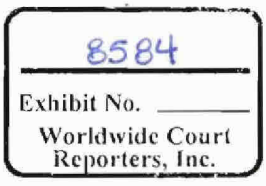
From: LeBlanc, Jason <jleblanc@core.com>
Sent: Tuesday, June 29, 2010 4:53 PM
To: McAughan, Kelly <Kelly.McAughan@bp.com>
Subject: Macondo PVT for 36126-19
Attach: 36129-19-5010068508.xlsx

Kelly,
Attached is the PVT study for PENCOR ID 36126-19 collected from 18,124 Ft. Depth. Hard copies will be generated tomorrow and mailed to you.

I'll also have the reported wellstreams and results from the zero flash tests from the 18,086 ft. samples to you tomorrow, and that will wrap up all the testing that we have ordered up for Macondo.

Jason LeBlanc
Core Laboratories LP
PENCOR Division
5820 Highway 90 East
Broussard, LA 70518
337-839-9060 (office)



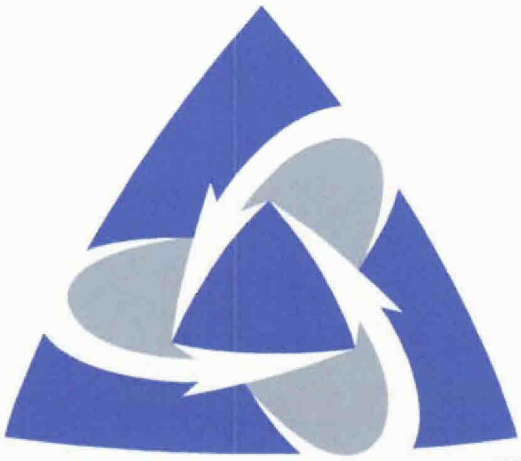
ATTACHMENT INFO

Attachment: 1 of 1 (36129-19-5010068508.xlsx)

Name: 36129-19-5010068508.xlsx

Comments: DOCUMENT PRODUCED AS NATIVE

ATTACHMENT INFO



Core Lab™

RESERVOIR OPTIMIZATION

Volatile Oil Reservoir Fluid Study

for

BP

OCS-G-32306 Well No. 1 ST00 BP01
18,124 Ft. MD Sample
Mississippi Canyon Block 252
'Macondo'
Offshore, Louisiana
Report No: 36126-19-5010068508

Standard Conditions:
15.025 psia at 60 °F

Petroleum Services Division
PENCOR
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June 30, 2010

BP
200 Westlake Park Blvd.
Houston, Texas 77079

Attention: Ms. Kelly McAughan

Subject: Volatile Oil Reservoir Fluid Study
OCS-G-32306 Well No. 1 ST00 BP01
18,124 Ft. MD Sample
Mississippi Canyon Block 252
'Macondo'
Offshore, Louisiana
Report No.: 36126-19-5010068508

Dear Ms. McAughan:

Reservoir fluid samples from the subject were collected on April 12, 2010 and received at our Broussard, Louisiana facility on April 16, 2010 for use in the performance of a reservoir fluid study. Please reference report no. 36126-5010048448 dated April 22, 2010 for a complete list of all samples collected.

One of the bottomhole samples, PENCOR ID No. 36126-19 was utilized to conduct a volatile oil reservoir fluid study. In the laboratory, the sample exhibited a saturation pressure of 6,500 psia at 242 °F and the reservoir fluid exists as an under-saturated fluid at current reservoir conditions (11,850 psia at 242 °F).

PENCOR is very pleased to have been of service to BP in this work. Should any questions arise concerning the data presented in this report, or if PENCOR may be of assistance in any other matter, please do not hesitate to contact us.

Yours sincerely,

Jason LeBlanc
BP Project Manager

Scope of Work

Findings and Recommendations

Findings

Please reference field sample summary report 36126-5010048448 dated April 22, 2010 for a complete listing of all samples collected as well as testing conducted with PENCOR's mobile laboratory.

In the laboratory, sample PENCOR ID No. 36126-19 (transferred from MPSR-4168) exhibited a saturation pressure of 6,500 psia at 242 °F and exists as an under-saturated fluid at current reservoir conditions (11,850 psia at 242 °F). This fluid is exhibiting near critical behavior where we are seeing drastic changes in liquid levels with small changes in pressure when below the saturation point. During the constant composition expansion (CCE) experiments as performed in the PVT cells utilized by PENCOR a dew point was observed and not a bubble point for this system. At pressures higher than saturation pressure the fluid column observed in the PVT cell was a dark colored fluid that we were unable to see through, behavior that is not typical of a gas system. As the pressure was decreased below saturation pressure two different color phases were observed, a small amount of dark fluid at the bottom of the PVT cell, and a slightly lighter colored fluid on top of the dark fluid. As the sample was expanded and pressure decreased the volume of the dark fluid phase increased to approximately 55 volume percent at 6,000 psia and then began decreasing again. The fluid that was observed on top of this darker fluid does get lighter and lighter in color as we decrease pressure. At no point during any of the three CCE experiments (100 °F, 170 °F or 242 °F) were we able to detect the presence of a third phase. Without being able to detect a third phase and classify this system as one that has two liquid layers and one gas phase we are assuming that the top layer of fluid is gas and the bottom layer of fluid is oil.

However in looking at the big picture, including gas-liquid ratio, fluid density, fluid viscosity, API gravity and color, it is logical that this fluid system should exhibit a bubble point, instead of a dew point. After having discussions with various BP representatives we came to the above conclusion and decided to perform a differential liberation test on the reservoir fluid. It should be noted that considerable condensate was produced during the gas displacement stages in the differential liberation experiment. This condensate was added back to the produced gas phase and is presented on page 22.

An oil base-mud contamination evaluation was performed on this sample. The results showed the residual oil was <1.0 percent by weight oil base mud contamination. **This study includes the oil base drilling fluid properties in its results.**

Comparison of results from the various flash liberation tests (separator test, single-stage flash liberation test, and differential test) exhibited the correct trends with respect to gas-liquid ratio, flash gas gravity, and stock tank gravity. This comparison is used as a validation check on the results and is tabulated on page 5 of this report.

A paraffin content of 2.2 wt % (wax appearance temperature of 79 °F) and an asphaltene content of 1.3 wt % were noted in the stock tank oil. Solids interference to the results of the PVT study, though, were not detected. Live fluid viscosity measurements did not exhibit trends indicative of a typical oil sample. The single phase region of the measurements did show some erratic behavior at cooler temperatures and the minimum viscosity value was not observed at saturation pressure. Also a significant difference was observed in viscosity between the single phase and two phase regions of the fluid.

Recommendations

Additional analyses that could be useful in the future planning and production of this well include:

Since the sample does have such a rich 'gas phase' associated with it, performing a constant volume depletion on the fluid might provide a better estimation of reservoir production than the standard black oil differential liberation.

According to the deBoer plot for the screening of crude oils for asphaltene precipitation, this sample falls into the "severe risk" category. A SARA analysis could be conducted to provide additional screening information. An asphaltene flocculation test could be performed if the SARA results reinforce the deBoer screening to identify whether or not this fluid exhibits asphaltene precipitation.

Storage of samples for future reference

Reservoir Fluid Summary

PENCOR ID No. 36126-19

Reservoir Summary

Sample Depth	18,124	Ft. MD
Reservoir Pressure	11,850	psia
Reservoir Temperature	242	°F

Stock Tank Oil Properties

Drilling Fluid Content	< 1.0	wt% STO
Drilling Fluid Type	Rheliant	
API Gravity (from R0F)	34.6	°API at 60 °F (water free)
Paraffin Content	2.2	wt%
Asphaltene Content	1.3	wt%
Sulfur Content	0.27	wt%
Wax Appearance Temp. (CPM)	79	°F
Pour Point	< -30	°F
Mini-Reid Vapor Pressure	3.10	psi
Total Acid Number	< 0.05	mg KOH / g

Fluid Properties at Reservoir Pressure & Temperature

Reservoir Pressure	11,850	psia at 242 °F
Density	0.583	g/cm^3
Density	36.4	lb/ft^3
FVF (from MSF)	2.107	P_{res} bbl/stb
Viscosity	0.203	cP
Compressibility	N/A	$\Delta vol/vol/\Delta psi \times 10^6$

Fluid Properties at Saturation Pressure & Temperature

Saturation Pressure	6,500	psia at 242 °F
Density	0.526	g/cm^3
Density	32.8	lb/ft^3
FVF (from MSF)	2.339	P_{sat} bbl/stb
Viscosity	0.187	cP
Compressibility	32.36	$\Delta vol/vol/\Delta psi \times 10^6$

Flash Comparison

Experimental Procedure	GLR (SCF/stb)	FVF (P_{sat} bbl/stb)	Gas Gravity	API at 60 °F
Reservoir Oil Single-Stage Flash	2,906	2.618	0.812	34.6
Differential Liberation at Reservoir Temperature	4,460	3.748	1.110	30.2
Multi-Stage Separator Test	2,485	2.339	0.731	38.3

Reservoir Fluid Composition

Component	Mole %
N_2	0.341
CO_2	0.908
H_2S	0.000
C1	65.828
C2	6.445
C3	4.623
iC4	0.960
nC4	2.187
iC5	0.889
nC5	1.072
C6	1.385
C7	1.976
C8	2.101
C9	1.505
C10	1.256
C11	0.936
C12	0.779
C13	0.740
C14	0.663
C15	0.546
C16	0.507
C17	0.419
C18	0.404
C19	0.350
C20	0.291
C21	0.248
C22	0.227
C23	0.190
C24	0.172
C25	0.164
C26	0.143
C27	0.136
C28	0.124
C29	0.108
C30	0.100
C31	0.095
C32	0.080
C33	0.073
C34	0.069
C35	0.062
C36	0.055
C37	0.045
C38	0.050
C39	0.040
C40	0.043
C41	0.037
C42	0.033
C43	0.032
C44	0.027
C45	0.026
C46	0.025
C47	0.025
C48	0.022
C49	0.020
C50+	0.417

C50+ Mole Wt	943.89
C50+ Sp Gr	1.132

Sample History and Information

Sample Inventory and History

PENCOR ID No.	Sample Depth (Ft. MD)	Sample Source	Reservoir Condition (psia / °F)		Sample Date	Sample Type	Opening Condition (psia / °F)		Restoration Time (Hours)	Restoration & Transfer Condition (psia / °F)		Transfer Date	Original Sample Volume (cc)
36126-01	N/A	Active Mud pit	N/A		4/10/2010	Drilling Mud	N/A		N/A	N/A		N/A	3,500
36126-01	N/A	Active Mud pit	N/A		4/10/2010	Drilling Mud	N/A		N/A	N/A		N/A	3,500
36126-05	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-06	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-07	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-08	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-09	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-10	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-11	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-12	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-13	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-14	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-15	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-16	18,124	MRSC-77	11,850	242	4/12/2010	Reservoir Fluid	6,440	68	12	14,000	170	4/13/2010	750
36126-17	18,124	MRSC-77	11,850	242	4/12/2010	Atmospheric Oil	6,440	68	12	14,000	170		355
36126-18	18,124	MPSR-2471	11,850	242	4/12/2010	Reservoir Fluid	6,255	66	120+	14,000	170	4/21/2010	355
36126-19	18,124	MPSR-4168	11,850	242	4/12/2010	Reservoir Fluid	6,100	66	120+	14,000	170	4/21/2010	350
36126-20	18,124	MPSR-4096	11,850	242	4/12/2010	Reservoir Fluid	6,500	66	120+	14,000	170	4/21/2010	345
36126-21	18,124	MPSR-1142	11,850	242	4/12/2010	Reservoir Fluid	6,035	66	120+	14,000	170	4/26/2010	340

