believe that the composition obtained from DST No. 3 is the best.

Table 1. Validity check of separator samples
(DST No. 1, Flow 2)

	<u>Gas composition (Mole %)</u>	
	<u>Gas Bottle A 7636</u>	<u>Gas Bottle A 4286</u>
CO ₂	3.08	
N ₂	1.64	
C ₁	76.58	Air in sample
C ₂	9.34	
C ₃	6.15	
i-C ₄	0.80	
n-C ₄	1.46	
i-C ₅	0.33	
n-C ₅	0.32	
C ₆	0.18	
C ₇	0.09	
C ₈	<u>0.03</u>	
	100.00	

Separator conditions : 30.7 Barg (445 psig) and 35°C (95°F)

Bubble point pressure of separator oil at ambient temperature : 25.4 Barg (370 psig)

Opening pressure of gas bottle at sep. temp : 30.7 Barg (445 psig)

Calculated gas gravity at sep. cond. from composition : 0.75

Gas gravity reported from rig : 0.73

Calculated Z factor at sep. cond. from composition : 0.908

Z factor reported from rig : 0.913

Table 2. Hydrocarbon analysis of oil and gas from flash of Separator oil (DST No. 1, Flow 2)

Component	Oil		Separator gas	Recombined	Mole	Density
	wt%	mole%	Mole %	separator fluid	weight	
				Mole %	g/g mol	g/cm ³
Carbondioxide	-	-	1.15	0.36		
Nitrogen	-	-	0.15	0.05		
Methane	-	-	28.70	8.87		
Ethane	0.078	0.30	16.01	5.16		
Propane	1.135	3.01	26.35	10.22		
iso-Butane	0.950	1.91	5.64	3.07		
n-Butane	3.087	6.21	11.71	7.91		
iso-Pentane	2.950	4.78	3.30	4.32		
n-Pentane	4.031	6.54	3.29	5.53		
Hexanes	7.871	10.83	1.95	8.08	85*	0.669
Heptanes	12.155	15.74	1.25	11.26	90*	0.733
Octanes	14.590	16.10	0.45	11.27	106	0.758
Nonanes	9.657	9.34	0.05	6.47	121	0.778
Decanes+	<u>43.496</u>	<u>25.24</u>	<u>0.00</u>	<u>17.43</u>	202*	0.846*
	100.000	100.00	100.00	100.00		

Properties of stock tank liquid and single flash results:

Density of oil at 15°C	:	0.758 g/cm ³
Mean molecular weight	:	117 g/g mol
GOR of separator liquid	:	68.5 SM ³ /M ³ (385 SCF/BBL)
Skrinkage of separator liquid	:	1.310 M ³ /M ³
Oil bottle	:	8088-86

Densities and molecular weights are measured values from TBP distillation.

* Calculated values (Measured values from distillation
M10+ 200, Density 10+ 0.825)

Table 3. Hydrocarbon analysis of separator products and calculated reservoir fluid composition (Test sep.). (DST No. 1, Flow 2)

Component	Separator	Separator	Reservoir	Mole	Density
	liquid	gas	fluid	weight	
	Mole %	Mole %	Mole %	g/g mol	g/cm ³
Carbondioxide	0.36	3.08	2.86		
Nitrogen	0.05	1.64	1.52		
Methane	8.87	76.58	71.17		
Ethane	5.16	9.34	9.01		
Propane	10.22	6.15	6.47		
iso-Butane	3.07	0.80	0.98		
n-Butane	7.91	1.46	1.97		
iso-Pentane	4.32	0.33	0.65		
n-Pentane	5.53	0.32	0.74		
Hexanes	8.08	0.18	0.81	85*	0.669
Heptanes	11.26	0.09	0.98	90*	0.733
Octanes	11.27	0.03	0.93	106	0.758
Nonanes	6.47	-	0.52	121	0.778
Decanes+	17.43	-	1.39	202*	0.846*
	100.00	100.00	100.00		

Separator and recombination data:

Primary separator conditions : 30.7 Barg and 35°C
 Calculated separator gas gravity (air=1.0) : 0.75
 GOR at separator conditions : 1952.9 SM³/sep M³
 (10965 SCF/sep BBL)
 Oil bottle : 8088-86
 Gas bottle : A 7636

Reservoir fluid properties:

Molecular weight : 27.4 g/g mol
 Density of reservoir fluid at dew. point. : 0.267 g/cm³
 (292 Barg and 103.5°C)

Densities and molecular weights are measured values from TBP distillation.

* Calculated values (Measured values from distillation
 M10+ 200, Density 10+ 0.825)

Table 4. Hydrocarbon analysis of oil and gas of single flash from Condensate cell

Component	Oil		Gas	Recombined
	wt%	mole%	mole %	reservoir fluid
				Mole %
Carbondioxide	-	-	2.93	2.85
Nitrogen	-	-	1.39	1.36
Methane	-	-	73.49	71.59
Ethane	0.009	0.05	9.21	8.98
Propane	0.061	0.21	6.64	6.48
iso-Butane	0.051	0.14	1.01	0.99
n-Butane	0.183	0.49	2.02	1.98
iso-Pentane	0.283	0.61	0.65	0.65
n-Pentane	0.470	1.01	0.72	0.73
Hexanes	2.032	3.69	0.71	0.79
Heptanes	5.984	10.08	0.71	0.95
Octanes	12.212	17.69	0.42	0.86
Nonanes	11.868	15.20	0.09	0.48
Decanes+	<u>66.847</u>	<u>50.83</u>	<u>0.01</u>	<u>1.31</u>
	100.000	100.00	100.00	100.00

Calculated Decane+ properties

Density at 15°C : 0.831 g/cm³
 Mol. weight : 204 g/g mol

Properties of stock tank liquid and single flash results

Density at 15°C : 0.802 g/cm³
 Mean mol. weight : 155 g/g mol
 GOR : 4673 SM³/M³ (26239 SCF/BBL)

Gas Grav. = 0.8195 (calc.)

Table 5. Constant mass pressure volume relation at 103.5°C

<u>Pressure</u> <u>(Barg)</u>	<u>Rel vol</u> <u>(vol/vol at DP)</u>	<u>Liquid</u> <u>(% of D.P.vol)</u>	<u>Z-factor</u>
399.7	0.850		1.116
369.5	0.882		1.071
330.4	0.935		1.015
299.5	0.985		0.971
292.0 (Dew point)	1.000	0	0.961
290.1	1.004	< 0.02	
275.8	1.034	0.38	
250.8	1.103	1.63	
221.8	1.213	3.41	
190.4	1.385	5.33	
162.1	1.615	6.59	
131.0	2.002	7.32	
106.4	2.491	7.54	
83.3	3.226	7.37	
61.5	4.450	6.87	

Gas formation volume factor at
299.5 Barg and 103.5°C : 233.5 SM³/M³

Gas formation volume factor at
292 Barg and 103.5°C : 230.0 SM³/M³

Table 6. Constant volume depletion exp. at 103.5°C
Hydrocarbon analysis of produced wellstream

<u>Component</u>	<u>Reservoir pressure (BARG)</u>						
	292	251	211	169	129	96	64
Carbondioxide	2.86	2.85	2.88	2.91	2.91	2.97	2.97
Nitrogen	1.52	1.34	1.60	1.46	1.47	1.55	1.47
Methane	71.17	72.33	72.53	73.05	73.69	74.24	73.41
Ethane	9.01	9.10	9.09	9.20	9.27	9.16	9.38
Propane	6.47	6.54	6.49	6.53	6.53	6.40	6.76
iso-Butane	0.98	1.00	0.99	0.99	0.97	0.94	1.02
n-Butane	1.97	1.98	1.94	1.93	1.90	1.84	1.99
iso-Pentane	0.65	0.64	0.62	0.61	0.59	0.56	0.60
n-Pentane	0.74	0.73	0.70	0.69	0.65	0.62	0.65
Hexanes	0.81	0.75	0.72	0.71	0.63	0.59	0.61
Heptanes	0.98	0.88	0.78	0.78	0.65	0.59	0.62
Octanes	0.93	0.66	0.67	0.62	0.45	0.40	0.41
Nonanes	0.52	0.28	0.31	0.22	0.14	0.12	0.10
Decanes+	1.39	0.92	0.68	0.30	0.15	0.02	0.01
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Mol wt of C10+	202	174	163	147	142	142	142
Density of C10+	0.846	0.80	0.79	0.78	0.78	0.78	0.78
Real gas deviation factor, Z	0.961	0.891	0.855	0.854	0.810	0.888	0.919
Mole % Produced	0	9.5	10.5	15.1	15.0	12.8	12.1
Cum % of initial	0	9.5	20.0	35.1	50.1	62.9	75.0

Table 7. Liquid dropout during constant volume depletion at 103.5°C

<u>Pressure (Barg)</u>	<u>% liquid drop out (% of D.P vol)</u>
292.0	0
250.7	1.68
211.2	3.96
168.6	5.71
128.5	6.24
95.5	6.05
63.7	5.53
0	3.42

Table 8. Validity check of separator samples (DST No. 1, Flow 3)

	<u>Gas composition (Mole %)</u>	
	<u>Gas Bottle A 7148</u>	<u>Gas Bottle A 11342</u>
CO ₂	3.07	3.07
N ₂	1.61	1.63
C ₁	76.24	76.14
C ₂	9.40	9.43
C ₃	6.22	6.26
i-C ₄	0.82	0.83
n-C ₄	1.50	1.51
i-C ₅	0.35	0.35
n-C ₅	0.35	0.35
C ₆	0.22	0.22
C ₇	0.15	0.15
C ₈	0.06	0.05
C ₉	<u>0.01</u>	<u>0.01</u>
	100.00	100.00

Separator conditions : 30.3 Barg (440 psig), 36°C (96°F)

Bubble point pressure of separator oil at ambient temperature : 25.4 Barg (370 psig)

Opening pressure of gas bottles at sep. temp. : 30.3 Barg

Calculated gas gravity at sep. cond. from composition : 0.75

Gas gravity reported from rig : 0.73

Calculated Z factor at sep. cond. from composition : 0.907

Z factor reported from rig. : 0.914

Bottle No. A 7148 was used for analysis

Table 9. Hydrocarbon analysis of oil and gas from flash of Separator oil (DST No. 1, Flow 3)

Component	Oil		Separator gas	Recombined	Mole	Density
	wt%	mole%	Mole %	separator fluid	weight	
				Mole %	g/g mol	g/cm ³
Carbondioxide	-	-	1.47	0.46		
Nitrogen	-	-	0.13	0.04		
Methane	-	-	30.69	9.50		
Ethane	0.062	0.24	16.92	5.41		
Propane	1.101	2.92	26.42	10.20		
iso-Butane	0.950	1.91	5.48	3.02		
n-Butane	3.081	6.20	11.00	7.69		
iso-Pentane	2.921	4.74	2.81	4.14		
n-Pentane	4.008	6.50	2.68	5.32		
Hexanes	7.823	10.76	1.39	7.86	85*	0.669
Heptanes	12.034	15.58	0.79	11.00	90*	0.733
Octanes	14.463	15.96	0.21	11.09	106	0.758
Nonanes	9.587	9.27	0.01	6.40	121	0.778
Decanes+	<u>43.970</u>	<u>25.92</u>	<u>0.00</u>	<u>17.87</u>	199*	0.846*
	100.000	100.00	100.00	100.00		

Properties of stock tank liquid and single flash results:

Density of oil at 15°C	:	0.758 g/cm ³
Mean molecular weight	:	117
GOR of separator liquid	:	68.7 SM ³ /M ³ (386 SCF/BBL)
Skrinkage of separator liquid	:	1.320
Oil bottle	:	8088-51

Densities and molecular weights are measured values from TBP distillation.

