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CORE LABORATORIES UK LTD.
Petroleum Reservoir Engineering
ABERDEEN, SCOTLAND

RESERVOIR FLUID STUDY

for

STATOIL NORWAY

WELL: 34/10-4

DST: 2

NORTH SEA

NORWAY.

- 8 FEB 1980

REGISTRY
OSLORGE
OSLORGE

CORE LABORATORIES UK LTD.

Petroleum Reservoir Engineering

ABERDEEN, SCOTLAND

9th January, 1980

Statoil Norway,
P.O. Box 300,
7001, Stavanger,
Norway.

Attention: Mr. Per Thomassen.

Subject: Reservoir Fluid Study
Well: 34/10-4 DST 2
North Sea, Norway.
Our File Number:
RFLA:79192

Gentlemen:

Fluid samples from the subject well were sent to our laboratory in Aberdeen for use in a reservoir fluid study. The results of that study are tabulated in the following report.

The fluid was subjected to hydrocarbon analysis by both low and high temperature fractional distillation. The analysis to undecanes plus with densities and mole weights is found on page nine. A further breakdown and boiling ranges are given on page ten.

A small portion of the subsurface fluid was analysed by constant composition expansion at the reported reservoir temperature of 71.7°C. During this expansion a saturation pressure of 243.73 barg was measured. The results of the pressure-volume relations are found on page three; the associated compressibility data is tabulated on page two.

A differential vaporization was then performed at 71.7°C. The data including gas-oil ratio, relative oil volume, oil densities and deviation factors are tabulated on page four.

Viscosity was measured in a rolling ball viscosimeter over a wide pressure range at 71.7°C. The sample was found to have a minimum viscosity of 0.00111 pascal seconds at the saturation pressure. The remainder of the data is found on page seven.

A separator test was performed at 0 barg and 18.3°C. The results of this test is on page eleven. The gas and liquid from this test were analysed for hydrocarbons. The gas was analysed to undecanes plus by chromatograph. This data is on page twelve.

Continued/

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Continued/

Page Two.

The liquid was only analysed to C_7+ because there was not enough sample for the high temperature distillation. This analysis is found on page thirteen.

A reservoir fluid composition was calculated to heptanes plus using the compositions from the flash products. This composition is found on page fourteen.

Thank you for the opportunity to perform this reservoir fluid study. It is always a pleasure to serve Statoil, and we look forward to assisting you again in the near future.

Very truly yours
Core Laboratories U.K. Limited



JDO/rmb:
10cc/Addressee:

John D. Owen.
Supervisor.

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File RFLA 79192

Company STATOIL Date Sampled

Well 34/10-4 DST 2 County NORTH SEA

Field State NORWAY

FORMATION CHARACTERISTICS

Formation Name

Date First Well Completed, 19.....

Original Reservoir Pressure PSIG @ Ft.

Original Produced Gas-Liquid Ratio SCF/Bbl

 Production Rate Bbl/Day

 Separator Pressure and Temperature PSIG..... ° F.

 Oil Gravity at 60°F. ° API

Datum Ft. Subsea

Original Gas Cap

WELL CHARACTERISTICS

Elevation Ft.

Total Depth Ft.

Producing Interval Ft.

Tubing Size and Depth In. to..... Ft.

Productivity Index Bbl/D/PSI @ Bbl/Day

Last Reservoir Pressure PSIG @ Ft.

 Date, 19.....

 Reservoir Temperature 71.7 ° C @ Ft.

 Status of Well

 Pressure Gauge

Normal Production Rate Bbl/Day

 Gas-Oil Ratio SCF/Bbl

 Separator Pressure and Temperature PSIG..... ° F.

 Base Pressure PSIA

Well Making Water % Cut

SAMPLING CONDITIONS

Sampled at Ft.

Status of Well

 Gas-Oil Ratio SCF/Bbl

 Separator Pressure and Temperature PSIG..... ° F.

 Tubing Pressure PSIG

 Casing Pressure PSIG

Sampled by

Type Sampler

REMARKS :

Received cylinder 20475-66 on 29th November, 1979.

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Well34/10-4 DST 2.....