Sample Validation Data

PENCOR ID No.	Laboratory Opening Pressure (psia / °F)	Saturation Pressure (psia / °F)	Laboratory Analyses: G / L Ratio (scf / stb)	API Gravity (API)	Drilling Fluid (wt % STO)	Gas Gravity (Air = 1.000)	Liq Analysis	CCE	Diff Lib	Vis	MSF	ASTM Tests	Remaining Pressurized Sample (cc)
36126-10**	6,440 / 68		2,909	34.7	< 1.0	0.812	x						750
36126-19	6,100 / 66	6,500 / 242	2,906	34.6	< 1.0	0.812	x	x	x	x	x	x	66
36126-20 *	6,500 / 66		2,875	34.8	< 1.0	0.811	x						0
36126-21 *										x			57

*** Samples from these ID numbers were shipped to other laboratories as requested by BP**

**** Results presented are from mobile laboratory testing that was performed onsite.**

Reservoir Fluid Composition

PENCOR ID No. 36126-20

Flash Summary (14,000 psia and 170 °F to atmospheric pressure and 80 °F)

Gas-Liquid Ratio	2,875	scf/stb	Vapor Gravity	0.811	(Air = 1.00)
FVF	N/A	Vsat/Vstd	API Gravity	34.8	°API at 60 °F (Water Free)
			Water Content	0.14	weight %

	Component	Atmospheric Vapor	Atmospheric Liquid	Atmospheric Liquid	Molecular Weight	Specific Gravity	Reservoir Fluid	Reservoir Fluid
	(Symbol / Name)	(mole %)	(mole %)	(weight %)		(Water = 1.0)	(mole %)	(weight %)
N_2	Nitrogen	0.530	0.000	0.000	28.01	0.809	0.448	0.240
CO_2	Carbon Dioxide	1.071	0.000	0.000	44.01	0.818	0.906	0.762
H_2S	Hydrogen Sulfide	0.000	0.000	0.000	34.08	0.801	0.000	0.000
C1	Methane	77.646	0.002	0.000	16.04	0.300	65.676	20.133
C2	Ethane	7.569	0.090	0.013	30.07	0.356	6.416	3.686
C3	Propane	5.313	0.358	0.075	44.10	0.507	4.549	3.833
iC4	i-Butane	1.085	0.223	0.062	58.12	0.563	0.952	1.057
nC4	n-Butane	2.436	0.835	0.230	58.12	0.584	2.189	2.431
iC5	i-Pentane	0.903	0.853	0.292	72.15	0.624	0.895	1.234
nC5	n-Pentane	1.025	1.397	0.478	72.15	0.631	1.082	1.492
C6	Hexanes	0.968	3.749	1.531	86.18	0.664	1.397	2.300
C7	Heptanes	0.879	8.133	3.615	93.16	0.706	1.997	3.555
C8	Octanes	0.418	11.374	5.807	107.17	0.731	2.107	4.315
C9	Nonanes	0.114	9.243	5.255	120.00	0.764	1.521	3.488
C10	Decanes	0.043	7.989	5.073	134.13	0.779	1.268	3.250
C11	Undecanes		6.111	4.257	147.00	0.790	0.942	2.646
C12	Dodecanes		5.106	3.895	161.00	0.801	0.787	2.422
C13	Tridecanes		4.852	4.024	175.00	0.812	0.748	2.501
C14	Tetradecanes		4.343	3.910	190.00	0.816	0.670	2.431
C15	Pentadecanes		3.573	3.488	206.00	0.828	0.551	2.168
C16	Hexadecanes		3.277	3.447	222.00	0.832	0.505	2.143
C17	Heptadecanes		2.739	3.075	237.00	0.842	0.422	1.912
C18	Octadecanes		2.625	3.122	251.00	0.842	0.405	1.941
C19	Nonadecanes		2.301	2.867	263.00	0.848	0.355	1.783
C20	Eicosanes		2.003	2.610	275.00	0.855	0.309	1.623
C21	Heneicosanes		1.523	2.100	291.00	0.868	0.235	1.305
C22	Docosanes		1.502	2.171	305.00	0.873	0.232	1.349
C23	Tricosanes		1.307	1.970	318.00	0.878	0.201	1.224
C24	Tetracosanes		1.092	1.713	331.00	0.882	0.168	1.065
C25	Pentacosanes		1.173	1.918	345.00	0.886	0.181	1.192
C26	Hexacosanes		0.863	1.467	359.00	0.890	0.133	0.913
C27	Heptacosanes		0.884	1.567	374.00	0.894	0.136	0.974
C28	Octacosanes		0.789	1.451	388.00	0.897	0.122	0.902
C29	Nonacosanes		0.718	1.368	402.00	0.900	0.111	0.850
C30	Triacontanes		0.651	1.284	416.00	0.903	0.100	0.798
C31	Hentriacontanes		0.617	1.258	430.00	0.907	0.095	0.782
C32	Dotriacontanes		0.517	1.088	444.00	0.910	0.080	0.676
C33	Tritriacontanes		0.481	1.045	458.00	0.913	0.074	0.649
C34	Tetratriacontanes		0.447	1.000	472.00	0.915	0.069	0.621
C35	Pentatriacontanes		0.408	0.941	486.00	0.918	0.063	0.584
C36	Hexatriacontanes		0.355	0.840	500.00	0.920	0.055	0.523
C37	Heptatriacontanes		0.322	0.785	514.00	0.923	0.050	0.488
C38	Octatriacontanes		0.323	0.808	528.00	0.925	0.050	0.502
C39	Nonatriacontanes		0.272	0.699	542.00	0.927	0.042	0.434
C40	Tetracontanes		0.258	0.679	556.00	0.929	0.040	0.423
C41	Hentetracontanes		0.247	0.668	570.00	0.931	0.038	0.415
C42	Dotetracontanes		0.217	0.600	584.00	0.932	0.033	0.373
C43	Tritetracontanes		0.203	0.575	598.00	0.934	0.031	0.358
C44	Tetratetracontanes		0.188	0.546	612.00	0.936	0.029	0.339
C45	Pentatetracontanes		0.183	0.542	626.00	0.938	0.028	0.337
C46	Hexatetracontanes		0.157	0.477	640.00	0.941	0.024	0.296
C47	Heptatetracontanes		0.160	0.497	654.00	0.942	0.025	0.308
C48	Octactetracontanes		0.146	0.462	668.00	0.944	0.023	0.287
C49	Nonatetracontanes		0.150	0.485	682.00	0.945	0.023	0.301
C50+	Pentacontanes Plus		2.671	11.870	938.82	1.131	0.412	7.386
Total		100.000	100.000	100.000			100.000	100.000
Calculated Mole Weight		23.41	211.04				52.34	
Measured Mole Weight			211.04					

- See following pages for Liquid Analysis parameters, Different Compositional Groupings, Oil-Based Mud Calculations, Liberated gas properties, etc.
- Compositional groupings based on normal to normal carbon distribution.
- Pristane is included as C_{17} and Phytane is included as C_{18}.

Compositional Groupings of Reservoir Fluid

Group	Mole %	Weight %	MW	SG	T_b
Total Fluid	100.000	100.000	52.34		N/A
C7+	15.489	62.831	212.30	0.852	1,015
C10+	9.863	51.473	273.13	0.883	1,147
C20+	3.211	28.278	460.93	0.949	1,437
C30+	1.383	16.881	638.66	1.003	1,627
C50+	0.412	7.386	938.82	1.131	1,904

* Tb by Correlation

Atmospheric Fluid Properties (PENCOR ID No. 36126-20)

Liberated Gas Properties

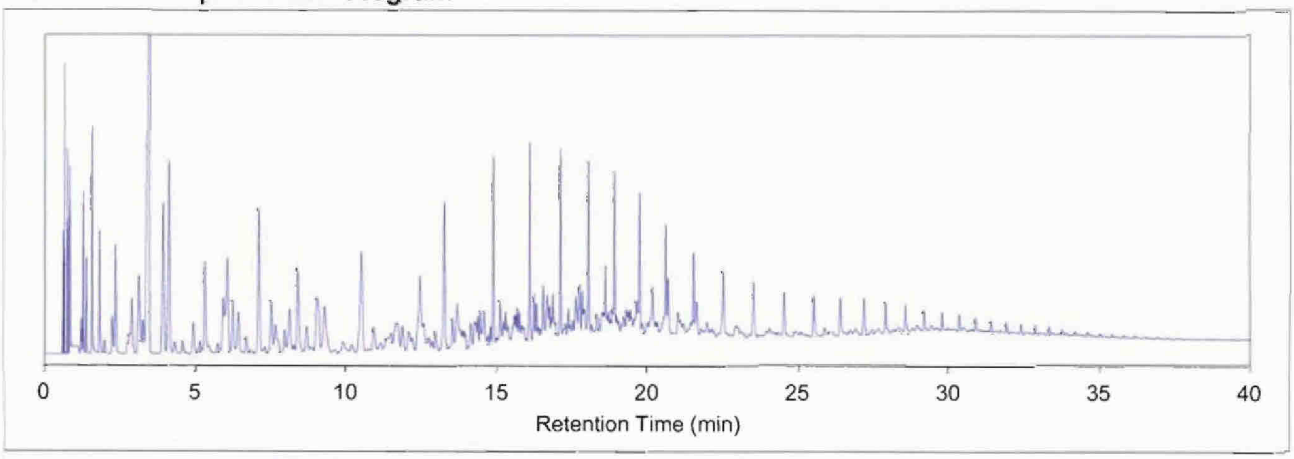
Gas specific gravity (air = 1.00)	0.811	
Net Heat of combustion (dry)	1,276.7	Real
Gross heat of combustion (dry)	1,403.7	Real
Gross heat of combustion (wet)	1,379.2	Water Saturated
Gas Compressibility (at 1 atm at 60 °F)	0.996	
GPM at 15.025 psia	6.46	

Heat of combustion is BTU/cu.ft. at 15.025 psia at 60 °F

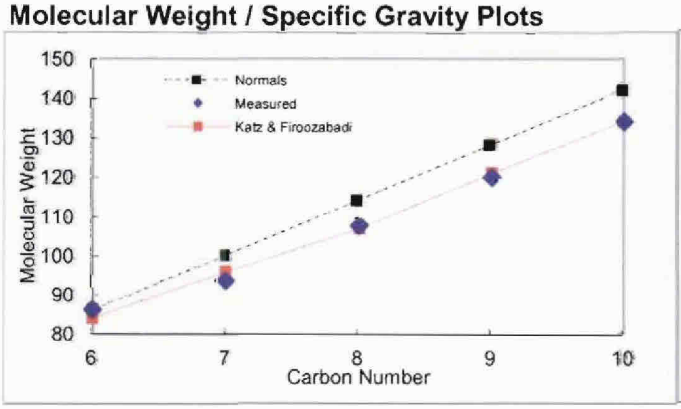
Oil Based Mud Evaluation

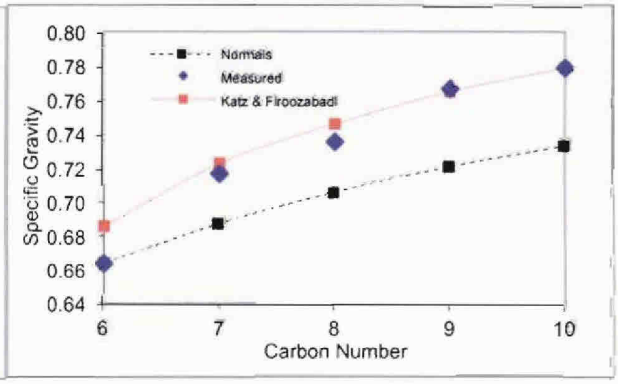
Mud Type	Rheliant	
Mud Content in STO	< 1.0	wt%
Mud Content in Res. Fluid	< 1.0	wt%
API Gravity of Contaminated STO	34.8	°API
API Gravity of Uncontaminated STO	34.8	°API
Measured GLR	2,875	scf/bbl
Corrected GLR	2,875	scf/bbl

Stock Tank Liquid Chromatogram



Molecular Weight / Specific Gravity Plots





Reservoir Fluid Composition

PENCOR ID No. 36126-19

Flash Summary (14,000 psia and 170 °F to atmospheric pressure and 80 °F)