* Calculated values (Measured values from distillation
M10+ 200, Density 10+ 0.825)

Table 10. Hydrocarbon analysis of separator products and
calculated reservoir fluid composition (Test sep.)
(DST No. 1, Flow 3)

Component	Separator	Separator	Reservoir	Mole	Density
	liquid	gas	fluid	weight	
	Mole %	Mole %	Mole %	g/g mol	g/cm ³
Carbondioxide	0.46	3.07	2.87		
Nitrogen	0.04	1.61	1.48		
Methane	9.50	76.24	70.97		
Ethane	5.41	9.40	9.09		
Propane	10.20	6.22	6.54		
iso-Butane	3.02	0.82	1.00		
n-Butane	7.69	1.50	1.98		
iso-Pentane	4.14	0.35	0.65		
n-Pentane	5.32	0.35	0.74		
Hexanes	7.86	0.22	0.82	85*	0.669
Heptanes	11.00	0.15	1.01	90*	0.733
Octanes	11.09	0.06	0.93	106	0.758
Nonanes	6.40	0.01	0.51	121	0.778
Decanes+	<u>17.87</u>	<u>-</u>	<u>1.41</u>	199*	0.846*
	100.00	100.00	100.00		

Separator and recombination data:

Primary separator conditions	: 30.3 Barg, 36 ^o C
Calculated separator gas gravity (air=1.0)	: 0.75
GOR at separator conditions	: 1961.6 SM ³ /sep M ³ (11014 SCF/sep BBL)
Oil bottle	: 8088-51
Gas bottle	: A 7148

Densities and molecular weights are measured values from TBP distillation.

* Calculated values (Measured values from distillation
M10+ 200, Density 10+ 0.825)

Table 11. Hydrocarbon analysis of oil and gas from single flash of RFT chamber (2812 m)

Component	Oil		Gas	Recombined
	wt%	mole%	mole %	reservoir fluid
				Mole %
Carbondioxide	-	-	2.61	2.53
Nitrogen	-	-	1.61	1.56
Methane	-	-	73.64	71.20
Ethane	0.017	0.08	9.31	9.00
Propane	0.172	0.56	6.57	6.37
iso-Butane	0.134	0.33	1.03	1.01
n-Butane	0.467	1.16	2.13	2.10
iso-Pentane	0.606	1.21	0.69	0.70
n-Pentane	0.968	1.93	0.76	0.80
Hexanes	3.353	5.65	0.70	0.86
Heptanes	8.376	13.14	0.62	1.03
Octanes	14.412	19.40	0.29	0.92
Nonanes	11.702	13.93	0.04	0.50
Decanes+	<u>59.793</u>	<u>42.61</u>	<u>-</u>	<u>1.42</u>
	100.000	100.00	100.00	100.00

Calculated Decane+ properties

Density at 15°C : 0.835 g/cm³
 Mol. weight : 202 g/g mol

Properties of stock tank liquid and single flash results

Density at 15°C : 0.793 g/cm³
 Mean mol. weight : 144 g/g mol
 GOR : 3798 SM³/M³ (21326 SCF/BBL)

Table 12

Collected fractions and their densities and molecular weights

Hydrocarbon group	boiling ranges (°C)	% by weight of charge	% by weight distilled	density at 15°C (g/cc)	mol. weight
gas	< 36	10.222	10.222	0.5979 *	63.93 *
C ₆	69	9.534	19.759	0.669	88
C ₇	99	11.771	31.527	0.733	98
C ₈	126	13.272	44.799	0.758	106
C ₉	151	10.438	55.237	0.778	121
C ₁₀₊	>151	44.763		0.8254	200

Crude oil analysis:Density at 15°C : 0.7601 g/cm³

Molecular weight : 117 g/g mol

* Calculated values from G.C. composition

Table 13. Total composition of the gas and the light-end fractions determined by G.C. (Weight % of charge:)

<u>Hydrocarbon group</u>	<u>Weight % of charge</u>
C ₁	0.049
C ₂	0.211
C ₃	0.406
nC ₄	0.310
nC ₅	6.774
SC ₆	0.182
SC ₇	0.006

Table 14. A comparison of the composition of the crude oil from C₁ to C₁₀₊ analysed by capillary gas chromatography and by TBP destillation.

<u>Hydrocarbon group</u>	Amount (% by weight)	
	<u>GC analysis</u>	<u>TBP destillation</u>
C ₁	-	0.049
C ₂	0.118	0.211
C ₃	1.284	0.406
C ₄	4.102	2.595
C ₅	6.861	6.774
C ₆	7.708	9.716
C ₇	11.955	11.777
C ₈	14.380	13.271
C ₉	9.520	10.438
C ₁₀₊	44.071	44.763

Table 15. Validity check of separator samples (DST No. 2)

	<u>Gas composition (Mole %)</u>	
	<u>Gas Bottle A 4987</u>	<u>Gas Bottle A 10915</u>
CO ₂	0.25	
N ₂	1.42	
C ₁	74.72	Air in sample
C ₂	11.35	
C ₃	7.98	
i-C ₄	1.18	
n-C ₄	1.88	
i-C ₅	0.45	
n-C ₅	0.39	
C ₆	0.21	
C ₇	0.12	
C ₈	<u>0.05</u>	
	100.00	

Separator conditions : 9.9 Barg (144 psig) and
18°C (65°F)

Bubble point pressure of
separator oil at ambient : 9.5 Barg (138 psig)
temperature

Opening pressure of gas
bottle at sep. temp. : 10.0 Barg (145 psig)

Calculated gas gravity at
sep. cond. from composition : 0.76

Gas gravity reported from rig : 0.72

Calculated Z factor at
sep. cond. from composition : 0.960

Z factor reported from rig. : 0.964

Table 16. Hydrocarbon analysis of oil and gas from flash of Separator oil (DST No. 2)

Component	Oil		Separator Gas	Recombined	Mole weight	Density
	wt%	mole%	Mole %	separator fluid		
				Mole %	g/g mol	g/cm ³
Carbondioxide	-	-	0.15	0.03		
Nitrogen	-	-	-	0		
Methane	-	-	18.79	3.09		
Ethane	0.082	0.29	15.85	2.85		
Propane	1.427	3.46	30.25	7.87		
iso-Butane	1.330	2.45	7.43	3.27		
n-Butane	3.771	6.94	14.34	8.16		
iso-Pentane	3.812	5.65	4.67	5.49		
n-Pentane	4.612	6.84	4.27	6.42		
Hexanes	9.078	11.41	2.25	9.90	85*	0.662
Heptanes	13.361	15.84	1.29	13.45	90*	0.731
Octanes	17.337	17.50	0.69	14.73	106	0.766
Nonanes	10.230	9.05	0.01	7.56	121	0.789
Decanes+	34.960	20.57	0	17.19	182*	0.892*
	100.000	100.00	100.00	100.00		

Properties of stock tank liquid and single flash results:

Density of oil at 15°C	:	0.757 g/cm ³
Mean molecular weight	:	107 g/g mol
GOR of separator liquid	:	33 SM ³ /M ³ (185 SCF/BBL)
Skrinkage of separator liquid	:	1.181 M ³ /M ³
Oil bottle	:	9209/100

Densities and molecular weights are measured values from TBP distillation (LAB 81.65)

* Calculated values (Measured values from distillation
M10+ 183, Density 10+ 0.825)

Table 17. Hydrocarbon analysis of separator products and
calculated reservoir fluid composition (Test sep.)
(DST No. 2)

Component	Separator liquid Mole %	Separator gas Mole %	Reservoir fluid Mole %	Mole weight g/g mol	Density g/cm ³
Carbondioxide	0.03	0.25	0.23		
Nitrogen	0	1.42	1.32		
Methane	3.09	74.72	69.40		
Ethane	2.85	11.35	10.71		
Propane	7.87	7.98	7.97		
iso-Butane	3.27	1.18	1.34		
n-Butane	8.16	1.88	2.35		
iso-Pentane	5.49	0.45	0.82		
n-Pentane	6.42	0.39	0.84		
Hexanes	9.90	0.21	0.93	85*	0.662
Heptanes	13.45	0.12	1.11	90*	0.731
Octanes	14.73	0.05	1.14	106	0.766
Nonanes	7.56	0	0.56	121	0.789
Decanes+	<u>17.18</u>	<u>0</u>	<u>1.28</u>	182*	0.892*
	100.00	100.00	100.00		

Separator and recombination data:

Primary separator conditions	: 9.9 Barg and 18 ^o C
Calculated separator gas gravity (air=1.0)	: 0.76
GOR at separator conditions	: 2113 SM ³ /sep M ³ (11864 SCF/BBL)
Oil bottle	: 9209/100
Gas bottle	: A 4987

Densities and molecular weights are measured values from TBP distillation.

* Calculated values (Measured values from distillation
M10+ 183, Density 10+ 0.825)

Table 18. Validity check of separator samples (DST No. 3, Flow 1)

	<u>Gas composition (Mole %)</u>	
	<u>Gas Bottle A 12060</u>	<u>Gas Bottle A 12056</u>
CO ₂	0.27	
N ₂	1.48	
C ₁	76.36	Air in sample
C ₂	11.17	
C ₃	7.26	
i-C ₄	1.00	
n-C ₄	1.53	
i-C ₅	0.35	
n-C ₅	0.29	
C ₆	0.16	
C ₇	0.09	
C ₈	<u>0.04</u>	
	100.00	

Separator conditions : 33.5 Barg (485 psig) and
32°C (90°F)

Bubble point pressure of
separator oil at ambient : 27.5 Barg (398 psig)
temperature

Opening pressure of gas
bottle at sep. temp. : 33.5 Barg (485 psig)

Calculated gas gravity at
sep. cond. from composition : 0.74

Gas gravity reported from rig : 0.73

Calculated Z factor at
sep. cond. from composition : 0.891

Z factor reported from rig. : 0.901

Table 19. Hydrocarbon analysis of oil and gas from flash of Separator oil DST No. 3, Flow 1)

Component	Oil		Separator Gas	Recombined	Mole	Density
	wt%	mole%	Mole %	separator fluid	weight	
				Mole %	g/g mol	g/cm ³
Carbondioxide	-	-	0.18	0.08		
Nitrogen	-	-	0.08	0.03		
Methane	-	-	25.37	10.88		
Ethane	0.068	0.24	16.83	7.36		
Propane	1.319	3.23	28.32	13.99		
iso-Butane	1.308	2.43	6.64	4.24		
n-Butane	3.777	7.02	12.08	9.19		
iso-Pentane	3.895	5.83	3.59	4.87		
n-Pentane	4.712	7.05	3.17	5.39		
Hexanes	9.159	11.62	1.93	7.46	85*	0.662
Heptanes	11.910	14.36	1.24	8.73	90*	0.731
Octanes	17.336	17.50	0.52	10.21	106	0.766
Nonanes	10.566	9.43	0.05	5.41	121	0.789
Decanes+	<u>35.950</u>	<u>21.29</u>	-	<u>12.16</u>	182*	0.854*
	100.000	100.00	100.00	100.00		

Properties of stock tank liquid and single flash results:

Density of oil at 15°C	:	0.749 g/cm ³
Mean molecular weight	:	108 g/g mol
GOR of separator liquid	:	123.2 SM ³ /M ³ (692 SCF/BBL)
Srinkage of separator liquid	:	1.485 M ³ /M ³
Oil bottle	:	9214/368

Densities and molecular weights are measured values from TBP distillation (LAB 81.65)

* Calculated values (Measured values from distillation M10+ 183, Density 10+ 0.825)

Table 20. Hydrocarbon analysis of separator products and
calculated reservoir fluid composition (Test sep.)
(DST No. 3, Flow 1)

Component	Separator liquid Mole %	Separator gas Mole %	Reservoir fluid Mole %	Mole weight g/g mol	Density g/cm ³
Carbondioxide	0.08	0.27	0.26		
Nitrogen	0.03	1.48	1.37		
Methane	10.88	76.36	71.28		
Ethane	7.36	11.17	10.88		
Propane	13.99	7.26	7.78		
iso-Butane	4.24	1.00	1.25		
n-Butane	9.19	1.53	2.12		
iso-Pentane	4.87	0.35	0.70		
n-Pentane	5.39	0.29	0.69		
Hexanes	7.46	0.16	0.72	85*	0.662
Heptanes	8.73	0.09	0.76	90*	0.731
Octanes	10.21	0.04	0.83	106	0.766
Nonanes	5.41	-	0.42	121	0.789
Decanes+	<u>12.16</u>	<u>-</u>	<u>0.94</u>	182*	0.854*
	100.00	100.00	100.00		

Separator and recombination data:

Primary separator conditions	: 33.5 Barg and 32°C
Calculated separator gas gravity (air=1.0)	: 0.74
GOR at separator conditions	: 2305 SM ³ /M ³ (12943 SCF/BBL)
Oil bottle	: 9214/268
Gas bottle	: A 12060

Densities and molecular weights are measured values from TBP distillation.