VOLUMETRIC DATA OF Reservoir Fluid SAMPLE

1. Saturation pressure (bubble-point pressure) 243.73 BAR G @ 71.7 ° C
2. Specific volume at saturation pressure : L/Kg1.309..... @ 71.7 ° C
3. Thermal expansion of saturated oil @ 344.74 Bar g = $\frac{V @ 71.7 \text{ } ^\circ\text{C}}{V @ 20 \text{ } ^\circ\text{C}} = 1.05055$
4. Compressibility of saturated oil @ reservoir temperature : Vol/Vol/PSI :
 - From 344.74 BAR G to 310.26 BAR G = 7.87×10^{-6}
 - From 310.26 BAR G to 275.79 BAR G = 8.37×10^{-6}
 - From 275.79 BAR G to 243.73 BAR G = 8.33×10^{-6}

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Well34/10-4 DST. 2.....

Pressure-Volume Relations at ..71.7... ° C

<u>Pressure</u> BAR G	RELATIVE VOLUME <u>V/VSAT (1)</u>	Y <u>Function (2)</u>
344.74	0.9881	1.245
310.26	0.9920	1.250
275.79	0.9961	1.255
268.90	0.9969	1.256
262.00	0.9978	1.257
255.11	0.9986	1.258
248.21	0.9995	1.259
<u>243.73</u>	Bubble Point	1.0000
233.59	Pressure	1.260
221.80	1.0085	5.072
200.29	1.0200	4.928
177.33	1.0459	4.702
145.48	1.0839	4.438
119.97	1.1636	4.098
96.04	1.2695	3.796
76.74	1.4292	3.545
61.91	1.6428	3.340
51.16	1.9102	3.173
39.16	2.2050	3.062
29.65	2.7457	2.915
21.51	3.5510	2.735
	4.8958	2.530

(1) Relative Volume: V/Vsat is cubic metres at indicated pressure per cubic metre at saturation pressure.

$$(2) Y \text{ Function} = \frac{(P_{sat}-P)}{(P_{abs})(V/V_{sat}-1)}$$

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Differential Vaporization at 71.7 ° C

Pressure BAR G	Solution Gas/Oil Ratio (1)	Relative Oil Volume (2)	Relative Total Volume (3)	Oil Density KgM/M3	Deviation Factor Z	Gas Formation Volume Factor (4)	Incremental Gas Gravity
243.73	99.0	1.263	1.263	0.7640	0.883	0.00482	0.667
220.63	89.6	1.244	1.289	0.7694	0.880	0.00549	0.642
193.05	78.7	1.222	1.333	0.7764	0.880	0.00641	0.634
165.47	68.2	1.199	1.397	0.7844	0.884	0.00772	0.631
137.89	57.7	1.176	1.495	0.7926	0.895	0.00972	0.630
110.32	46.7	1.153	1.662	0.8010	0.918	0.01326	0.634
82.74	36.0	1.131	1.966	0.8094	0.941	0.02026	0.645
55.16	25.1	1.108	2.605	0.8182	0.970	0.04112	0.674
27.58	13.9	1.085	4.586	0.8269	0.985	0.08059	0.728
13.79	8.2	1.074	8.394	0.8306			1.185
0	0	1.044		0.8432			