Gas-Liquid Ratio	2,906	scf/stb	Vapor Gravity	0.812	(Air = 1.00)
FVF	2.618	Vsat/Vstd	API Gravity	34.6	°API at 60 °F (Water Free)
			Water Content	0.03	weight %

Component (Symbol / Name)		Atmospheric Vapor (mole %)	Atmospheric Liquid (mole %)	Atmospheric Liquid (weight %)	Molecular Weight	Specific Gravity (Water = 1.0)	Reservoir Fluid (mole %)	Reservoir Fluid (weight %)
N_2	Nitrogen	0.402	0.000	0.000	28.01	0.809	0.341	0.183
CO_2	Carbon Dioxide	1.071	0.000	0.000	44.01	0.818	0.908	0.766
H_2S	Hydrogen Sulfide	0.000	0.000	0.000	34.08	0.801	0.000	0.000
C1	Methane	77.669	0.004	0.000	16.04	0.300	65.828	20.254
C2	Ethane	7.584	0.113	0.016	30.07	0.356	6.445	3.717
C3	Propane	5.386	0.382	0.080	44.10	0.507	4.623	3.910
iC4	i-Butane	1.093	0.222	0.061	58.12	0.563	0.960	1.070
nC4	n-Butane	2.434	0.816	0.224	58.12	0.584	2.187	2.438
iC5	i-Pentane	0.902	0.818	0.279	72.15	0.624	0.889	1.230
nC5	n-Pentane	1.021	1.356	0.462	72.15	0.631	1.072	1.483
C6	Hexanes	0.981	3.633	1.479	86.18	0.664	1.385	2.290
C7	Heptanes	0.891	8.006	3.548	93.24	0.706	1.976	3.533
C8	Octanes	0.424	11.421	5.806	107.12	0.731	2.101	4.315
C9	Nonanes	0.106	9.279	5.257	119.96	0.764	1.505	3.461
C10	Decanes	0.036	8.039	5.087	134.21	0.779	1.256	3.233
C11	Undecanes		6.140	4.262	147.00	0.790	0.936	2.639
C12	Dodecanes		5.112	3.887	161.00	0.801	0.779	2.407
C13	Tridecanes		4.856	4.013	175.00	0.812	0.740	2.485
C14	Tetradecanes		4.347	3.901	190.00	0.816	0.663	2.415
C15	Pentadecanes		3.581	3.484	206.00	0.828	0.546	2.157
C16	Hexadecanes		3.325	3.485	222.00	0.831	0.507	2.158
C17	Heptadecanes		2.749	3.076	237.00	0.842	0.419	1.905
C18	Octadecanes		2.651	3.142	251.00	0.842	0.404	1.946
C19	Nonadecanes		2.294	2.849	263.00	0.849	0.350	1.764
C20	Eicosanes		1.907	2.477	275.00	0.858	0.291	1.533
C21	Henelcosanes		1.629	2.239	291.00	0.868	0.248	1.386
C22	Docosanes		1.488	2.144	305.00	0.873	0.227	1.327
C23	Tricosanes		1.249	1.875	318.00	0.878	0.190	1.161
C24	Tetracosanes		1.129	1.765	331.00	0.882	0.172	1.093
C25	Pentacosanes		1.077	1.754	345.00	0.886	0.164	1.086
C26	Hexacosanes		0.938	1.590	359.00	0.890	0.143	0.985
C27	Heptacosanes		0.893	1.578	374.00	0.894	0.136	0.977
C28	Octacosanes		0.814	1.491	388.00	0.897	0.124	0.924
C29	Nonacosanes		0.710	1.347	402.00	0.900	0.108	0.835
C30	Triacontanes		0.653	1.283	416.00	0.903	0.100	0.794
C31	Hentriacontanes		0.626	1.272	430.00	0.907	0.095	0.787
C32	Dotriacontanes		0.522	1.095	444.00	0.910	0.080	0.678
C33	Tritriacontanes		0.478	1.035	458.00	0.913	0.073	0.640
C34	Tetratriacontanes		0.452	1.007	472.00	0.915	0.069	0.624
C35	Pentatriacontanes		0.409	0.939	486.00	0.918	0.062	0.581
C36	Hexatriacontanes		0.359	0.847	500.00	0.920	0.055	0.525
C37	Heptatriacontanes		0.295	0.715	514.00	0.923	0.045	0.443
C38	Octatriacontanes		0.329	0.820	528.00	0.925	0.050	0.508
C39	Nonatriacontanes		0.264	0.674	542.00	0.927	0.040	0.418
C40	Tetracontanes		0.284	0.744	556.00	0.929	0.043	0.462
C41	Hentetracontanes		0.242	0.652	570.00	0.931	0.037	0.403
C42	Dotetracontanes		0.216	0.596	584.00	0.932	0.033	0.369
C43	Tritetracontanes		0.213	0.602	598.00	0.934	0.032	0.372
C44	Tetratetracontanes		0.176	0.507	612.00	0.936	0.027	0.315
C45	Pentatetracontanes		0.171	0.505	626.00	0.938	0.026	0.313
C46	Hexatetracontanes		0.164	0.495	640.00	0.941	0.025	0.307
C47	Heptatetracontanes		0.162	0.500	654.00	0.942	0.025	0.310
C48	Octactetracontanes		0.145	0.457	668.00	0.944	0.022	0.283
C49	Nonatetracontanes		0.129	0.414	682.00	0.945	0.020	0.257
C50+	Pentacontanes Plus		2.733	12.183	943.89	1.132	0.417	7.543
Total		100.000	100.000	100.000			100.000	100.000
Calculated Mole Weight		23.43	211.75				52.14	
Measured Mole Weight			211.75					

- See following pages for Liquid Analysis parameters, Different Compositional Groupings, Oil-Based Mud Calculations, Liberated gas properties, etc.
- Compositional groupings based on normal to normal carbon distribution.
- Pristane is included as C_{17} and Phytane is included as C_{18}.

Compositional Groupings of Reservoir Fluid

Group	Mole %	Weight %	MW	SG	T_b
Total Fluid	100.000	100.000	52.14		N/A
C7+	15.362	62.659	212.68	0.852	1,016
C10+	9.781	51.349	273.75	0.884	1,149
C20+	3.180	28.240	463.07	0.951	1,441
C30+	1.376	16.933	641.88	1.005	1,631
C50+	0.417	7.543	943.89	1.132	1,907

* Tb by Correlation

Stock Tank Oil Properties

Compositional Groupings of Flash Liquid (PENCOR ID No. 36126-19)

Group	Mole %	Weight %	MW	SG
Total Fluid	100.000	100.000	211.75	0.852
Heptanes plus (C7+)	92.656	97.399	222.61	0.860
Decanes plus (C10+)	63.950	82.788	274.16	0.884
Eicosanes plus (C20+)	20.856	45.602	463.07	0.951
Triacontanes plus (C30+)	9.022	27.342	641.88	1.005
Pentacontanes plus (C50+)	2.733	12.183	943.89	1.132

Atmospheric Liquid Pipeline Package (PENCOR ID Nos. 36126-17 & -21)

Test	Method	Result	Units
Color	Visual	Light Crude	
API Gravity at 60 °F (water free)	ASTM D 5002	34.8	°API
Water Content	ASTM D 4377	0.03	wt%
Paraffin Content	UOP 46 modified	2.2	wt%
Asphaltene Content *	ASTM D 4055 modified	1.3	wt%
Wax Appearance Temperature	CPM	79	°F
Pour Point	ASTM D 97	< -30	°F
Reid Vapor Pressure	ASTM D 5191	3.10	psi
Total Acid Number **	ASTM D 664	< 0.05	mg KOH/g
Total Sulfur **	ASTM D 4294	0.27	wt%
Viscosity at 80 °F	ASTM D 7042	5.03	cPoise
	ASTM D 7042	5.98	cStokes
Viscosity at 100 °F	ASTM D 7042	3.76	cPoise
	ASTM D 7042	4.51	cStokes
Viscosity at 120 °F	ASTM D 7042	2.92	cPoise
	ASTM D 7042	3.54	cStokes

* Asphaltenes defined as pentane insoluble

** Analysis performed by third party

Additional Testing in Mini Assay (performed by third party) (PENOR ID No. 36126-17)

Test	Method	Result	Units
Hydrogen Sulfide	UOP163	< 1	ppm wt
Mercaptan Sulfur	ASTM D3227	< 2	ppm wt
Organically Bound Nitrogen	ASTM D5762	1090	ppm wt
Carbon Residue Ramsbottom	ASTM D524	2.05	wt %
Carbon Residue Conradson	ASTM D189	1.80	wt %
Nickel	ASTM D5708	3.5	ppm wt
Vanadium	ASTM D5708	0.6	ppm wt
Hydrogen Content	ASTM D5291	13.43	wt %

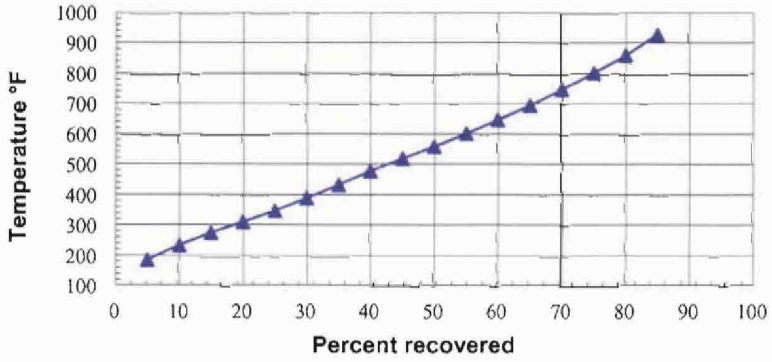
Pipeline package and mini-assay testing was performed on combined residual oils from the PVT testing. This is not always the preferred sample type to use, but was necessary in this case due to limited sample volume.

Simulated Distillation

ASTM D-5307 Distillation weight percent recovered	Temperature ° F
Initial Boiling Point	35
5	185
10	233
15	274
20	310
25	347
30	389
35	432
40	477
45	518
50	558
55	601
60	646
65	694
70	746
75	801
80	860
85	927
90	-
95	-

Recovery	88.8 at 1,000 °F
Residual	11.2 at 1,000 °F

Temperature vs. Percent Recovered



Atmospheric Fluid Properties (PENCOR ID 36126-19)

Liberated Gas Properties

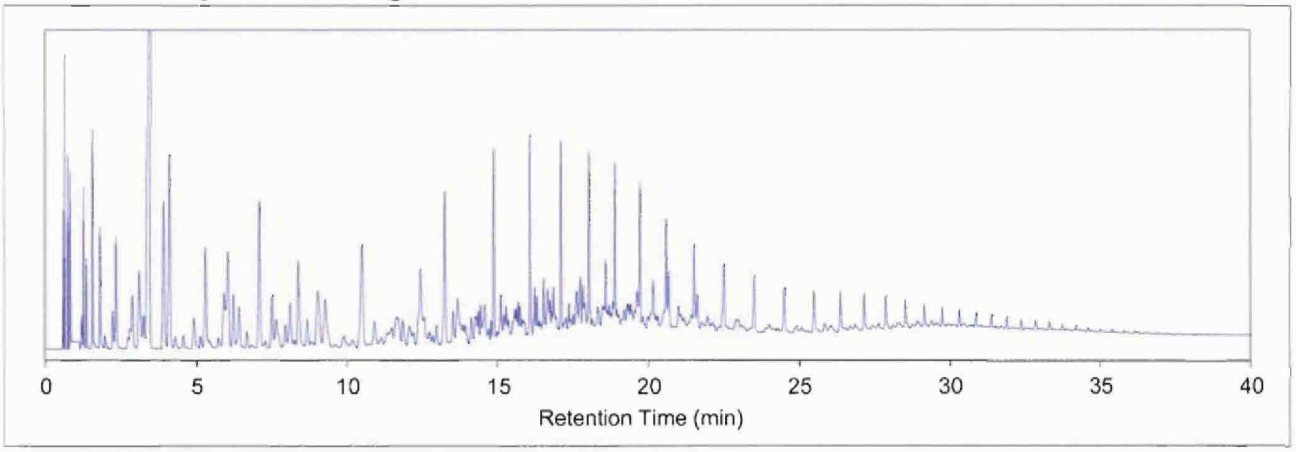
Gas specific gravity (air = 1.00)	0.812	
Net Heat of combustion (dry)	1,279.5	Real
Gross heat of combustion (dry)	1,406.7	Real
Gross heat of combustion (wet)	1,382.1	Water Saturated
Gas Compressibility (at 1 atm at 60 °F)	0.996	
GPM at 15.025 psia	6.49	