* Calculated values (Measured values from distillation
M10+ 183, Density 10+ 0.825)

Reservoir fluid study 15/9-11
 DST no.1, recombined sample
 GOR 1529,9 $\text{sm}^3/\text{sep m}^3$

Fig.1 P-V and liquid drop out curves at 103,5°C

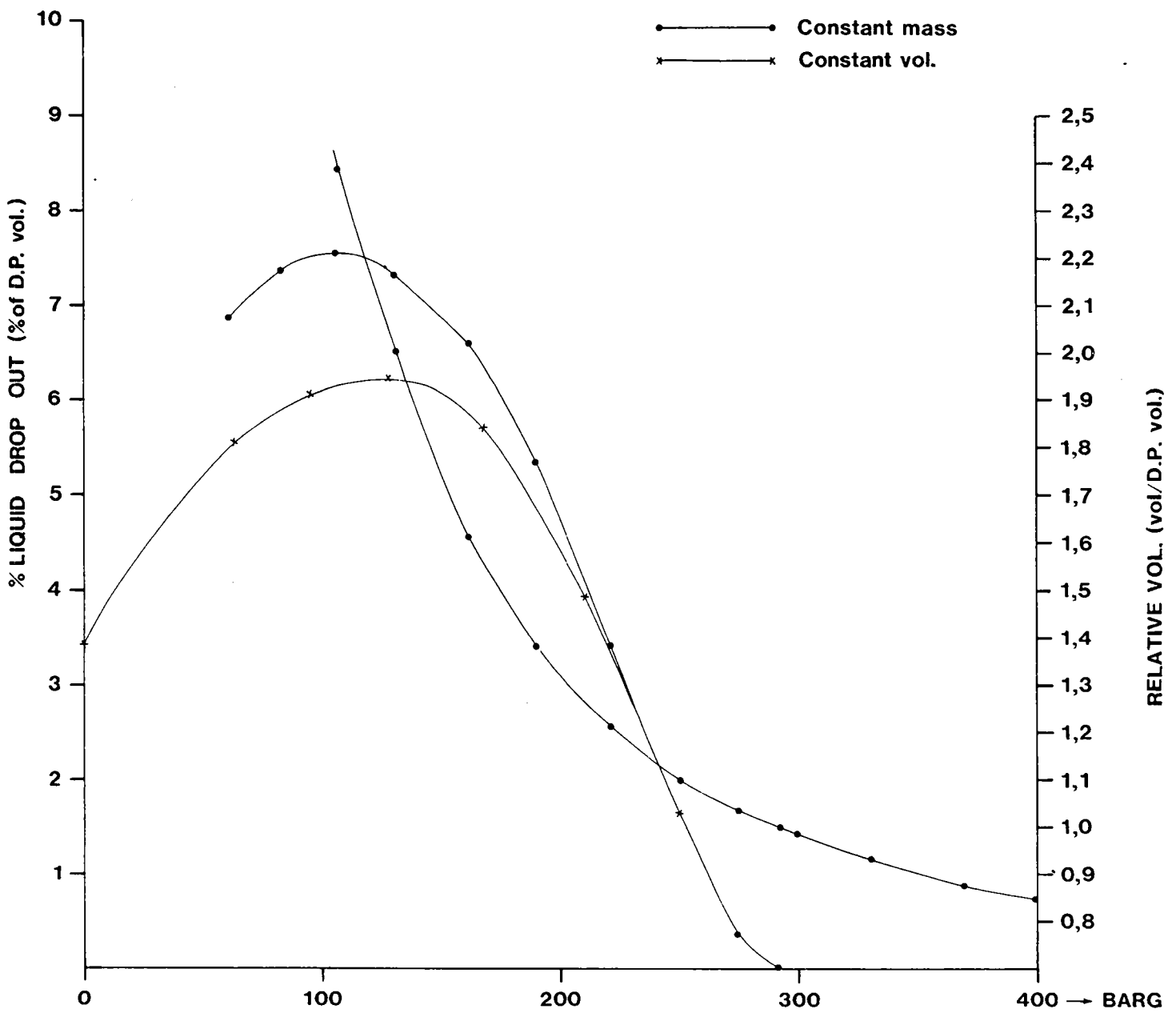


FIG. 2

MOL % AS FUNCTION OF PRESSURE
NITROGEN

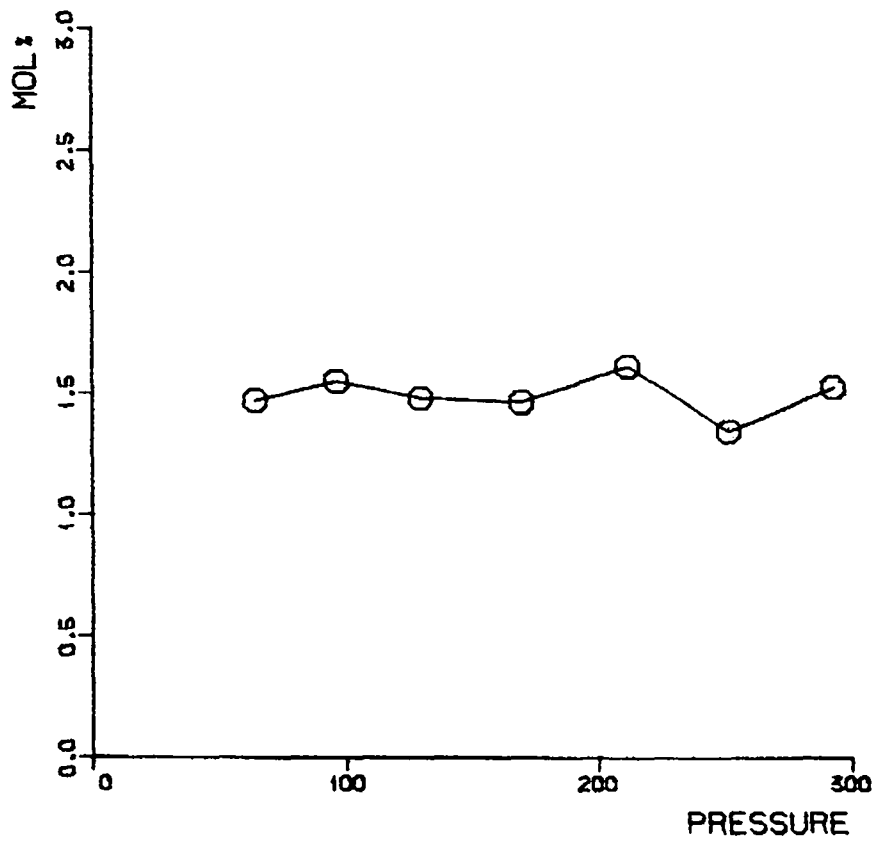


FIG. 3

MOL% AS FUNCTION OF PRESSURE CARBON DIOXIDE

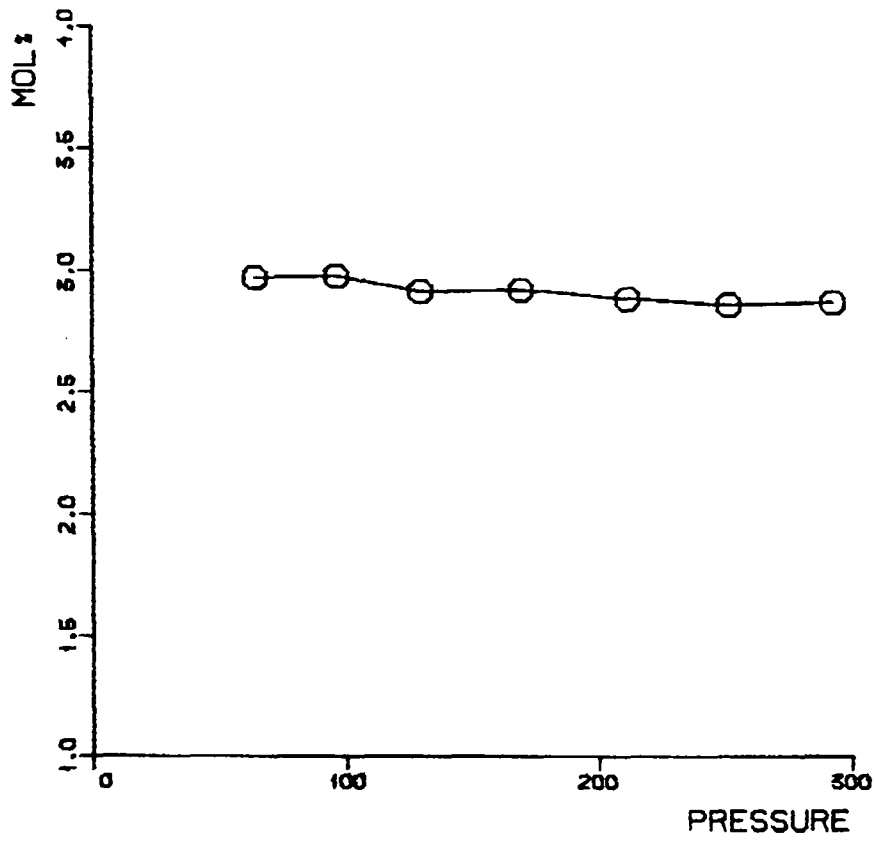


FIG. 4

MOL % AS FUNCTION OF PRESSURE
METHANE

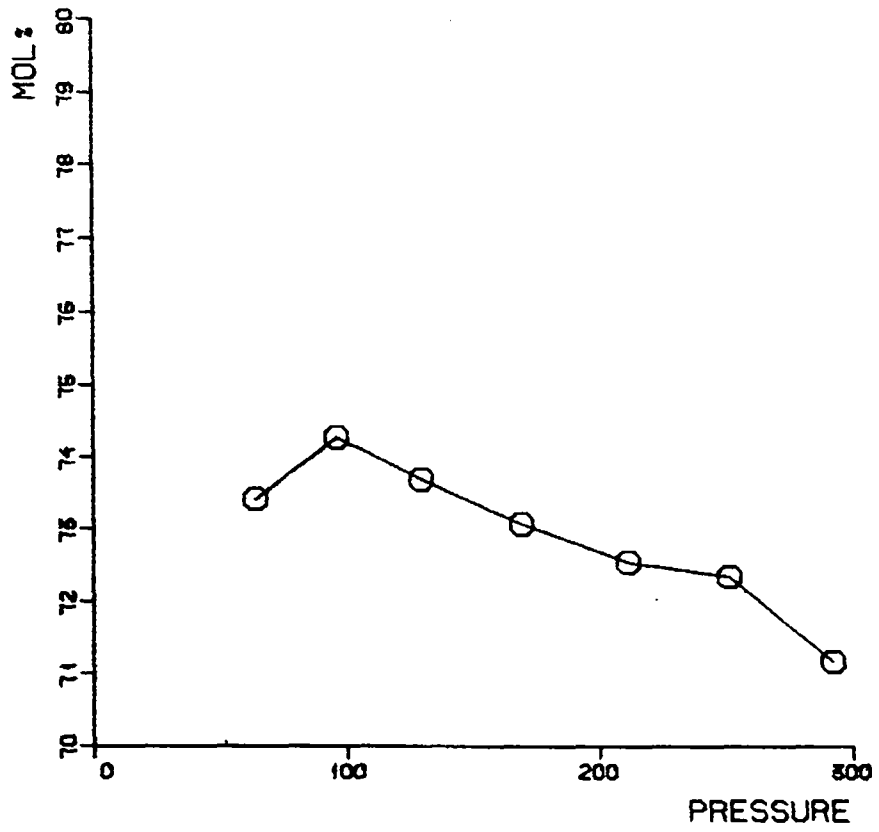


FIG. 5

MOL z AS FUNCTION OF PRESSURE
ETHANE

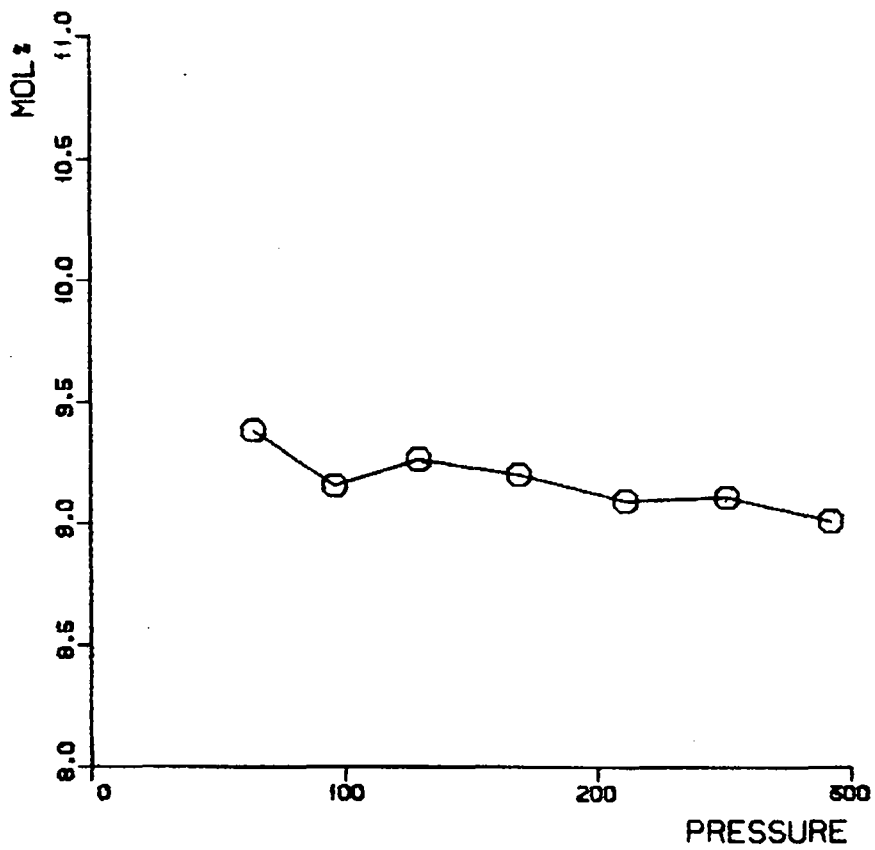


FIG. 6

MOL % AS FUNCTION OF PRESSURE
PROPANE

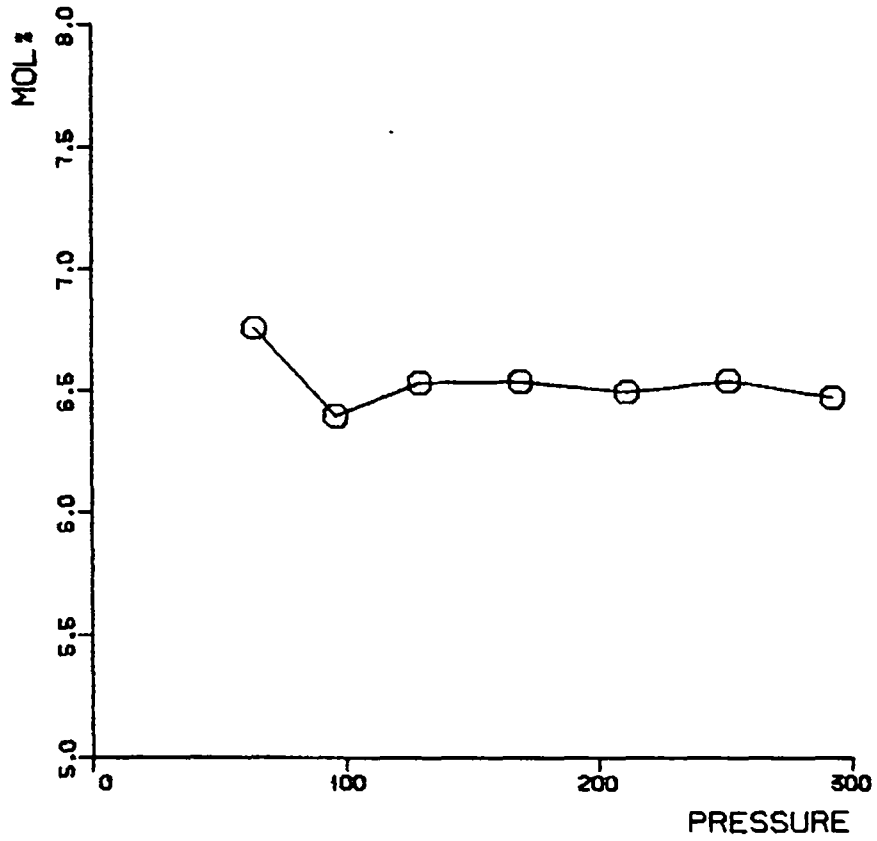


FIG. 7

MOL% AS FUNCTION OF PRESSURE
ISO-BUTAN

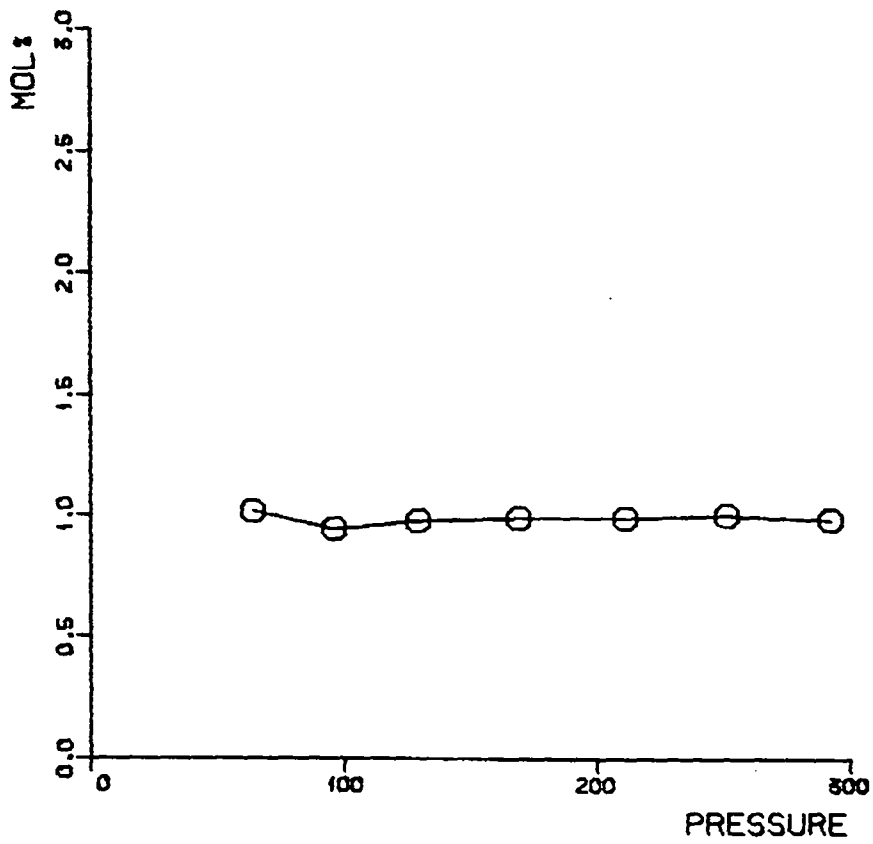


FIG. 8

MOL% AS FUNCTION OF PRESSURE
NORMAL-BUTANE

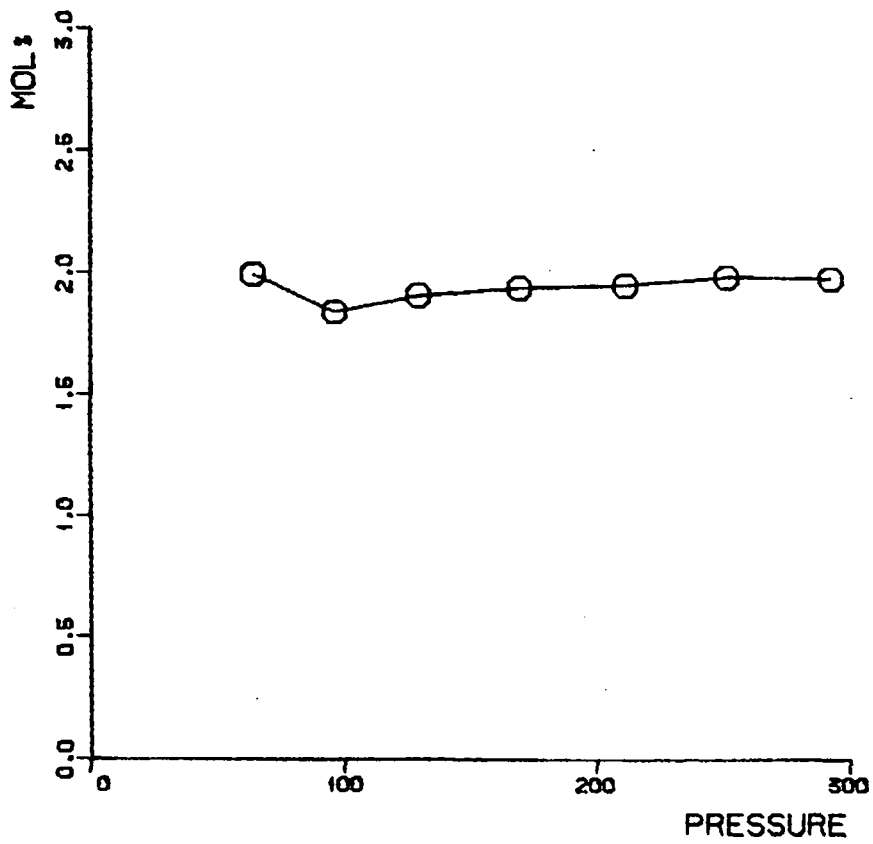


FIG. 9

MOL % AS FUNCTION OF PRESSURE
ISO-PENTANE

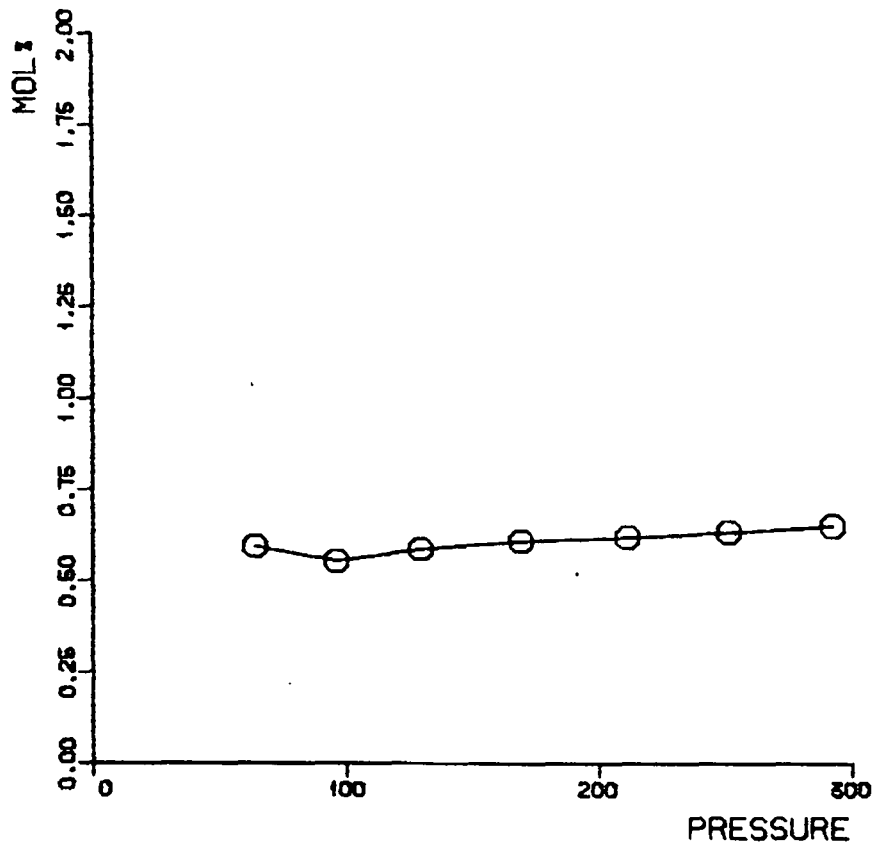


FIG. 10

MOL% AS FUNCTION OF PRESSURE NORMAL-PENTANE

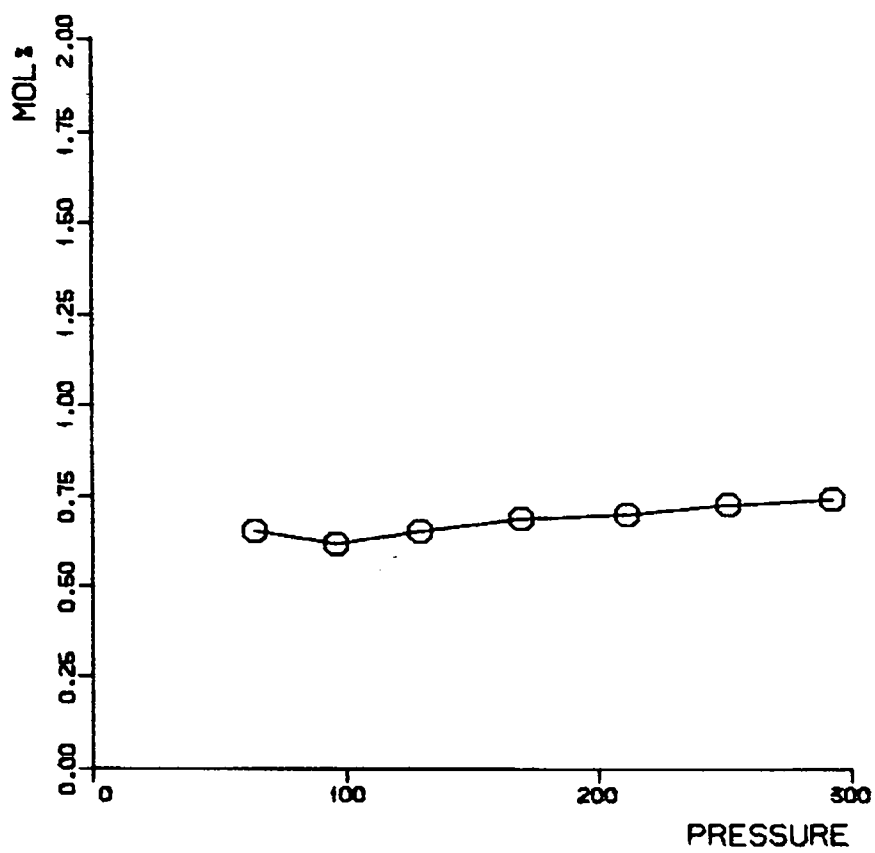


FIG. 11

MOL% AS FUNCTION OF PRESSURE HEXANES

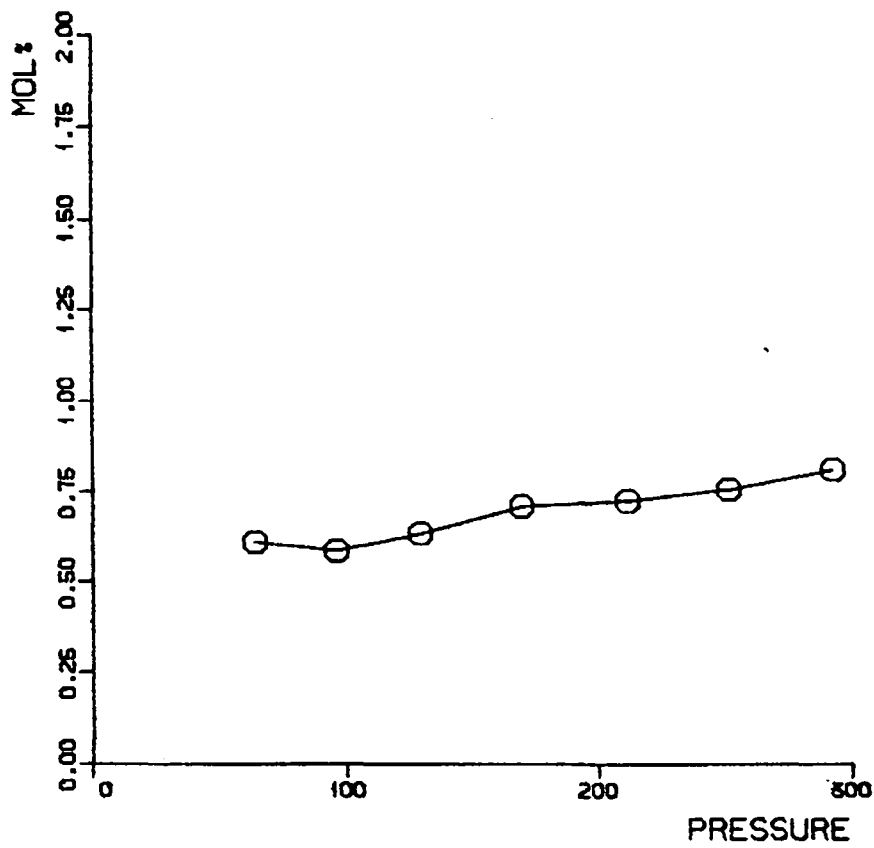


FIG. 12

MOL % AS FUNCTION OF PRESSURE HEPTANES

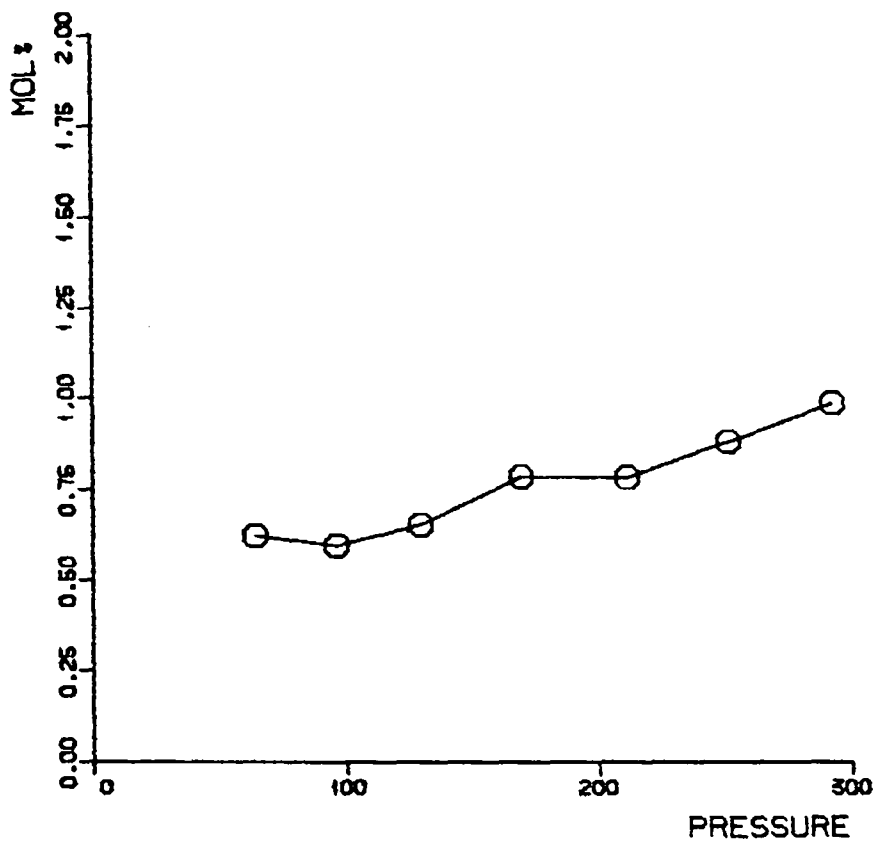


FIG. 13

MOL% AS FUNCTION OF PRESSURE OCTANES

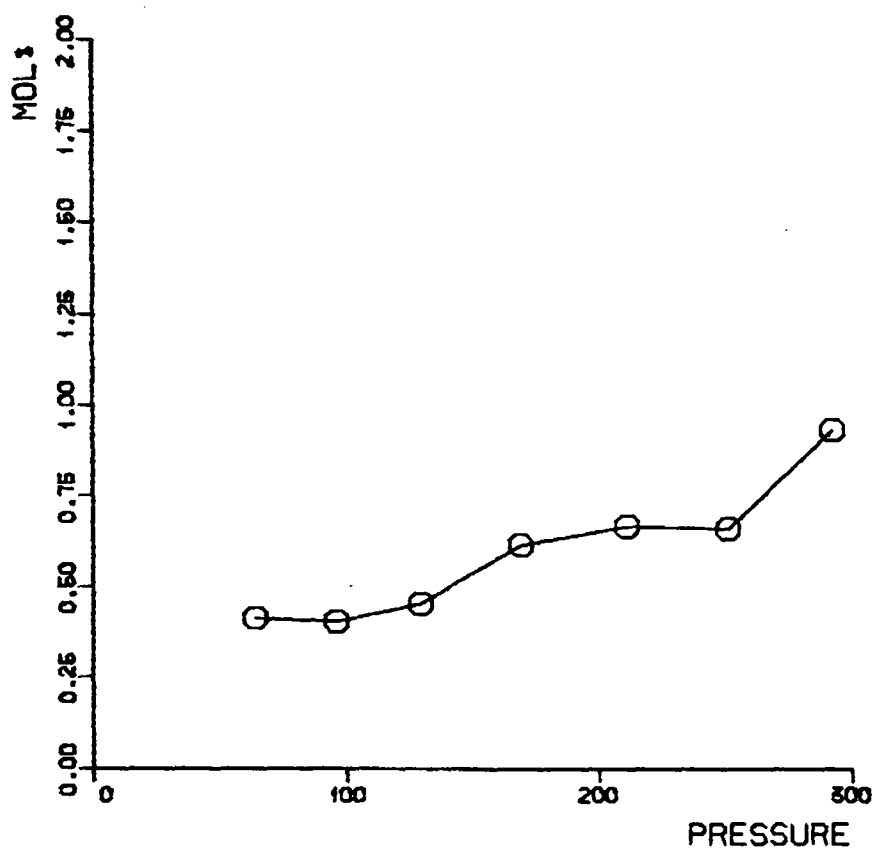


FIG. 14

MOL% AS FUNCTION OF PRESSURE NONANES

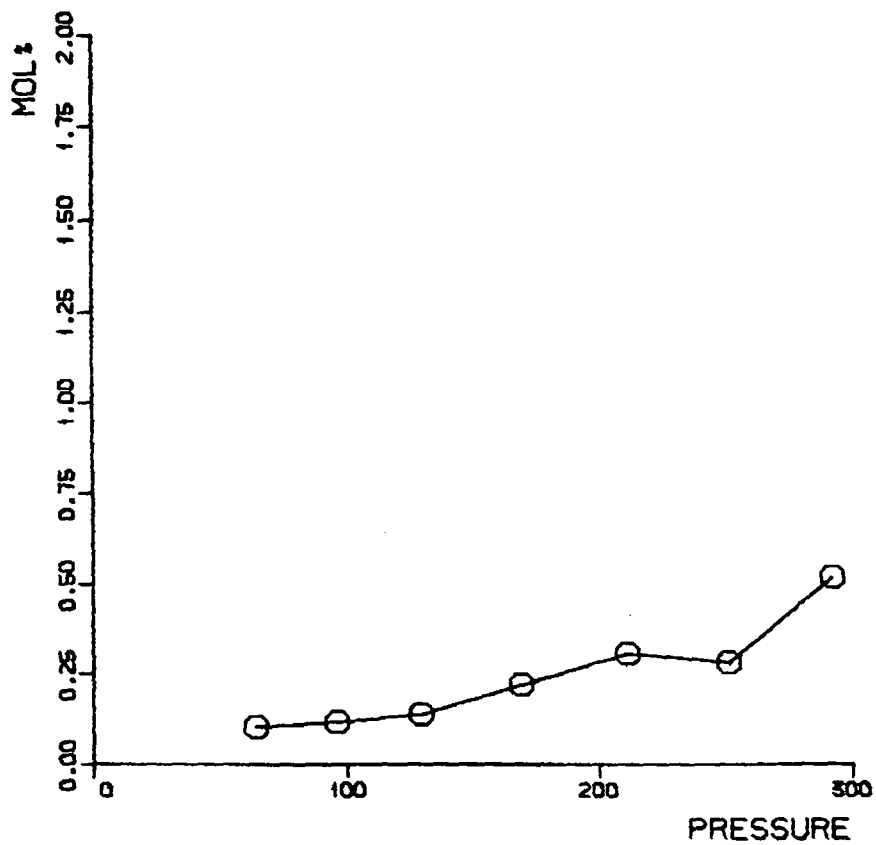
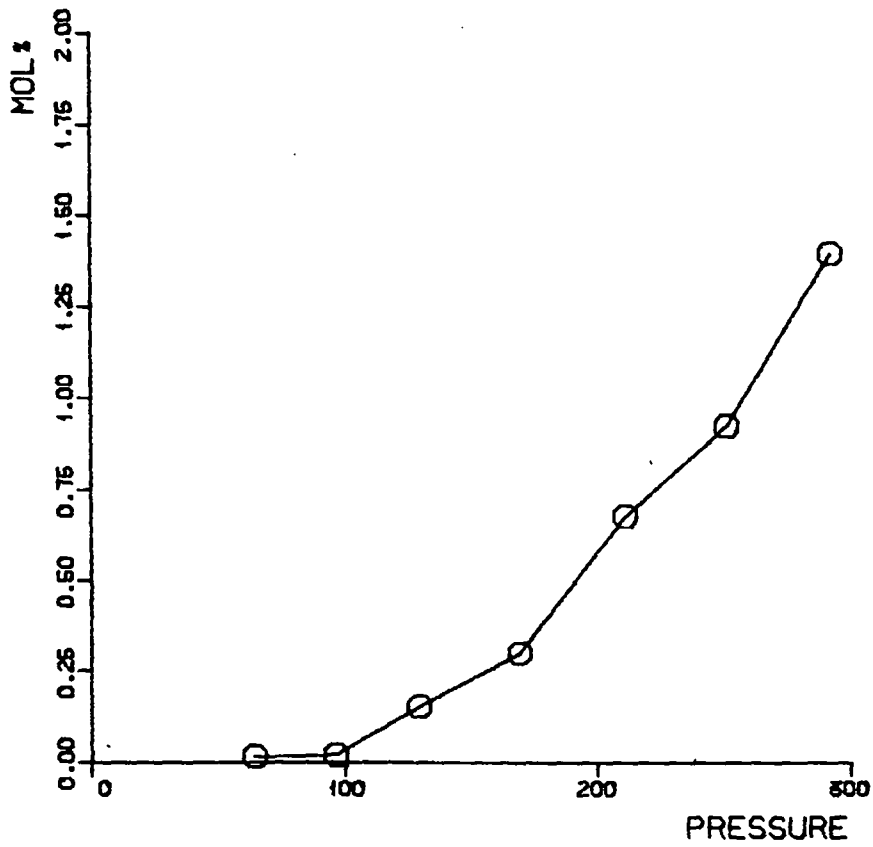


FIG. 15

MOL % AS FUNCTION OF PRESSURE
DECAN-PLUS



A P P E N D I X

FLOPETROL

Client: STATOIL

Section: ANNEX

42Base: STAVANGERField: 15/9 - GAMMA

Page: _____

Well: 15/9-11

Report N°: _____

DST # 1

SURFACE SAMPLING

PVT set # 2Date of sampling: Dec. 1st 19 Service order: _____ Sampling No.: 4Sample nature: Condensate Sampling point: Sep. oil outlet**A - RESERVOIR AND WELL CHARACTERISTICS-**Producing zone: Jura. Perforations: 2797m - 2807m Sampling interval: _____Depth origin: PKB Tubing Dia.: 5" VAM Casing Dia.: 7" LinerSurface elevation: 111m Shoe: 2792m Shoe: 2950m

Bottom hole static conditions	Initial pressure	: <u>4332 PSIA</u>	at depth: <u>2787.24m</u>	date: <u>2/12-81</u>
	Latest pressure measured	: <u>4332 PSIA</u>	at depth: <u>2787.24m</u>	date: <u>2/12-81</u>
	Temperature	: <u>105°C</u>	at depth: <u>2787.24m</u>	date: <u>2/12-81</u>