At 15°C = 1.000

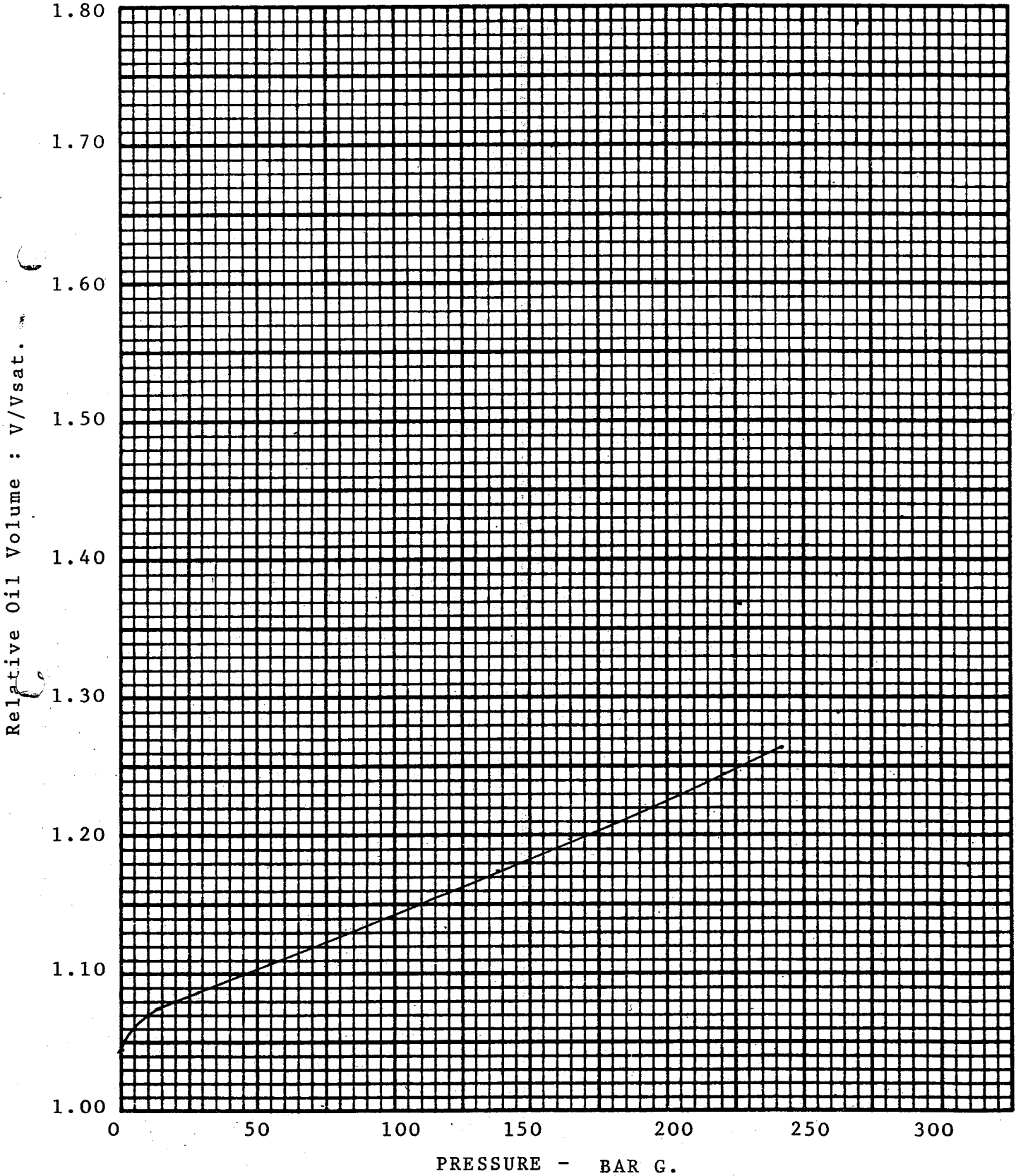
Gravity of residual oil = ... 29.0 ° API @ 15°C

- (1) Cubic feet of gas at 1.013 Bar A and 60°F. per barrel of residual oil at 60°F.
- (2) Barrels of oil at indicated pressure and temperature per barrel of residual oil at 60°F.
- (3) Barrels of oil plus liberated gas at indicated pressure and temperature per barrel of residual oil at 60°F.
- (4) Cubic feet of gas at indicated pressure and temperature per cubic foot at 1.013 BarA and 60°F.