Heat of combustion is BTU/cu.ft. at 15.025 psia at 60 °F

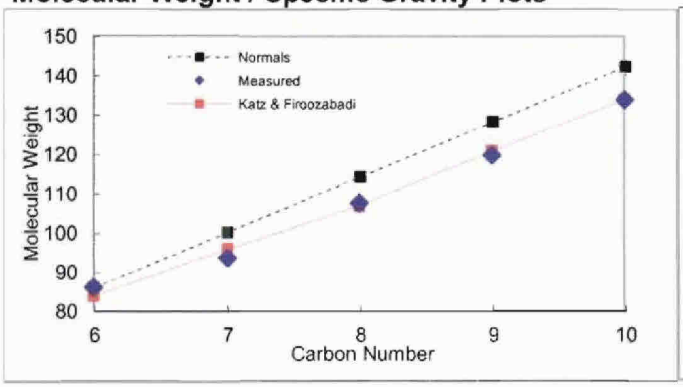
Oil Based Mud Evaluation

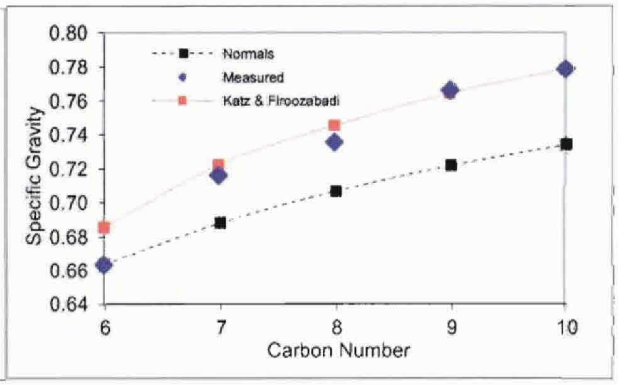
Mud Type	Rheliant	
Mud Content in STO	< 1.0	wt%
Mud Content in Res. Fluid	< 1.0	wt%
API Gravity of Contaminated STO	34.6	°API
API Gravity of Uncontaminated STO	34.6	°API
Measured GLR	2,906	scf/bbl
Corrected GLR	2,906	scf/bbl

Stock Tank Liquid Chromatogram



Molecular Weight / Specific Gravity Plots





Solids Screening

SARA Analysis**

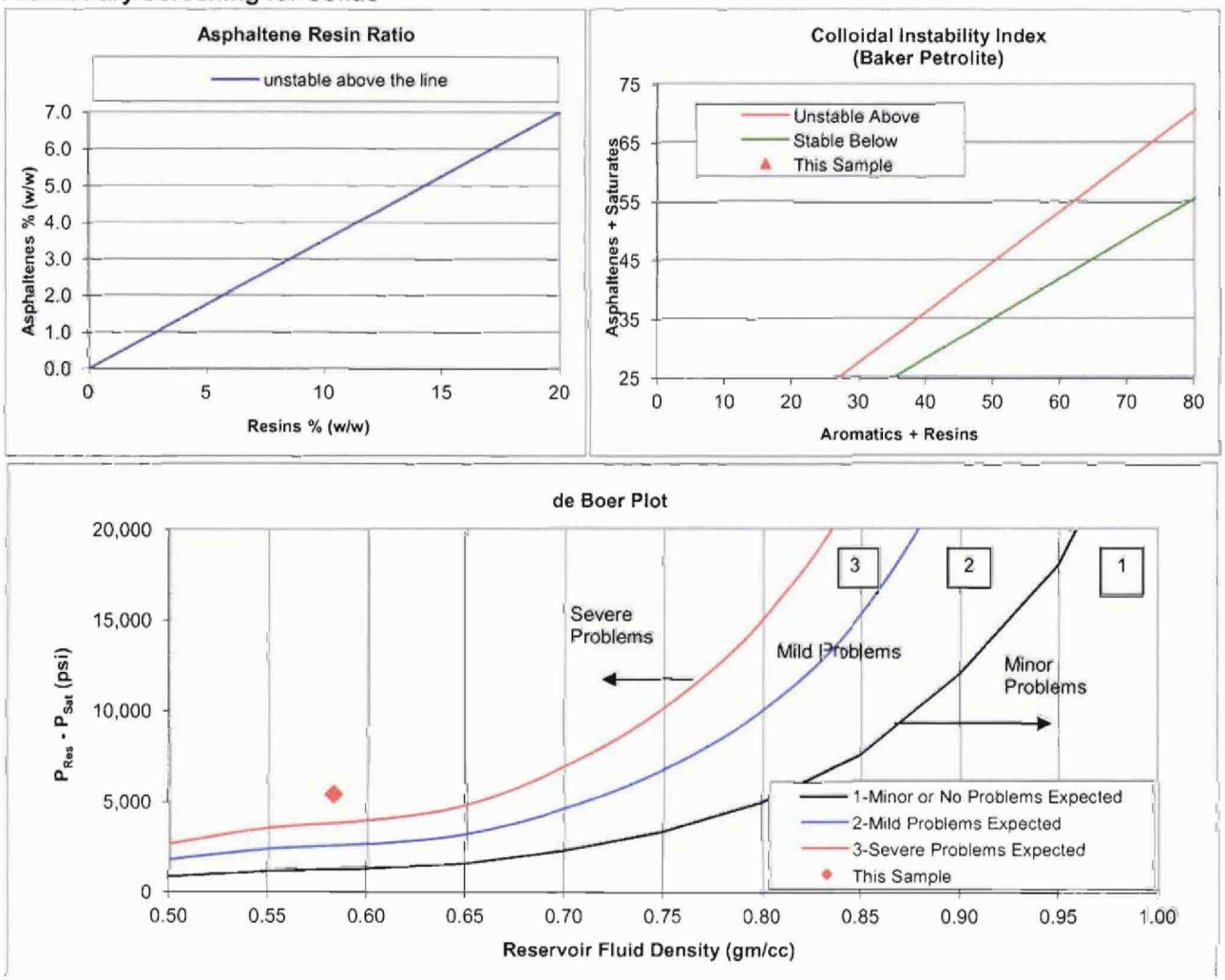
Topped	N/A	wt%
Remaining	N/A	wt%
Saturates	N/A	wt%
Aromatics	N/A	wt%
Resins	N/A	wt%
Asphaltenes*	N/A	wt%

Topping performed at 60 °C under N_2 stream for 42 hours

*Asphaltenes defined as heptane insoluble, methylene chloride soluble fraction

** Analysis performed by third party

Preliminary Screening for Solids



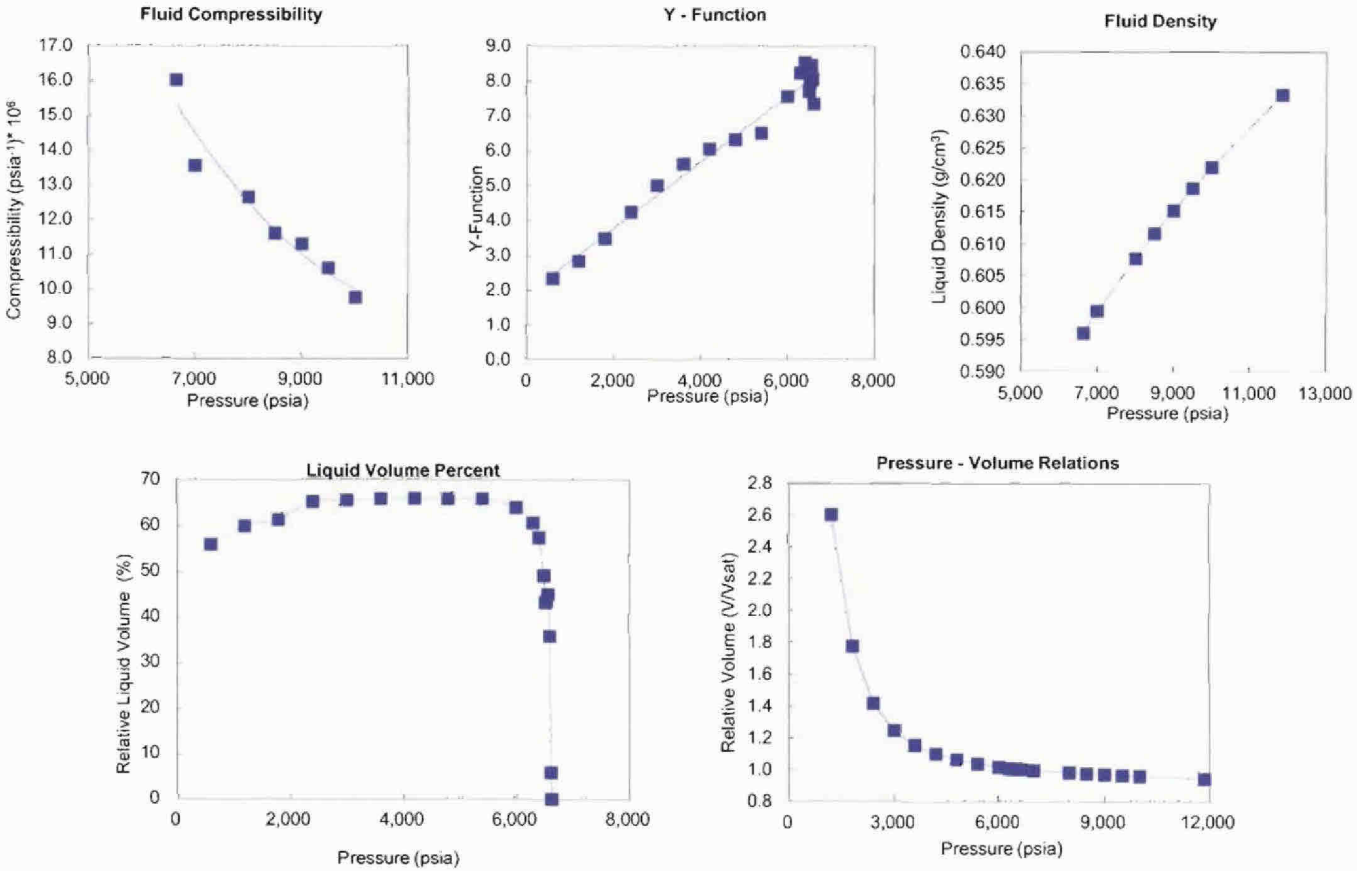
Constant Composition Expansion at 100 °F
Pressure-Volume Relations

Pressure (psia)		Relative Volume (V / V_{sat})	Fluid Density (g/cm^3)	Relative Liquid Volume (%)	Fluid Compress. ($\Delta V/V/\Delta psi) \times 10^6$	Y-Function ($(P_{sat}-P)/P(V/V_{sat}-1)$)
11,850	**Reservoir**	**0.941**	**0.633**			
10,000		0.958	0.622		9.76	
9,500		0.963	0.619		10.61	
9,000		0.969	0.615		11.31	
8,500		0.975	0.612		11.61	
8,000		0.981	0.608		12.65	
7,000		0.994	0.599		13.57	
6,640	**Saturation**	**1.000**	**0.596**	**0.0**	**16.04**	
6,630		1.001		5.9		
6,600		1.001		35.7		7.34
6,575		1.001		44.9		8.06
6,550		1.002		43.4		8.45
6,525		1.002		43.2		7.97
6,500		1.003		48.9		7.70
6,400		1.004		57.3		8.53
6,300		1.007		60.5		8.24
6,000		1.014		63.9		7.55
5,400		1.035		65.8		6.50
4,800		1.061		65.8		6.31
4,200		1.096		65.9		6.05
3,600		1.150		65.8		5.62
3,000		1.243		65.4		5.00
2,400		1.417		65.2		4.24
1,800		1.774		61.2		3.47
1,200		2.603		59.8		2.83
600		5.335		55.8		2.32