B - MEASUREMENT AND SAMPLING CONDITIONSTime at which sample was taken: 21.10 Time elapsed since stabilisation: _____

Bottom hole dynamic conditions	Choke size: <u>42/64"</u>	since: <u>11.26</u>	Well head pressure: <u>2472^{PSIA}</u>	Well head temp.: <u>118°F</u>
	Bottom hole pressure:	<u>4102 PSIA</u>	at depth: <u>2783.7m</u>	date: <u>1/12-81</u>
	Bottom hole temp.:	<u>103.5</u>	at depth: <u>2783.7m</u>	date: <u>1/12-81</u>

Flow measurement of sampled gas - Gravity (air: 1): 0.73 Factor Fpv = $\frac{1}{VZ}$: 1.0468Values used for calculations: see Otis report.

Separator	Pressure: <u>4</u> PSIG	Rates - Gas: <u>19.431</u> MMSCFD	GOR: <u>11087.6</u> (separator cond.)
	Temp.: <u>96</u> °F	Oil (separator cond.): <u>1797.6</u> BOPD	

Stock tank	Atmosphere: <u>14.73 PSI</u> mmHg.	<u>60</u> °F	Oil at 60°F: <u>1564.82</u> BOPD
	Tank temperature: _____ °F		Oil grav. <u>57</u> API

BSW: _____ % WLR: _____ %

Transferring fluid: Mercury Transfer duration: 20 minFinal conditions of the shipping bottle: 19 cc Hg
Pressure: 280 PSIG Temp.: 46°F Amb.**C - IDENTIFICATION OF THE SAMPLE**Shipping bottle No.: 8088 96 sent on: _____ by: _____ Shipping order No.: _____
Addressee: _____

Coupled with	LIQUID	GAS
Bottom hole samples No.		
Surface samples No.		<u>A-7636</u> <u>A-4286</u>

Measurement conditions.

 Tank - Meter - Dump - Corrected with shrinkage tester - Corrected with tank -**D - REMARKS -**This is a 620 cc bottle.

Visa Chief Operator

Knut Nerdal.

FLOPETROL

Client : STATOIL

Section : ANNEX

42Base : STAVANGERField : 15/9-GAMMA

Page : _____

Well : 15/9-11

Report N° : _____

DST # 1

SURFACE SAMPLING

PVT set # 2.

Date of sampling : Dec. 1st 1981 Service order : _____ Sampling No. : 6Sample nature : Gas Sampling point : Sep. gas outlet**A - RESERVOIR AND WELL CHARACTERISTICS-**Producing zone : Jura Perforations : 2797 m - 2807 m Sampling interval : _____Depth origin : RKB Tubing Dia. : 5" VAM Casing Dia. : 7" LinerSurface elevation : M m Shoe : 2792 m Shoe : 2950 m

Bottom hole static conditions

Initial pressure : 4338 PSIA at depth : 2783.24 m date : 2/12-81
Latest pressure measured : 4332 PSIA at depth : 2783.24 m date : 2/12-81
Temperature : 105°C at depth : 2783.24 m date : 2/12-81

B - MEASUREMENT AND SAMPLING CONDITIONSTime at which sample was taken : 21.40 Time elapsed since stabilisation : _____

Bottom hole dynamic conditions

Choke size : 42/64" since : 11.26 Well head pressure : 2472 PSIA Well head temp. : 118°F