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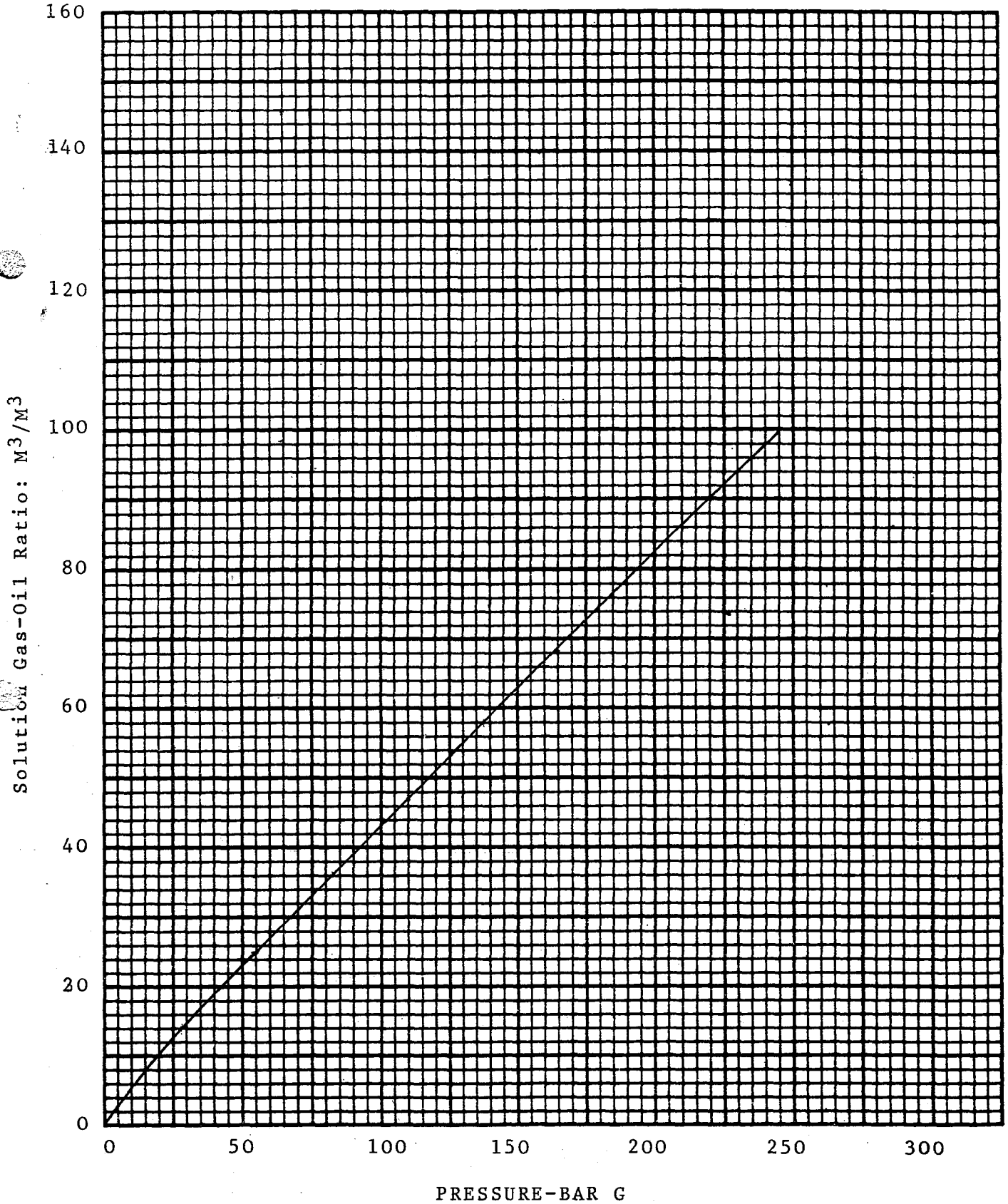
Differential Vaporization of Reservoir Fluid
At 71.7°C.

Company	STATOIL NORWAY	Formation	
Well	34/-10-4 DST 2	County	NORTH SEA
Field		State	NORWAY



Differential Vaporization of Reservoir Fluid
at 71.7°C.

Company STATOIL NORWAY Formation _____
Well 34/10-4 DST 2 County NORTH SEA
Field _____ State NORWAY