Notes:

- Relative Volume (V / V_{sat}) is the fluid volume at the indicated pressure and temperature relative to the saturated fluid volume
- Density (lb/ft^3) = Density (g/cm^3) x 62.428
- Compressibility is the average compressibility between the indicated and the next highest pressure

Constant Composition Expansion at 100 °F
Data Presentation Figures



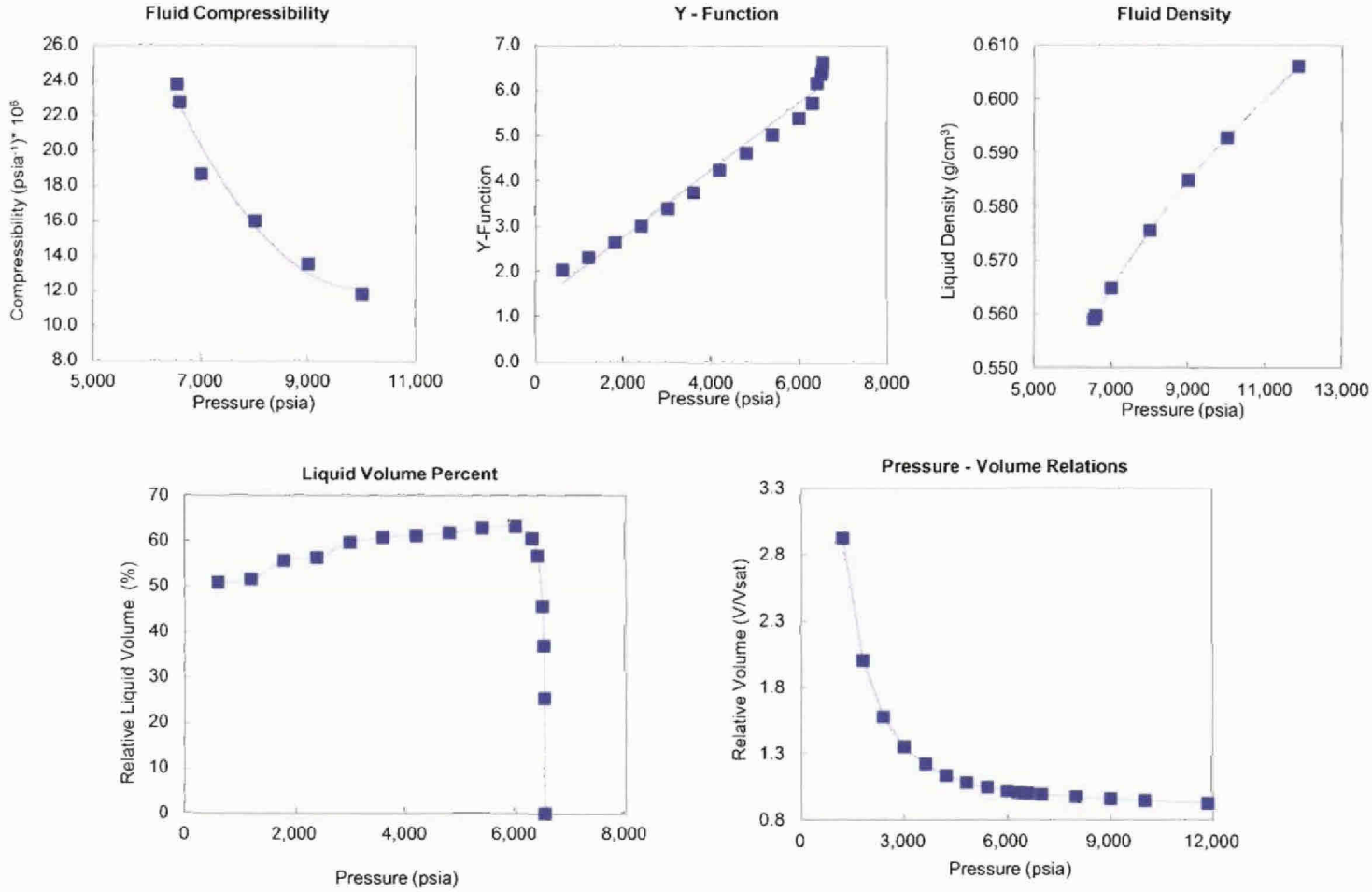
Constant Composition Expansion at 170 °F
Pressure-Volume Relations

Pressure (psia)		Relative Volume (V / V_{sat})	Fluid Density (g/cm^3)	Relative Liquid Volume (%)	Fluid Compress. ($\Delta V/V/\Delta psi) \times 10^6$	Y-Function $(P_{sat}-P)/P(V/V_{sat}-1)$
11,850	**Reservoir**	**0.922**	**0.606**			
10,000		0.943	0.593		11.82	
9,000		0.956	0.585		13.55	
8,000		0.971	0.575		16.00	
7,000		0.990	0.565		18.64	
6,600		0.999	0.560		22.75	
6,550	**Saturation**	**1.000**	**0.559**	**0.0**	**23.80**	
6,537		1.000		25.3		6.62
6,525		1.001		36.8		6.44
6,500		1.001		45.6		6.37
6,400		1.004		56.6		6.18
6,300		1.007		60.4		5.73
6,000		1.017		63.1		5.40
5,400		1.042		62.8		5.05
4,800		1.079		61.7		4.64
4,200		1.131		61.1		4.26
3,600		1.217		60.7		3.77
3,000		1.349		59.6		3.39
2,400		1.573		56.2		3.02
1,800		1.998		55.6		2.64
1,200		2.924		51.4		2.32
600		5.866		50.7		2.04

Notes:

- Relative Volume (V / V_{sat}) is the fluid volume at the indicated pressure and temperature relative to the saturated fluid volume
- Density (lb/ft^3) = Density (g/cm^3) x 62.428
- Compressibility is the average compressibility between the indicated and the next highest pressure

Constant Composition Expansion at 170 °F
Data Presentation Figures



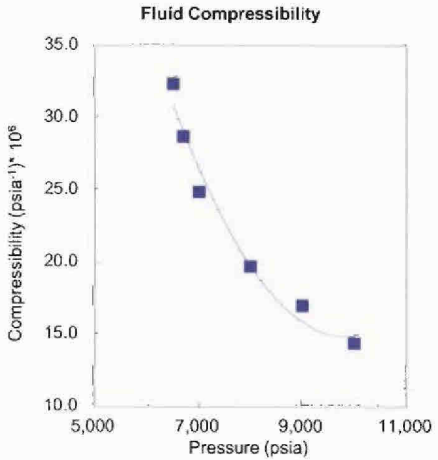
Constant Composition Expansion at 242 °F
Pressure-Volume Relations

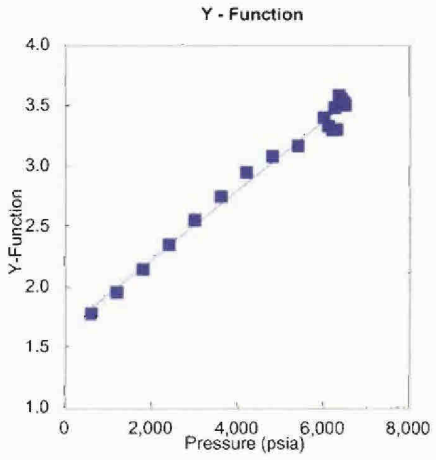
Pressure (psia)		Relative Volume (V / V_{sat})	Fluid Density (g/cm^3)	Relative Liquid Volume (%)	Fluid Compress. ($\Delta V/V/\Delta psi) \times 10^6$	Y-Function $(P_{sat}-P)/P(V/V_{sat}-1)$
11,850	**Reservoir**	**0.901**	**0.583**			
10,000		0.926	0.568		14.39	
9,000		0.942	0.558		17.01	
8,000		0.960	0.547		19.72	
7,000		0.985	0.534		24.87	
6,700		0.994	0.529		28.71	
6,500	**Saturation**	**1.000**	**0.526**	**0.0**	**32.36**	
6,490		1.000		1.4		3.51
6,475		1.001		15.5		3.52
6,450		1.002		30.3		3.53
6,400		1.004		43.0		3.56
6,350		1.007		50.0		3.59
6,300		1.010		51.0		3.31
6,250		1.011		54.5		3.49
6,200		1.015		53.5		3.30
6,100		1.020		54.5		3.33
6,000		1.024		54.9		3.40
5,400		1.064		55.2		3.17
4,800		1.115		54.5		3.09
4,200		1.186		53.7		2.95
3,600		1.293		52.8		2.75
3,000		1.456		52.0		2.56
2,400		1.726		49.3		2.35
1,800		2.214		48.3		2.15
1,200		3.253		44.1		1.96
600		6.517		43.9		1.78

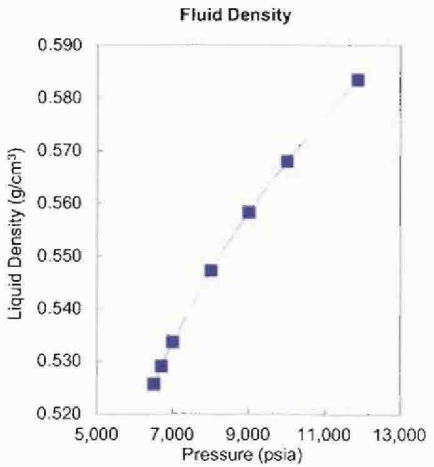
Notes:

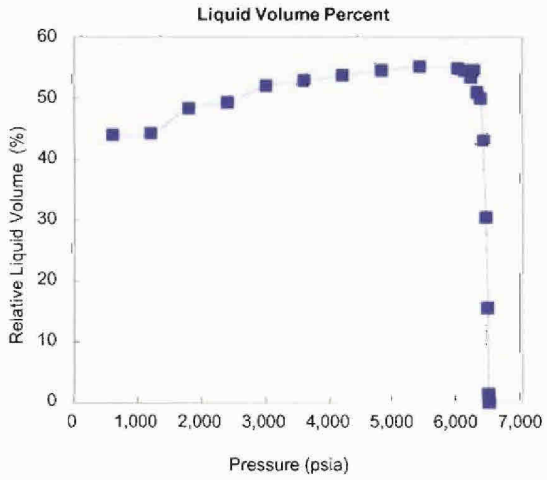
- Relative Volume (V / V_{sat}) is the fluid volume at the indicated pressure and temperature relative to the saturated fluid volume
- Density (lb/ft^3) = Density (g/cm^3) x 62.428
- Compressibility is the average compressibility between the indicated and the next highest pressure

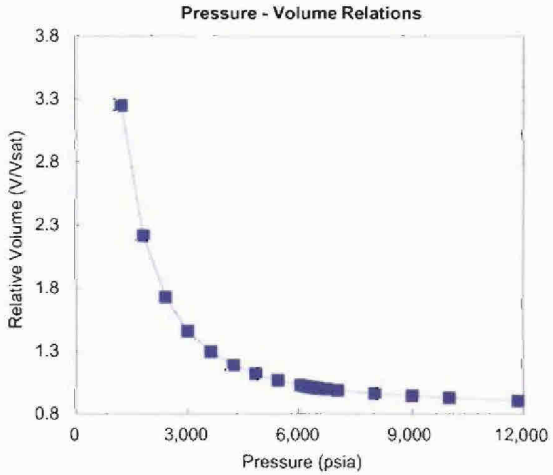
Constant Composition Expansion at 242 °F
Data Presentation Figures