Bottom hole pressure : 4109 PSIA at depth : 2783.7 m date : 11 Dec 81
Bottom hole temp. : 103.6°C at depth : 2783.7 m date : 1/12-81

Flow measurement of sampled gas - Gravity (air: 1) : 0.73 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0468Values used for calculations : see Otis report

Separator

Pressure : 445 PSIG Rates - Gas : 20.061 M4 SCFD GOR : 11189.8
Temp. : 95 °F Oil (separator cond.) : 1792.8 BOPD (separator cond.)

Stock tank

Atmosphere : 14.73 PSI mmHg 60 °F Oil at 60°F : 1560.64 BOPD
Tank temperature : _____ °F Oil grav. 57 API

BSW : _____ % WLR : _____ %d

Transferring fluid : Evacuated container Transfer duration : 20 min

Final conditions of the shipping bottle :

Pressure : 445 PSIG Temp. : 46°F Amb.

C - IDENTIFICATION OF THE SAMPLEShipping bottle No. : A-4286 sent on : _____ by : _____ Shipping order No. : _____

Addressee : _____

Coupled with	LIQUID	GAS
Bottom hole samples No.		
Surface samples No.	<u>8088 86</u>	<u>A-7636</u>

Measurement conditions. Tank - Corrected with shrinkage tester Meter - Corrected with tank Dump -**D - REMARKS -**

Visa Chief Operator

Arnut Nerdal.

FLOPETROL

Client : STATION

Section : ANNEX

42Base : STAVANGERField : IS/9 - GAMMA

Page : _____

Well : IS/9 - 11

Report N°: _____

DST # 1.

SURFACE SAMPLING

PVT set # 2.

Date of sampling : Dec. 1st 1981 Service order : _____ Sampling No. : 5
 Sample nature : Gas Sampling point : Sep. gas outlet

A - RESERVOIR AND WELL CHARACTERISTICS -Producing zone : Jura Perforations : 2797m - 2807m Sampling interval : _____Depth origin : RKB Tubing Dia. : 5" VAM Casing Dia. : 7" LinerSurface elevation : 111m Shoe : 2792m Shoe : 2950m

Bottom hole static conditions	Initial pressure	: <u>4338 PSIA</u>	at depth : <u>2787.24m</u>	date : <u>2/12-81</u>
	Latest pressure measured	: <u>4332 PSIA</u>	at depth : <u>2787.24m</u>	date : <u>2/12-81</u>
	Temperature	: <u>105 °C</u>	at depth : <u>2787.24m</u>	date : <u>2/12-81</u>

B - MEASUREMENT AND SAMPLING CONDITIONSTime at which sample was taken : 21.10 Time elapsed since stabilisation : _____

Bottom hole dynamic conditions	Choke size : <u>42/64"</u>	since : <u>11.26</u>	Well head pressure : <u>2472 PSIA</u>	Well head temp. : <u>118 °F</u>
	Bottom hole pressure	: <u>4102 PSIA</u>	at depth : <u>2783.7m</u>	date : <u>1/10-81</u>
	Bottom hole temp.	: <u>103.5 °C</u>	at depth : <u>2783.7m</u>	date : <u>1/12-81</u>