Differential Liberation at 242 °F

Oil Properties

Pressure (psia)		Oil Density (g/cm^3)	Oil Compress. (V/V/psi) x 10^6	Oil Viscosity (cP)	Liberated GLR, R_l (scf/bbl)	Solution GLR, R_{sd} (scf/bbl)	Oil FVF, B_{od} (vol/resid. vol)	Solution GLR, R_s (scf/bbl)	Sep. Adj. FVF, B_o (vol/ST vol)
11,850	**Reservoir**	**0.583**		**0.203**	**0**	**4,460**	**3.377**	**2,485**	**2.107**
10,000		0.568	14.39	0.184	0	4,460	3.469	2,485	2.165
9,000		0.558	17.01		0	4,460	3.529	2,485	2.202
8,000		0.547	19.72	0.168	0	4,460	3.600	2,485	2.247
7,000		0.534	24.87	0.169	0	4,460	3.692	2,485	2.304
6,700		0.529	28.71		0	4,460	3.724	2,485	2.324
6,500	**Saturation**	**0.526**	**32.36**	**0.187**	**0**	**4,460**	**3.748**	**2,485**	**2.339**
6,000		0.605	20.08	0.234	2,251	2,209	2.237	1,231	1.629
4,500		0.649	14.73	0.329	3,153	1,307	1.771	728	1.410
3,000		0.691	11.09	0.445	3,646	814	1.542	454	1.303
1,500		0.730	9.45	0.594	4,017	443	1.374	247	1.224
150		0.783	7.57	0.933	4,358	102	1.172	57	1.129
15		0.796		1.021	4,460	0	1.090	0	1.090
15	at 60°F	0.874	**API = 30.2 °**				1.000		

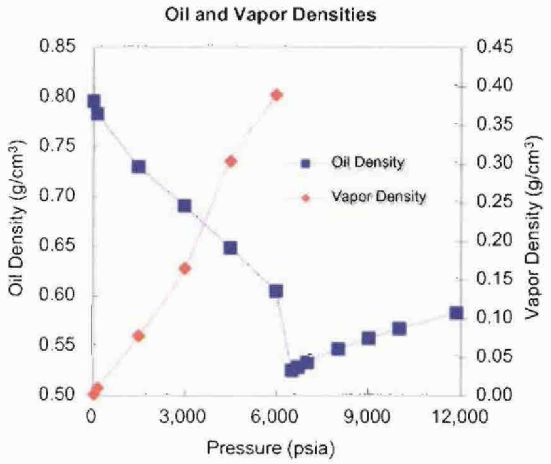
Vapor Properties

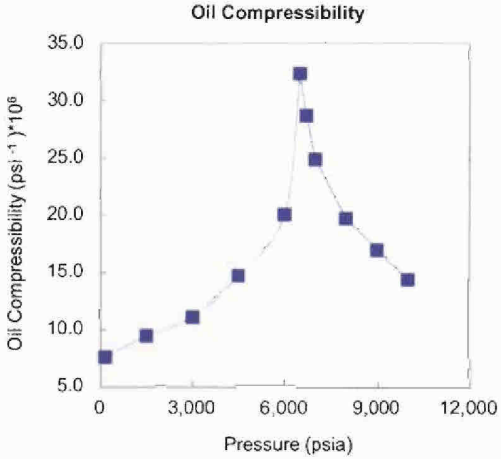
Pressure (psia)	Gas Density (g/cm^3)	Gas Z Factor (vol/vol at std)	Incr. Gas Gravity (Air = 1.00)	Cum. Gas Gravity (Air = 1.00)	Gas FVF, B_g (res bbl /mmscf)	Gas FVF, B_g (res cu ft / scf)	Total FVF, B_t (vol/resid. vol)	Calc. Gas Viscosity (cP)
6,000	0.389	1.160	1.220	1.220	698	0.004	3.808	0.057
4,500	0.303	0.934	1.022	1.163	750	0.004	4.134	0.038
3,000	0.165	0.882	0.787	1.112	1,062	0.006	5.416	0.022
1,500	0.078	0.907	0.763	1.080	2,184	0.012	10.149	0.016
150	0.010	0.985	1.081	1.080	23,716	0.133	104.518	0.012
15	0.002	1.000	2.376	1.110	240,485	1.350	1,073.637	0.009

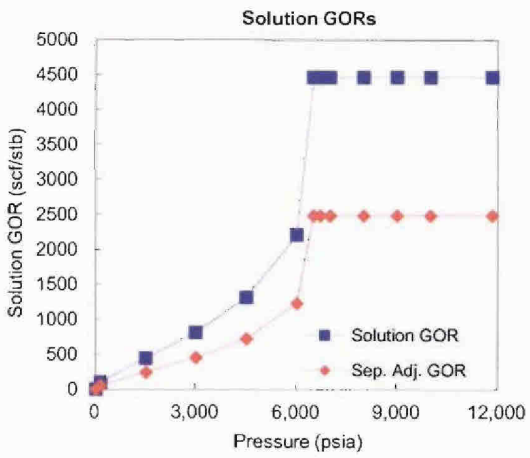
Notes:

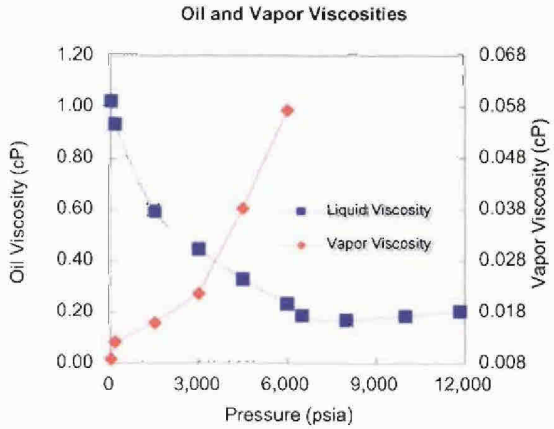
- ❒ Compressibility is calculated using the indicated and previous pressures
- ❒ The Separator Adjusted GLR and FVF represent the differentially liberated oil produced through the surface separators (see MSF)
- ❒ Sep. Adjusted Data using Muhammad A. Al-Marhoun method
- ❒ Gas MW = Vapor Gravity x Molecular Weight Air
- ❒ Standard Conditions: 15.025 psia at 60 °F
- ❒ Atmospheric Step completed at Reservoir Temperature
- ❒ B_o = Oil Volume at P,T / Stock Tank Volume at 60 °F
- ❒ B_{od} = Oil Volume at P,T / Residual Oil Volume at 60 °F
- ❒ R_s = Gas Volume at Standard Conditions / Stock Tank Volume at 60 °F
- ❒ $B_t = B_o + [(\text{Total Liberated Vapor, } R_l) \times B_o] \times 10^{-6}$
- ❒ R_l is cumulative liberated gas / Residual Oil Volume
- ❒ Vapor Viscosity calculated with Lee-Gonzales Correlation
- ❒ Oil Viscosity measured using electro-magnetic viscometer, more data on Pg 23

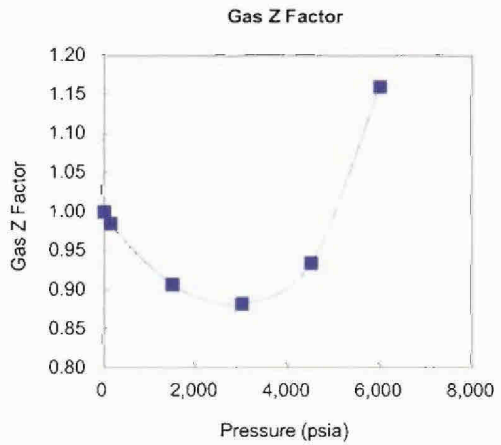
Differential Liberation at 242 °F

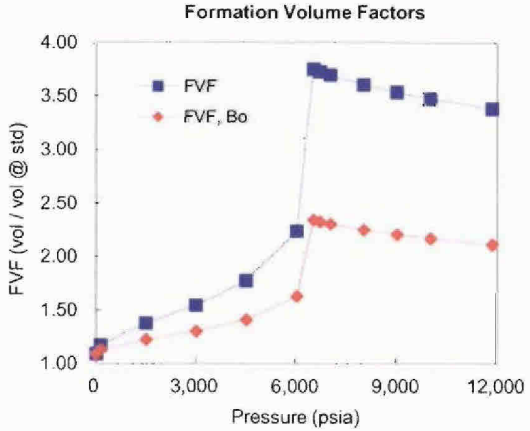












Differential Liberation Fluid Compositions

Component	Liberated Gas 6,000 psia (mole %)	4,500 psia (mole %)	3,000 psia (mole %)	1,500 psia (mole %)	150 psia (mole %)	15 psia (mole %)	Residual Liquid (mole %)	Calc. Res. Fluid (mole %)
Nitrogen	0.585	0.501	0.415	0.300	0.160	0.095	0.000	0.437
Carbon Dioxide	0.908	0.967	1.090	1.190	1.310	0.435	0.000	0.892
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methane	71.884	76.568	81.780	80.847	58.613	11.309	0.003	65.565
Ethane	6.182	6.322	6.780	7.751	12.316	7.143	0.004	6.258
Propane	4.228	4.023	4.054	4.483	10.680	12.739	0.017	4.425
Iso-Butane	0.877	0.795	0.745	0.772	2.218	4.085	0.028	0.921
N-Butane	1.968	1.731	1.569	1.593	4.988	11.332	0.123	2.089
Iso-Pentane	0.808	0.674	0.541	0.507	1.742	5.817	0.222	0.849
N-Pentane	0.983	0.802	0.613	0.564	1.965	7.321	0.412	1.028
Hexanes	1.337	1.043	0.633	0.554	1.880	9.574	1.551	1.382
Heptanes	2.064	1.506	0.672	0.618	1.926	12.517	4.437	2.141
Octanes	1.942	1.104	0.401	0.431	1.181	9.280	8.556	2.232
Nonanes	1.362	1.000	0.145	0.179	0.520	4.502	7.629	1.673
Decanes	1.181	0.765	0.058	0.083	0.253	2.250	7.319	1.437
Undecanes	0.766	0.457	0.032	0.042	0.117	0.926	5.865	1.013
Dodecanes	0.582	0.316	0.027	0.028	0.060	0.388	4.916	0.798
Tridecanes	0.427	0.290	0.038	0.021	0.028	0.179	5.131	0.736
Tetradecanes	0.303	0.222	0.046	0.017	0.018	0.077	4.648	0.620
Pentadecanes	0.236	0.157	0.047	0.012	0.014	0.022	4.439	0.556
Hexadecanes	0.194	0.117	0.047	0.005	0.008	0.005	4.326	0.518
Heptadecanes	0.154	0.088	0.053	0.001	0.002	0.002	3.771	0.442
Octadecanes	0.149	0.082	0.060	0.001	0.001	0.002	3.832	0.445
Nonadecanes	0.123	0.064	0.037	0.000	0.000	0.001	3.296	0.378
Eicosanes	0.756	0.406	0.115	0.000	0.000	0.000	2.764	0.312
Heneicosanes							2.340	0.262
Docosanes							2.087	0.233
Tricosanes							1.887	0.209
Tetracosanes							1.666	0.184
Pentacosanes							1.611	0.177
Hexacosanes							1.397	0.153
Heptacosanes							1.227	0.133
Octacosanes							1.234	0.133
Nonacosanes							0.974	0.106
Triacontanes Plus							12.288	1.265
Totals	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
C30+ MW	-	-	-	-	-	-	640.56	640.56
C30+ Gravity	-	-	-	-	-	-	1.014	1.014
Mol. Weight	35.34	29.59	22.81	22.09	31.31	68.83	249.36	52.49
SP. Gravity (Air = 1.0)	1.220	1.022	0.787	0.763	1.081	2.376	-	-

Oil Viscosities at Specified Temperatures

Measured using Electro-Magnetic Viscometer
PENCOR ID No. 36126-21

Pressure (psia)		Viscosity at 242 °F 36126-21 Centipoise (cP)	Viscosity at 170 °F 36126-21 Centipoise (cP)	Viscosity at 100 °F 36126-21 Centipoise (cP)	Viscosity at 40 °F 36126-21 Centipoise (cP)
15,000				0.434	
14,500		0.233	0.293		
14,300					0.589
14,000		0.226	0.287	0.407	0.577
13,500		0.221	0.280		0.565
13,000		0.216	0.274	0.388	0.581
12,500		0.210	0.270		0.572
11,850	**Reservoir**	**0.203**	**0.260**	**0.369**	**0.546**
11,000			0.252	0.354	0.527
10,000		0.184	0.238	0.721	0.773
9,000					0.856
8,000		0.168	0.257	0.367	0.560
7,500		0.180	0.235		0.479
7,000	**Est Psat at 40°F**	0.169	0.234	0.369	**0.442**
6,705					0.695
6,640	**Psat at 100 °F**			**0.408**	0.728
6,600					0.756
6,550	**Psat at 170 °F**		**0.265**	0.417	
6,500	**Psat at 242 °F**	**0.187**			
6,470			0.277		
6,450				0.428	
6,400		0.206			
6,380			0.287		
6,300		0.214			
6,000		0.234	0.321	0.494	0.866
4,500		0.329	0.444	0.633	1.214
3,000		0.445	0.578	0.845	1.725
1,500		0.594	0.757	1.199	2.178
150		0.933	1.326	2.110	3.315
15		1.021	1.847	4.432	10.927

Temperature (°F)	Saturation Pressure (psia)
40	7,000 estimate
100	6,640
170	6,550
242	6,500

Reservoir Pressure = 11,850 psia

Post Test Calibration Check (0.25 - 5 cP piston) used for 40 °F

Fluid Standard	Standard Viscosity (cP)	Measured Viscosity (cP)
N.4	0.268	0.273
S6	5.061	5.078

Post Test Calibration Check (0.2 - 2 cP piston) used for 100 °F, 170 °F and 242 °F

Fluid Standard	Standard Viscosity (cP)	Measured Viscosity (cP)
N.4	0.271	0.276
S3	2.000	1.998

Multi-Stage Separator Test

Separator Conditions Pressure (psia)	Separator Conditions Temperature (°F)	Liquid Density (g/cm^3)	Gas Density (g/cm^3)	Gas Gravity (Air = 1.0)	Solution GLR, R_s (scf/stb)	Solution GLR, R_s (scf/sep bbl)	Liberated GLR, R_l (scf/stb)	Separator Shrinkage (stb/bbl at P,T)
6,504	**243**	**0.526**		**N/A**	**2,485**		**0**	**N/A**
1,250	130	0.745	0.074	0.684	410	503	2,075	0.815
450	120	0.770	0.026	0.727	202	231	208	0.876
150	120	0.783	0.010	0.902	109	120	93	0.909
15	60	0.832	0.002	1.496	0	0	109	1.000

Summary Data

Total Solution Gas-Liquid Ratio	2,485	scf/stb
Stock Tank Oil Gravity	38.3	°API at 60 °F
Formation Volume Factor	2.339	(Bbl at P_{sat} /stb)
Accumulated Gas Gravity	0.731	(Air = 1.00)
Color of Stock Tank Fluid	Light Crude	

Notes:

- stb: stock tank barrel at 60 °F
- sep bbl: volume of separator liquid at P,T.
- Solution GLR is given as the gas volume per stock tank barrel (stb) and per separator barrel (sep bbl)
- Separator Volume Factor is the inverse of the Separator Shrinkage Factor
- Liberated GLR (R_l) is gas liberated from previous stage to current stage per stock tank barrel (stb)
- See following page for flash gas compositional analyses

Multi-Stage Flash Fluid Compositions

Stage Condition	Stage 1	Stage 2	Stage 3	Stage 4	Stock Tank Liquid
Pressure (psia)	1,250	450	150	15	15
Temperature (°F)	130	120	120	60	60
Component	*(mole %)*	*(mole %)*	*(mole %)*	*(mole %)*	*(mole %)*
Nitrogen	0.546	0.244	0.021	0.005	0.000
Carbon Dioxide	1.096	1.435	1.824	1.085	0.000
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000
Methane	85.693	79.802	61.231	17.040	0.034
Ethane	6.584	10.014	17.848	21.475	0.291
Propane	3.371	5.239	11.735	31.278	2.037
Iso-Butane	0.528	0.753	1.742	6.081	1.170
N-Butane	1.001	1.372	3.183	12.541	3.766
Iso-Pentane	0.274	0.325	0.736	3.270	2.622
N-Pentane	0.282	0.319	0.708	3.176	4.040
Hexanes	0.223	0.209	0.441	1.949	6.526
Heptanes	0.197	0.160	0.317	1.356	9.883
Octanes	0.118	0.080	0.144	0.550	11.160
Nonanes	0.048	0.026	0.044	0.144	7.474
Decanes Plus	0.040	0.021	0.025	0.050	50.997
Totals	100.000	100.000	100.000	100.000	100.000
Mole Weight	19.757	20.998	25.989	42.671	189.84
Gravity (Air = 1.0)	0.684	0.727	0.902	1.496	-
Net Heat of combustion (dry)	1,090.3	1,151.2	1,405.6	2,311.4	-
Gross heat of combustion (dry)	1,204.2	1,269.4	1,542.1	2,513.7	-
Gross heat of combustion (wet)	1,183.1	1,247.2	1,515.2	2,469.7	-
Gas Compressibility (at 1 atm at 60 °F)	0.997	0.997	0.995	0.984	-
GPM at 15.025 psia	3.683	5.364	10.750	24.952	-

- Heat of combustion is the quantity of heat produced when gas is burned completely to carbon dioxide and water, BTU/cuft
- Wet and dry refer to the condition of the gas prior to combustion
- Wet refers to a gas that is saturated with water vapor, and dry refers to a gas that contains no water vapor prior to combustion
- Net and gross refer to the condition of the water resulting from combustion
- Gross heat is the heat produced in complete combustion under constant pressure with the combustion products cooled to standard conditions and the water of the combustion products condensed to the liquid state
- Net heat is the heat produced in complete combustion under constant pressure with the combustion products cooled to standard conditions and the water of combustion products remains in the vapor phase

Chromatographic Analysis of Stock Tank Oil
Multi Stage Flash Residual Oil

	Component	Mole %	Volume %	Weight %	Molecular Weight	Specific Gravity
C1	Methane	0.034	0.008	0.003	16.04	0.300
C2	Ethane	0.291	0.108	0.046	30.07	0.356
C3	Propane	2.037	0.778	0.473	44.10	0.507
iC4	i-Butane	1.170	0.530	0.358	58.12	0.563
nC4	n-Butane	3.766	1.645	1.153	58.12	0.584
iC5	i-Pentane	2.622	1.330	0.997	72.15	0.624
nC5	n-Pentane	4.040	2.027	1.536	72.15	0.631
C6	Hexanes	6.526	3.719	2.963	86.18	0.664
C7	Heptanes	9.883	5.598	4.845	93.04	0.721
C8	Octanes	11.160	7.103	6.298	107.13	0.739
C9	Nonanes	7.474	5.185	4.748	120.56	0.763
C10	Decanes	6.385	4.822	4.507	134.00	0.779
C11	Undecanes	4.815	3.933	3.729	147.00	0.790
C12	Dodecanes	3.859	3.405	3.273	161.00	0.801
C13	Tridecanes	3.835	3.628	3.535	175.00	0.812
C14	Tetradecanes	3.279	3.364	3.282	190.00	0.813
C15	Pentadecanes	2.913	3.215	3.161	206.00	0.819
C16	Hexadecanes	2.597	3.072	3.037	222.00	0.824
C17	Heptadecanes	2.137	2.664	2.668	237.00	0.834
C18	Octadecanes	2.108	2.783	2.787	251.00	0.834
C19	Nonadecanes	1.782	2.441	2.468	263.00	0.843
C20	Eicosanes	1.477	2.090	2.140	275.00	0.853
C21	Heneicosanes	1.265	1.861	1.939	291.00	0.868
C22	Docosanes	1.122	1.720	1.802	305.00	0.873
C23	Tricosanes	1.022	1.625	1.712	318.00	0.878
C24	Tetracosanes	0.909	1.497	1.585	331.00	0.882
C25	Pentacosanes	0.877	1.499	1.594	345.00	0.886
C26	Hexacosanes	0.758	1.343	1.434	359.00	0.890
C27	Heptacosanes	0.690	1.267	1.359	374.00	0.894
C28	Octacosanes	0.666	1.264	1.361	388.00	0.897
C29	Nonacosanes	0.543	1.064	1.149	402.00	0.900
C30+	Triacontanes Plus	7.958	23.412	28.058	669.40	0.999
	Total	100.000	100.000	100.000		

Properties of Liquid at 60/60 °F	Measured	Calculated	Calculated Properties of C30+	
Specific Gravity	0.833	0.833	Specific Gravity	0.999
Molecular Weight	189.83	189.83	Molecular Weight	669.40

* Calculations are based on normal carbon distribution (from normal to normal)

Compositional Analysis of Rheliant Oil Base Mud

PENCOR ID No. 36126-01

	Component	Mole %	Volume %	Weight %	Molecular Weight	Specific Gravity
C1	Methane	0.009	0.002	0.001	16.04	0.300
C2	Ethane	0.003	0.001	0.000	30.07	0.356
C3	Propane	0.004	0.001	0.001	44.10	0.507
iC4	i-Butane	0.002	0.001	0.001	58.12	0.563
nC4	n-Butane	0.001	0.000	0.000	58.12	0.584
iC5	i-Pentane	0.005	0.002	0.001	72.15	0.624
nC5	n-Pentane	0.001	0.000	0.000	72.15	0.631
C6	Hexanes	0.024	0.010	0.008	86.18	0.664
C7	Heptanes	0.109	0.051	0.045	96.31	0.704
C8	Octanes	0.094	0.048	0.044	109.56	0.729
C9	Nonanes	0.117	0.066	0.062	124.92	0.739
C10	Decanes	0.097	0.056	0.055	134.00	0.779
C11	Undecanes	0.518	0.322	0.322	147.00	0.790
C12	Dodecanes	0.698	0.469	0.475	161.00	0.801
C13	Tridecanes	0.636	0.458	0.470	175.00	0.812
C14	Tetradecanes	1.291	1.071	1.072	196.39	0.791
C15	Pentadecanes	10.211	9.266	9.086	210.41	0.775
C16	Hexadecanes	44.106	42.429	41.862	224.44	0.780
C17	Heptadecanes	12.739	12.885	12.847	238.47	0.788
C18	Octadecanes	22.058	23.468	23.553	252.49	0.793
C19	Nonadecanes	3.492	3.871	3.935	266.52	0.804
C20	Eicosanes	1.567	1.807	1.860	280.55	0.814
C21	Heneicosanes	0.307	0.344	0.378	291.00	0.868
C22	Docosanes	0.230	0.269	0.297	305.00	0.873
C23	Tricosanes	0.081	0.098	0.109	318.00	0.878
C24	Tetracosanes	0.062	0.078	0.087	331.00	0.882
C25	Pentacosanes	0.049	0.063	0.071	345.00	0.886
C26	Hexacosanes	0.017	0.023	0.026	359.00	0.890
C27	Heptacosanes	0.070	0.098	0.111	374.00	0.894
C28	Octacosanes	0.054	0.079	0.089	388.00	0.897
C29	Nonacosanes	0.090	0.134	0.153	402.00	0.900
C30+	Triacontanes Plus	1.258	2.530	2.979	560.15	0.930
	Total	100.000	100.000	100.000		

Properties of Liquid at 60/60 °F	Measured	Calculated	Calculated Properties of C30+	
Specific Gravity	0.790	0.790	Specific Gravity	0.930
Molecular Weight	230.78	236.47	Molecular Weight	560.15

* Calculations are based on normal carbon distribution (from normal to normal).

Laboratory Procedures

Sample Quality
The selected samples are heated to collection temperature prior to performing any further testing to avoid wax deposition problems and assure a uniform sample. A reservoir to zero flash is performed in duplicate to assure repeatable results.

Sample Restoration
Reservoir fluid samples are heated to 170 °F or reservoir temperature, depending on the sample container, pressured to some safe pressure above reservoir and continually agitated for a period of from 24 to 120 hours. This assures that any asphaltenes, if flocculation is reversible, have been dispersed throughout the sample, paraffins have been resoluablized, and the sample is homogonous.