Flow measurement of sampled gas - Gravity (air: 1) : 0.73 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0468Values used for calculations : see Otis report

Separator	Pressure : <u>445 PSIG</u>	Rates - Gas : <u>19.931 MM SCFD</u>	GOR : <u>11087.6</u> (separator cond.)
	Temp. : <u>95 °F</u>	Oil (separator cond.) : <u>1797.6 BOPD</u>	

Stock tank	Atmosphere : <u>17.73 Psi mmHg.</u>	<u>60 °F</u>	Oil at 60°F : <u>1564.82 BOPD</u>
	Tank temperature : _____ °F		Oil grav. <u>57 API</u>

BSW : _____ % WLR : _____ %

Transferring fluid : Evacuated container Transfer duration : 20 min.

Final conditions of the shipping bottle : _____
 Pressure : 445 PSIG Temp. : 46 °F Amb.

C - IDENTIFICATION OF THE SAMPLE

Shipping bottle No. : A-7636 sent on : _____ by : _____ Shipping order No. : _____
 Addressee : _____

Coupled with

Bottom hole samples No.

Surface samples No.

LIQUID

GAS

8088 86A-4286

Measurement conditions.

 Tank - Meter - Dump - Corrected with shrinkage tester - Corrected with tank -

D - REMARKS -

Visa Chief Operator

Knut Nerdal

FLOPETROL

Client : STATOIL

Section : ANNEX

42Base : STAVANGERField : 15/9-GAMMA

Page : _____

Well : 15/9-11

Report N°: _____

DST #1

SURFACE SAMPLING

PVI set #3

Date of sampling : Dec. 1st 1981 Service order : _____ Sampling No. : 8Sample nature : Gas Sampling point : sep. gas outlet**A - RESERVOIR AND WELL CHARACTERISTICS-**Producing zone : _____ Perforations : 2797m - 2807m Sampling interval : _____Depth origin : RKB Tubing Dia. : 5" Casing Dia. : 7" LinerSurface elevation : 111 m Shoe : 2792 m Shoe : 2950 m

Bottom hole static conditions	Initial pressure : <u>4338 PSIA</u> at depth : <u>2787.24m</u> date : <u>2/12-81</u>
	Latest pressure measured : <u>4332 PSIA</u> at depth : <u>2787.24m</u> date : <u>2/12-81</u>
	Temperature : <u>105°C</u> at depth : <u>2787.24m</u> date : <u>2/12-81</u>

B - MEASUREMENT AND SAMPLING CONDITIONSTime at which sample was taken : 22.10 Time elapsed since stabilisation : _____

Bottom hole dynamic conditions	Choke size : <u>42/64"</u> since : <u>11.26</u> Well head pressure : <u>2473 PSIA</u> Well head temp. : <u>118°F</u>
	Bottom hole pressure : <u>4107 PSIA</u> at depth : <u>2783.7m</u> date : <u>1/12-81</u>
	Bottom hole temp. : <u>103.6°C</u> at depth : <u>2783.7m</u> date : <u>1/12-81</u>

Flow measurement of sampled gas - Gravity (air: 1) : 0.73 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0460Values used for calculations : see Otis report.

Separator	Pressure : <u>440 PSIG</u> Rates - Gas : <u>19.918 MM SCFD</u> GOR : <u>11124.9</u>
	Temp. : <u>96 °F</u> Oil (separator cond.) : <u>1790.4 BOPD</u> (separator cond.)

Stock tank	Atmosphere : <u>14.73 PSI mmHg.</u> <u>60 °F</u> Oil at 60°F : <u>1558.56 BOPD</u>
	Tank temperature : _____ °F <u>Oil grav. 57 API</u>

BSW : _____ % WLR : _____ %

Transferring fluid : Evacuated container Transfer duration : 15 min.Final conditions of the shipping bottle :
Pressure : 440 PSIG Temp. : 46°F Amb.**C - IDENTIFICATION OF THE SAMPLE**Shipping bottle No. : A-11342 sent on : _____ by : _____ Shipping order No. : _____
Addressee : _____

Coupled with

Bottom hole samples No.

Surface samples No.

LIQUID

GAS

8088 S1A-7148

Measurement conditions.

 Tank - Meter - Dump - Corrected with shrinkage tester - Corrected with tank -

D - REMARKS -

Visa Chief Operator

Knut Nordal.

FLOPETROL

Client : STATOIL

Section : ANNEX

42Base : STAVANGERField : 15/9 - GAMMA

Page : _____

Well : 15/9-11

Report N° : _____

DST # 1

SURFACE SAMPLING

PVT set # 3Date of sampling : Dec. 1st 1981

Service order : _____

Sampling No. : 9Sample nature : GasSampling point : Sep. gas outlet**A - RESERVOIR AND WELL CHARACTERISTICS-**Producing zone : Jura Perforations : 2797m - 2807m Sampling interval : _____Depth origin : RKB Tubing Dia. : 5" VAM Casing Dia. : 7" LinerSurface elevation : 111 m Shoe : 2792 m Shoe : 2950 m

tail pipe

Bottom hole static conditions	Initial pressure	: <u>4338 PSIA</u>	at depth : <u>2787.24m</u>	date : <u>2/12-81</u>
	Latest pressure measured	: <u>4332 PSIA</u>	at depth : <u>2787.24m</u>	date : <u>2/12-81</u>
	Temperature	: <u>105°C</u>	at depth : <u>2787.24m</u>	date : <u>2/12-81</u>

B - MEASUREMENT AND SAMPLING CONDITIONSTime at which sample was taken : 22.29 Time elapsed since stabilisation : _____

Bottom hole dynamic conditions	Choke size : <u>42/64"</u>	since : <u>11.26</u>	Well head pressure : <u>2474</u>	Well head temp. : <u>120°F</u>
	Bottom hole pressure :	<u>4107 PSIA</u>	at depth : <u>2783.4m</u>	date : <u>1/12-81</u>
	Bottom hole temp. :	<u>103.6°C</u>	at depth : <u>2783.4m</u>	date : <u>1/12-81</u>

Flow measurement of sampled gas - Gravity (air: 1) : 0.73 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0462Values used for calculations : see Otis report.

Separator	Pressure : <u>445 PSIG</u>	Rates - Gas : <u>20.268 MM SCFD</u>	GOR : <u>11284.1</u> (separator cond.)
	Temp. : <u>97 °F</u>	Oil (separator cond.) : <u>1796.16 BOPD</u>	

Stock tank	Atmosphere : <u>14.73 PSI mmHg.</u>	<u>60 °F</u>	Oil at 60°F : <u>1563.6 BOPD</u>
	Tank temperature : _____	_____ °F	Oil grav. <u>S7 API</u>

BSW : _____ % WLR : _____ %

Transferring fluid : Evacuated container Transfer duration : 16 min

Final conditions of the shipping bottle :	Pressure : <u>445 PSIG</u>	Temp. : <u>46°F</u>	Amb. : _____
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C - IDENTIFICATION OF THE SAMPLEShipping bottle No. : A-7148 sent on : _____ by : _____ Shipping order No. : _____
Addressee : _____

Coupled with	LIQUID	GAS
Bottom hole samples No.	_____	_____
Surface samples No.	<u>8088 S1</u>	<u>A-11342</u>

Measurement conditions.

 Tank - Meter - Dump - Corrected with shrinkage tester - Corrected with tank -

D - REMARKS -

Visa Chief Operator

Knut Nerdal.

FLOPETROL

Client: STATOIL

Section: ANNEX

42Base: STAVANGERField: 15/9-GAMMA

Page: _____

Well: 15/9-11

Report N°: _____

DST # 1.

SURFACE SAMPLING

PVI set # 3.

Date of sampling: Dec. 15th 1981 Service order: _____ Sampling No.: 7Sample nature: Condensate Sampling point: Sep. gas outletA - RESERVOIR AND WELL CHARACTERISTICS--Producing zone: Jura Perforations: 2797m - 2807m Sampling interval: _____Depth origin: RKB Tubing Dia.: 5" VAM Casing Dia.: 7" LinerSurface elevation: 111 m Shoe: 2792 m Shoe: 2950 m

Tail pipe

Bottom hole static conditions	Initial pressure	: <u>4338 PSIA</u>	at depth: <u>2787.24m</u>	date: <u>2/12-81</u>
	Latest pressure measured	: <u>4332 PSIA</u>	at depth: <u>2787.24m</u>	date: <u>2/12-81</u>
	Temperature	: <u>105°C</u>	at depth: <u>2787.24m</u>	date: <u>2/12-81</u>

B - MEASUREMENT AND SAMPLING CONDITIONSTime at which sample was taken: 22.10 Time elapsed since stabilisation: _____

Bottom hole dynamic conditions	Choke size: <u>42/64"</u>	since: <u>11.26</u>	Well head pressure: <u>2473 PSIA</u>	Well head temp.: <u>118°F</u>
	Bottom hole pressure:	<u>4107 PSIA</u>	at depth: <u>2783.7m</u>	date: <u>1/12-81</u>
	Bottom hole temp.:	<u>103.6°C</u>	at depth: <u>2783.7m</u>	date: <u>1/12-81</u>

Flow measurement of sampled gas - Gravity (air: 1): 0.73 Factor Fpv = $\frac{1}{VZ}$: 1.0460Values used for calculations: see Otis report.

Separator	Pressure: <u>440</u> PSIG	Rates - Gas: <u>19.918</u> MM SCFD	GOR: <u>11124.9</u>
	Temp.: <u>96</u> °F	Oil (separator cond.): <u>1790.4</u> BOPD	(separator cond.)

Stock tank	Atmosphere: <u>14.73</u> PSI mmHg	<u>60</u> °F	Oil at 60°F: <u>1558.56</u> BOPD
	Tank temperature: _____ °F		Oil grav. <u>ST API</u>

BSW: _____ % WLR: _____ %

Transferring fluid: Mercury Transfer duration: 15 min.Final conditions of the shipping bottle: 20 cc Hg
Pressure: 280 PSIG Temp.: 46°F Amb.C - IDENTIFICATION OF THE SAMPLEShipping bottle No.: 8088 51 sent on: _____ by: _____ Shipping order No.: _____
Addressee: _____

Coupled with

Bottom hole samples No.

Surface samples No.

LIQUID

GAS

A-11342

A-7148

Measurement conditions.

 Tank - Corrected with shrinkage tester - Meter - Corrected with tank - Dump -D - REMARKS -

This is a 610 cc bottle.

Visa Chief Operator

Arnet Nivald.

FLOPETROL

Client: STATAIL

Section: ANNEX

42Base: StarangerField: 15/9 - Gamma

Page: _____

Well: 15/9-11

Report N°: _____

DST # 2

SURFACE SAMPLING

Date of sampling: Dec 5th 1981 Service order: _____ Sampling No.: 1
Sample nature: Condensate Sampling point: Sep. oil outlet

A - RESERVOIR AND WELL CHARACTERISTICS-

Producing zone: Paleocene Perforations: 2432m-2440m Sampling interval: _____Depth origin: RKB Tubing Dia.: 5" VAM Casing Dia.: 9 5/8"
Surface elevation: 111m Shoe: 2426.42m Shoe: 2575mBottom hole static conditions
Initial pressure: 3539 PSIA at depth: 2406.36m date: 9/12-81
Latest pressure measured: 3539 PSIA at depth: 2406.36m date: 9/12-81
Temperature: 186 °F at depth: 2406.36m date: 9/12-81

B - MEASUREMENT AND SAMPLING CONDITIONS

Time at which sample was taken: 09-30 Time elapsed since stabilisation: _____Bottom hole dynamic conditions
Choke size: 32/64" since: 03.35 Well head pressure: 2095 PSIA Well head temp.: 86 °F
Bottom hole pressure: 3434 PSIA at depth: 2406.36m date: 9/12-81
Bottom hole temp.: 200.1 °F at depth: 2406.36m date: 9/12-81Flow measurement of sampled gas - Gravity (air: 1): 0.72 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0183Values used for calculations: See OHS reportSeparator Pressure: 147 PSIG Rates - Gas: 2.202 MM SCFD GOR: 12770
Temp.: 65 °F Oil (separator cond.): 691.2 BOPD (separator cond.)Stock tank Atmosphere: 14.73 PSI mmHg. 1.0 °F Oil at 60°F: 643.7 BOPD
Tank temperature: _____ °F Oil grav. 57° API

BSW: _____ % WLR: _____ %

Transferring fluid: Mercury Transfer duration: 25 minFinal conditions of the shipping bottle: 23cc Hg
Pressure: 120 PSIG Temp.: 36 °F Amb

C - IDENTIFICATION OF THE SAMPLE

Shipping bottle No.: 9209/100 sent on: _____ by: _____ Shipping order No.: _____
Addressee: _____

Coupled with	LIQUID	GAS
Bottom hole samples No.		
Surface samples No.		

Measurement conditions.