Reservoir Fluid Compositions
Each pressurized liquid is analyzed using a combination of flash separation and gas chromatography. The liquid is flashed at a controlled temperature and separated into liquid and gas components. The gas composition is determined by GPA 2286 method using a multi-column gas chromatograph and the flashed liquid by temperature programmed capillary chromatography. The two analyses are then mathematically recombined to the flash gas-liquid ratio.

Constant Composition Expansion
A portion of the reservoir fluid sample is charged to a high pressure visual cell that is maintained at reservoir temperature. A constant composition expansion is carried out during which the saturation pressure is determined. Pressure-volume data for the single phase and two-phase fluid are also determined. The density of the single phase fluid is determined by two separate methods. A reservoir to zero flash is performed on a portion of fluid from the PVT cell and the mass of the resulting fluids are used in conjunction with the cell volumetrics. Secondly, a calibrated, high-pressure Anton Paar densitometer is also employed to measure the density of the reservoir fluid. Density data for other pressures are calculated using the volumetric data.

Differential Vaporization
This test is typically performed on low-shrinkage reservoir oil samples. After discussions with multiple BP engineers it was decided to proceed with this test even though this fluid is not a low shrinkage oil, the DV will provide adequate data and compositions so that reservoir simulations can be constructed. The test is carried out in a high pressure visual cell, at reservoir temperature. At several pressure stages, below the observed saturation pressure, the sample is stabilized. The gas evolved is then displaced from the cell and the volume, compressibility and composition are determined. The final stage is performed by flashing the fluid to ambient pressure at reservoir temperature. The residual liquid and associated gas, maintained at reservoir temperature, are collected and their density and compositions determined.

Viscosity
Viscosity is measured in an electro-magnetic viscometer at reservoir temperature. The viscometer contains a stainless steel piston which is magnetically driven back and forth inside a measurement chamber and the travel time recorded. These times correlate directly to the dynamic viscosities of calibration standards used in the commissioning of the viscometer. Viscosity determinations are carried out over a wide range of pressures from above the reservoir pressure to atmospheric pressure. The viscosity measurement at each pressure stage is recorded when the standard deviation of the last 10 measurements is typically less than 0.1% of the measured viscosity. A viscosity standard is run before and after each test to confirm that the calibration coefficients stored within the viscometer remain valid.

Separator Tests
A multi-stage separator test is carried out using a visual PVT cell. A portion of the sample, at a pressure above saturation pressure, is transferred into the PVT cell and stabilized at the pressure and temperature required for the first stage of separation. The gas evolved is displaced from the cell and the volume and composition are determined. This is repeated for each successive pressurized stage. The final stage is conducted at atmospheric pressure and some temperature and the density of the residual liquid is determined.

Data Used in Gas Compositional Calculations

Component		Mole Weight	Sp Gravity at 60/60 °F	Component		Mole Weight	Sp Gravity at 60/60 °F
Hydrogen	*	2.016	N/A	33DMC5	*	100.2	0.6961
Oxygen/(Argon)	**	32.00	1.1421	Cyclohexane	*	84.16	0.7835
Nitrogen (Corrected)	**	28.01	0.8094	2MC6/23DMC5	*	100.2	0.6924
Methane	**	16.04	0.3000	11DMCYC5/3MC6	*	99.20	0.7260
Carbon Dioxide	**	44.01	0.8180	t13DMCYC5	*	98.19	0.7535
Ethane	**	30.07	0.3562	c13DMCYC5/3EC5	*	99.20	0.7269
Hydrogen Sulphide	**	34.08	0.8014	t12DMCYC5	*	98.19	0.7561
Propane	**	44.10	0.5070	Heptanes (nC7)	*	100.2	0.6882
i-Butane	**	58.12	0.5629	22DMC6	*	114.2	0.7001
n-Butane	**	58.12	0.5840	MCYC6	*	98.19	0.7748
Neo-Pentane	*	72.15	0.5974	ECYC5	*	98.19	0.7712
i-Pentane	**	72.15	0.6244	223TMC5/24&25DMC6	*	114.2	0.7067
n-Pentane	**	72.15	0.6311	ctc124TMCYC5	*	112.2	0.7518
22DMC4	*	86.18	0.6535	ctc123TMCYC5	*	112.2	0.7581
23DMC4/CYC5	*	78.16	0.7137	Toluene	*	92.14	0.8743
2MC5	*	86.18	0.6578	Octanes (nC8)	*	114.2	0.7070
3MC5	*	86.18	0.6689	E-Benzene	*	106.2	0.8744
Hexanes (nC6)	*	86.18	0.6638	M/P-Xylene	*	106.2	0.8680
22DMC5	*	100.2	0.6821	O-Xylene	*	106.2	0.8849
M-C-Pentane	*	84.16	0.7540	Nonanes (nC9)	*	128.3	0.7219
24DMC5	*	100.2	0.6764	Decanes	***	134.0	0.7788
223TMC4	*	100.2	0.6954	Undecanes	***	147.0	0.7898
Benzene	*	78.11	0.8829	Dodecanes	***	161.0	0.8008

Data Source References :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds.
** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas, GPA 2145-96.
*** Journal of Petroleum Technology, Nov 1978, Pages 1649-1655.
Predicting Phase Behavior of Condensate/Crude Oil Systems Using Methane Interaction Coefficients - D.L. Katz & A. Firoozabadi.

Note :
The gas mole % compositions were calculated from the measured weight % compositions using the most detailed analysis results, involving as many of the above components as were identified. The reported component mole % compositions were then sub-grouped into the generic carbon number components.

Katz and Firoozabadi Data Used in Liquid Composition Calculations

Component		Mole Weight	Density (g/cc at 60°F)	Component		Mole Weight	Density (g/cc at 60°F)
Hydrogen	*	2.016	N/A	Undecanes	***	147	0.7890
Hydrogen Sulfide	**	34.08	0.8006	Dodecanes	***	161	0.8000
Carbon Dioxide	**	44.01	0.8172	Tridecanes	***	175	0.8110
Nitrogen	**	28.01	0.8086	Tetradecanes	***	190	0.8220
Methane	**	16.04	0.2997	Pentadecanes	***	206	0.8320
Ethane	**	30.07	0.3558	Hexadecanes	***	222	0.8390
Propane	**	44.10	0.5065	Heptadecanes	***	237	0.8470
i-Butane	**	58.12	0.5623	Octadecanes	***	251	0.8520
n-Butane	**	58.12	0.5834	Nonadecanes	***	263	0.8570
i-Pentane	**	72.15	0.6238	Eicosanes	***	275	0.8620
n-Pentane	**	72.15	0.6305	Heneicosanes	***	291	0.8670
Hexanes	**	84.16	0.7533	Docosanes	***	305	0.8720
Me-cyclo-pentane	*	84.16	0.7533	Tricosanes	***	318	0.8770
Benzene	*	78.11	0.8820	Tetracosanes	***	331	0.8810
Cyclo-hexane	*	84.16	0.7827	Pentacosanes	***	345	0.8850
Heptanes	**	92.1	0.7220	Hexacosanes	***	359	0.8890
Me-cyclo-hexane	*	98.19	0.7740	Heptacosanes	***	374	0.8930
Toluene	*	92.14	0.8734	Octacosanes	***	388	0.8960
Octanes	**	106.2	0.7450	Nonacosanes	***	402	0.8990
Ethyl-benzene	*	106.2	0.8735	Triacontanes	***	416	0.9020
Meta/Para-xylene	*	106.2	0.8671	Hentriacontanes	***	430	0.9060
Ortho-xylene	*	106.2	0.8840	Dotriacontanes	***	444	0.9090
Nonanes	**	121.0	0.7640	Tritriacontanes	***	458	0.9120
1-2-4-T-M-benzene	*	120.2	0.8797	Tetratriacontanes	***	472	0.9140
Decanes	**	134.0	0.7780	Pentatriacontanes	***	486	0.9170

Data Source References :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds.
** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas GPA 2145-96.
*** Journal of Petroleum Technology, Nov 1978, Pages 1649-1655.
Predicting Phase Behavior of Condensate/Crude Oil Systems Using Methane Interaction Coefficients - D.L. Katz & A. Firoozabadi.

Note :
The residue mole weight and density values (eg heptanes plus, undecanes plus, eicosanes plus) are calculated so that the calculated average mole weights and densities correspond with the measured values. This can lead to anomalous residue mole weights and densities where the Katz and Firoozabadi values may not be suitable for

Normal Hydrocarbon Data Used in Liquid Composition Calculations

Component		Mole Weight	Density (g/cc at 60°F)	Component		Mole Weight	Density (g/cc at 60°F)
Hydrogen	*	2.016	N/A	Undecanes	*	156	0.7438
Hydrogen Sulfide	**	34.08	0.8006	Dodecanes	*	170	0.7520
Carbon Dioxide	**	44.01	0.8172	Tridecanes	*	184	0.7609
Nitrogen	**	28.01	0.8086	Tetradecanes	*	198	0.7625
Methane	**	16.04	0.2997	Pentadecanes	*	212	0.7714
Ethane	**	30.07	0.3558	Hexadecanes	*	226	0.7764
Propane	**	44.10	0.5065	Heptadecanes	*	240	0.7789
i-Butane	**	58.12	0.5623	Octadecanes	*	254	0.7812
n-Butane	**	58.12	0.5834	Nonadecanes	*	269	0.7861
i-Pentane	**	72.15	0.6238	Eicosanes	*	283	0.7916
n-Pentane	**	72.15	0.6305	Heneicosanes	*	297	0.7946
Hexanes	**	86.18	0.6631	Docosanes	*	311	0.7973
Me-cyclo-pentane	*	84.16	0.7533	Tricosanes	*	325	0.7996
Benzene	*	78.11	0.8820	Tetracosanes	*	339	0.8017
Cyclo-hexane	*	84.16	0.7827	Pentacosanes	*	353	0.8019
Heptanes	**	100.2	0.6875	Hexacosanes	*	367	0.8071
Me-cyclo-hexane	*	98.19	0.7740	Heptacosanes	*	381	0.8078
Toluene	*	92.14	0.8734	Octacosanes	*	395	0.8093
Octanes	**	114.2	0.7063	Nonacosanes	*	409	0.8112
Ethyl-benzene	*	106.2	0.8735	Triacontanes	*	423	0.8124
Meta/Para-xylene	*	106.2	0.8671	Hentriacontanes	*	437	0.8141
Ortho-xylene	*	106.2	0.8840	Dotriacontanes	*	451	0.8159
Nonanes	**	128.3	0.7212	Tritriacontanes	*	465	0.8179
1-2-4-T-M-benzene	*	120.2	0.8797	Tetratriacontanes	*	479	0.8200
Decanes	**	142.3	0.7335	Pentatriacontanes	*	493	0.8234

Data Source References :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds.
** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas GPA 2145-96.

Quality Assurance

The above work, and data presented herein, was performed by PENCOR (an ISO 9001 registered company) located at 5820 Highway 90 East, Broussard, LA 70518. As part of our quality assurance program, in addition to mass balance checks that must match within 1%, this data was modeled by equation-of-state (EOS) and met specific matching criteria before these results were approved for release. The signatures below verify that this process, and an overall quality assurance review of this report, was performed. All work was carried out according to PENCOR's ISO approved sample handling and analysis procedures. A detailed listing and explanation of these procedures may be found in PENCOR's Reference Manual.

PENCOR is committed to enhancing production by offering the best available reservoir fluid sampling and analytical technology, methodology, personnel and management. Our equipment is regularly calibrated, checked and upgraded as necessary. Our procedures are continually evolving based on the latest industry findings and requirements. Our people are thoroughly trained and held to the highest standards of professional conduct. Our management is committed to providing the resources and manpower necessary to get the timely answers needed to make informed reservoir engineering and production decisions. Constructive feedback is always welcome and we pledge to incorporate these ideas into our ongoing quest to provide the best available service and data in the reservoir fluid sampling and analysis industry.

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