 Tank - Meter - Dump
 Corrected with shrinkage tester -

D - REMARKS -

Visa Chief Operator

Jan Pyre

FLOPETROL

Client : STATOIL

Section : ANNEX

42Base : StavangerField : 15/9 - Gamma

Page : _____

Well : 15/9-11

Report N° : _____

DST # 2**SURFACE SAMPLING**Date of sampling : Dec 8th 1981 Service order : _____ Sampling No. : 2Sample nature : Gas Sampling point : Sep. gas outlet**A - RESERVOIR AND WELL CHARACTERISTICS-**

Producing zone : _____ Perforations : _____ Sampling interval : _____

Depth origin : RKB Tubing Dia. : 5" VAM Casing Dia. : 9 5/8"Surface elevation : 111m Shoe : _____ Shoe : _____

Bottom hole static conditions	Initial pressure	: <u>3539 PSIA</u>	at depth : <u>2406.36m</u>	date : <u>9/12-81</u>
	Latest pressure measured	: <u>3539 PSIA</u>	at depth : <u>2406.36m</u>	date : <u>9/12-81</u>
	Temperature	: <u>186 °F</u>	at depth : <u>2406.36m</u>	date : <u>9/12-81</u>

B - MEASUREMENT AND SAMPLING CONDITIONSTime at which sample was taken : 0930 Time elapsed since stabilisation : _____

Bottom hole dynamic conditions	Choke size : <u>32/64"</u>	since <u>03.35</u>	Well head pressure : <u>2095 PSIA</u>	Well head temp. : <u>86 °F</u>
	Bottom hole pressure	: <u>3434 PSIA</u>	at depth : <u>2406.36m</u>	date : <u>8/12-81</u>
	Bottom hole temp.	: <u>260.1 °F</u>	at depth : <u>2406.36m</u>	date : <u>8/12-81</u>

Flow measurement of sampled gas - Gravity (air: 1) : 0.72 Factor $F_{pv} = \frac{1}{\sqrt{Z}}$: 1.0183Values used for calculations : See Otis report

Separator	Pressure : <u>144</u> PSIG	Rates - Gas : <u>8.202 MM SCFD</u>	GOR : <u>12770</u> (separator cond.)
	Temp. : <u>65</u> °F	Oil (separator cond.) : <u>691.2</u> BOPD	

Stock tank	Atmosphere : <u>14.73</u> PSI mmHg.	<u>60</u> °F	Oil at 60°F : <u>645.7</u> BOPD
	Tank temperature : _____ °F		Oil grav. <u>57° API</u>

BSW : _____ % WLR : _____ %

Transferring fluid : Evacuated Containers Transfer duration : 2.5 minFinal conditions of the shipping bottle :
Pressure : 144 PSIG Temp. : 36 °F Amb**C - IDENTIFICATION OF THE SAMPLE**Shipping bottle No. : A-10915 sent on : _____ by : _____ Shipping order No. : _____

Addressee : _____

Coupled with	LIQUID	GAS
Bottom hole samples No.	_____	_____
Surface samples No.	<u>9209/100</u>	<u>A-4987</u>

Measurement conditions. Tank - Meter - Dump - Corrected with shrinkage tester - Corrected with tank -**D - REMARKS -**

Visa Chief Operator

Jan Pyre

FLOPETROL

Client: STATOIL

Section: ANNEX

42Base: StavangerField: 13/a - Gamma
Well: 16/a - 11Page: _____
Report N°: _____

SURFACE SAMPLING

Date of sampling: Dec 8th 1981 Service order: _____ Sampling No.: 3
Sample nature: Gas Sampling point: Sep. Gas outlet

A - RESERVOIR AND WELL CHARACTERISTICS-

Producing zone: _____ Perforations: _____ Sampling interval: _____
Depth origin: RKB Tubing Dia.: 5" VAM Casing Dia.: 9 5/8"
Surface elevation: 111m Shoe: _____ Shoe: _____Bottom hole static conditions
Initial pressure: 3539 PSIA at depth: 2406.36m date: 9/12-81
Latest pressure measured: 3539 PSIA at depth: 2406.36m date: 9/12-81
Temperature: 186°F at depth: 2406.36m date: 9/12-81

B - MEASUREMENT AND SAMPLING CONDITIONS

Time at which sample was taken: 10.10 Time elapsed since stabilisation: _____Bottom hole dynamic conditions
Choke size: 3 1/4" since: 03.35 Well head pressure: 2100 BIA Well head temp.: 84°F
Bottom hole pressure: 3435 PSIA at depth: 2406.36m date: 8/12-81
Bottom hole temp.: 200.3°F at depth: 2406.36m date: 8/12-81Flow measurement of sampled gas - Gravity (air: 1): 0.72 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0188Values used for calculations: See Otis reportSeparator Pressure: 146 PSIG Rates - Gas: 8.272 MM SCFD GOR: 12.710
Temp.: 63 °F Oil (separator cond.): 691 BOPD (separator cond.)Stock tank Atmosphere: 14.73 PSI mmHg 60 °F Oil at 60°F: 650.4 BOPD
Tank temperature: _____ °F Oil grav.: 57° API

BSW: _____ % WLR: _____ %

Transferring fluid: Evacuated container Transfer duration: 25 minFinal conditions of the shipping bottle:
Pressure: 146 PSIG Temp.: 36°F Amb

C - IDENTIFICATION OF THE SAMPLE

Shipping bottle No.: A-4987 sent on: _____ by: _____ Shipping order No.: _____
Addressee: _____

Coupled with	LIQUID	GAS
Bottom hole samples No.	_____	_____
Surface samples No.	<u>9209/100</u>	<u>A-10915</u>

Measurement conditions.

 Tank - Meter - Dump -
 Corrected with shrinkage tester - Corrected with tank -

D - REMARKS -

Visa Chief Operator

Jean Dyre

FLOPETROL

Client : STATOIL

Section : ANNEX

42Base : StavangerField : 15/4 - Gamma
Well : 15/4 - 11Page : _____
Report N° : _____

OST #3

SURFACE SAMPLING

PVT set = I

Date of sampling : Dec 14th 1981 Service order : _____ Sampling No. : 1
Sample nature : Condensate Sampling point : sep. oil outlet**A - RESERVOIR AND WELL CHARACTERISTICS-**Producing zone : Paleocene Perforations : 2395-2415 Sampling interval : _____
Depth origin : RKB Tubing Dia. : 5" VAM Casing Dia. : 9 5/8"
Surface elevation : 111 m Shoe : 2391 m Shoe : 2575 mBottom hole static conditions
Initial pressure : 3521 PSIA at depth : 2370.9 m date : Dec 14th 81
Latest pressure measured : 3520 PSIA at depth : 2370.9 m date : Dec 14th 81
Temperature : 186 °F at depth : 2370.9 m date : Dec 14th 81**B - MEASUREMENT AND SAMPLING CONDITIONS**Time at which sample was taken : 03:10 Time elapsed since stabilisation : _____Bottom hole dynamic conditions
Choke size : 43/64" ^{Dec 13th} since : 1558 Well head pressure : 2004 Well head temp. : 110
Bottom hole pressure : 3433 PSIA at depth : 2370.9 m date : Dec 14th 81
Bottom hole temp. : 197 °F at depth : 2370.9 m date : Dec 14th 81Flow measurement of sampled gas - Gravity (air: 1) : .734 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0536
Values used for calculations : See other reportSeparator Pressure : 485 PSIG Rates - Gas : 20684.20 SCFD GOR : 12558
Temp. : 90 °F Oil (separator cond.) : 1598 BOPD (separator cond.)Stock tank Atmosphere : 14.73 PSI mmHg. 60 °F Oil at 60°F : _____ BOPD
Tank temperature : _____ °F
Oil grav .572 API

BSW : _____ % WLR : _____ %

Transferring fluid : Mercury Transfer duration : 30 min.Final conditions of the shipping bottle : 23 CC
Pressure : 285 PSIE Temp. : 35 °F Amb.**C - IDENTIFICATION OF THE SAMPLE**Shipping bottle No. : 9214/368 sent on : _____ by : _____ Shipping order No. : _____
Addressee : _____

Coupled with

Bottom hole samples No.

Surface samples No.

LIQUID

GAS

Measurement conditions.

 Tank - Meter - Dump - Corrected with shrinkage tester -

with tank -

D - REMARKS -

Visa Chief Operator

Jan Pyre

FLOPETROL

Client : Statoil
 Field : 15/9 - GAMMA
 Well : 15/9 - 11

Section : ANNEX **42**
 Page : _____
 Report N° : _____

Base : Stavanger

DST #3

PVT Sett 1.

SURFACE SAMPLING

Date of sampling : Dec 14th 1981 Service order : _____ Sampling No. : 3
 Sample nature : gas Sampling point : sep gas outlet

A - RESERVOIR AND WELL CHARACTERISTICS-

Producing zone : Paleocene Perforations : 2395 - 2415 Sampling interval : _____
 Depth origin : RKB Tubing Dia. : 5" VAM Casing Dia. : 9 5/8"
 Surface elevation : 111 m Shoe : 2391 m Shoe : 2575 m

Bottom hole static conditions	Initial pressure	: <u>3521 PSIA</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th -81</u>
	Latest pressure measured	: <u>3520 PSIA</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th -81</u>
	Temperature	: <u>18.6 °F</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th -81</u>

B - MEASUREMENT AND SAMPLING CONDITIONS

Time at which sample was taken : 03.13 Time elapsed since stabilisation : _____

Bottom hole dynamic conditions	Choke size : <u>48/64"</u> since : <u>15.58</u> ^{Dec 14th}	Well head pressure : <u>2007</u>	Well head temp. : <u>109</u>
	Bottom hole pressure : <u>3433 PSIA</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th -81</u>
	Bottom hole temp. : <u>19.7 °F</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th -81</u>

Flow measurement of sampled gas - Gravity (air: 1) : 0.734 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0530

Values used for calculations : See this report.

Separator	Pressure : <u>485</u> PSIG	Rates - Gas : <u>20684.20</u> SCFD	GOR : <u>12.558</u>
	Temp. : <u>90</u> °F	Oil (separator cond.) : <u>1598</u> BOPD	(separator cond.)

Stock tank	Atmosphere : <u>14.73 PSI</u> mmHg. <u>60</u> °F	Oil at 60°F : _____ BOPD
	Tank temperature : _____ °F	<u>Oil gravity 53.2 API</u>

BSW : _____ % WLR : _____ %

Transferring fluid : Vacuum Transfer duration : 20 min.

Final conditions of the shipping bottle :
 Pressure : 485 PSI Temp. : 3.5 °F - Amb.

C - IDENTIFICATION OF THE SAMPLE

Shipping bottle No. : A-2060 sent on : _____ by : _____ Shipping order No. : _____
 Addressee : _____

Coupled with	LIQUID	GAS
Bottom hole samples No.	_____	_____
Surface samples No.	<u>4214/368</u>	<u>A-12056</u>

Measurement conditions.

Tank - Meter - Dump -
 Corrected with shrinkage tester - Corrected with tank -

D - REMARKS -

Visa Chief Operator

Jean Pyre

FLOPETROL

Client : STATOIL

Section : ANNEX

42Base : StavangerField : 15/9-Gamma

Page : _____

Well : 15/9-11

Report N° : _____

DST #13PVT soft 1.

SURFACE SAMPLING

Date of sampling : Dec 14th 1981 Service order : _____ Sampling No. : 2Sample nature : gas Sampling point : sep gas outlet

A - RESERVOIR AND WELL CHARACTERISTICS-

Producing zone : Paleocene Perforations : 2395-2415 Sampling interval : _____Depth origin : RWB Tubing Dia. : 5" UAM Casing Dia. : 9 5/8"Surface elevation : 111 m Shoe : 2391 m Shoe : 2575 m

Bottom hole static conditions	Initial pressure	: <u>3521 PSIA</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th 81</u>
	Latest pressure measured	: <u>3520 PSIA</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th 81</u>
	Temperature	: <u>186°F</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th 81</u>

B - MEASUREMENT AND SAMPLING CONDITIONS

Time at which sample was taken : 03:40 Time elapsed since stabilisation : _____

Bottom hole dynamic conditions	Choke size : <u>1 3/4"</u> since : <u>15-50</u>	Well head pressure : <u>2004</u>	Well head temp. : <u>110</u>
	Bottom hole pressure : <u>3433 PSIA</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th 81</u>
	Bottom hole temp. : <u>147°F</u>	at depth : <u>2370.9 m</u>	date : <u>Dec 14th 81</u>

Flow measurement of sampled gas - Gravity (air: 1) : 0.734 Factor Fpv = $\frac{1}{VZ}$: 1.0536Values used for calculations : See Otis report

Separator	Pressure : <u>485</u> PSIG	Rates - Gas : <u>20657.2</u> SCFD	GOR : <u>12558</u> (separator cond.)
	Temp. : <u>90</u> °F	Oil (separator cond.) : <u>1598</u> BOPD	

Stock tank	Atmosphere : <u>14.73 Psi</u> mmHg. <u>60°</u> °F	Oil at 60°F : _____ BOPD
	Tank temperature : _____ °F	<u>Oil grav. by 57.2 API</u>

BSW : _____ % WLR : _____ %

Transferring fluid : Vacuum Transfer duration : 20 min.

Final conditions of the shipping bottle :
Pressure : <u>485 Psi</u> Temp. : <u>35°C / 4 mb</u>

C - IDENTIFICATION OF THE SAMPLE

Shipping bottle No. : A-12056 sent on : _____ by : _____ Shipping order No. : _____
Addressee : _____

Coupled with	LIQUID	GAS
Bottom hole samples No.	_____	_____
Surface samples No.	<u>9214 / 368</u>	<u>A-12060</u>

Measurement conditions.

Tank - Meter - Dump -
 Corrected with shrinkage tester - Corrected with tank -

D - REMARKS -

Visa Chief Operator

Jan Dyre