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Well ...34/10-4.DST.2

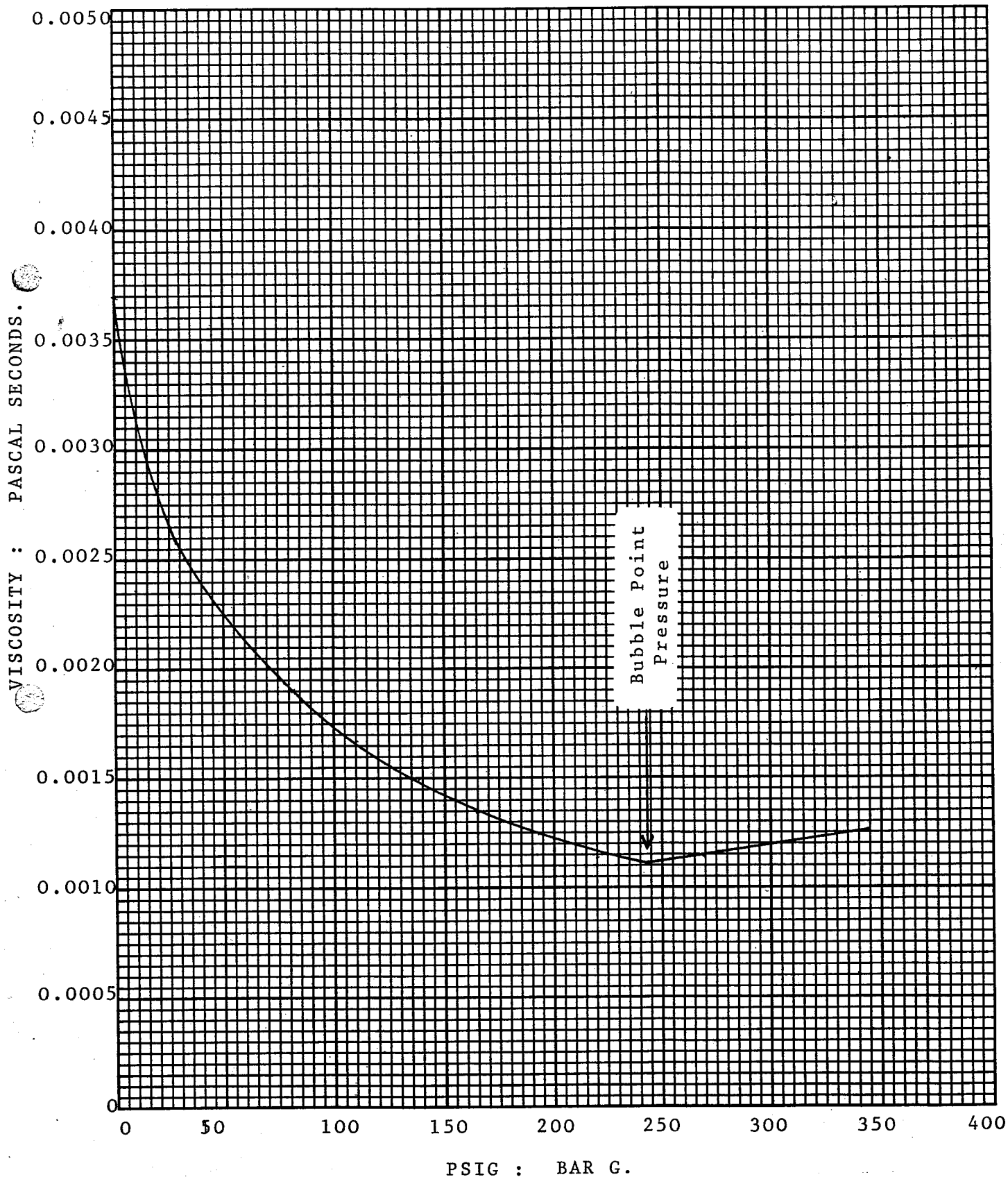
Viscosity Data at 71.7 °C

<u>Pressure</u> Bar g	<u>Oil Viscosity</u> Pascal-second	<u>Calculated</u> <u>Gas Viscosity</u> Pascal-second	<u>Oil/Gas</u> <u>Viscosity</u> <u>Ratio</u>
344.74	0.00126		
310.26	0.00121		
275.79	0.00116		
268.90	0.00114		
262.00	0.00113		
255.11	0.00112		
<u>243.73</u> Bubble Point	0.00111		
220.63 Pressure	0.00114	0.0000213	53.5
193.05	0.00123	0.0000194	63.4
165.47	0.00134	0.0000179	74.9
137.89	0.00149	0.0000166	89.8
110.32	0.00167	0.0000155	107.7
82.74	0.00190	0.0000145	131.0
55.16	0.00218	0.0000136	160.3
27.58	0.00259	0.0000129	200.8
13.79	0.00285	0.0000124	229.8
0	0.00369		

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Viscosity of Reservoir Fluid
at 71.7°C.

Company STATOIL NORWAY Formation _____
Well 34/10-4 DST 2 County NORTH SEA
Field _____ State NORWAY.



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Company ...STATOIL..... Date Sampled
 Well 34/10-4 DST 2..... County NORTH SEA.....
 Field State NORWAY.....

HYDROCARBON ANALYSIS OF RESERVOIR FLUID..... SAMPLE

COMPONENT	MOL PERCENT	WEIGHT PERCENT	DENSITY @ 60° F. GRAMS PER CUBIC CENTIMETER	° API @ 60° F.	MOLECULAR WEIGHT
Hydrogen Sulfide	Nil	Nil			
Carbon Dioxide	1.35	0.52			
Nitrogen	0.59	0.15			
Methane	1 45.03	6.34			
Ethane	2 3.49	0.92			
Propane	3 1.16	0.45			
iso-Butane	4 0.62	0.31			
n-Butane	0.95	0.49			
iso-Pentane	5 0.62	0.39			
n-Pentane	0.44	0.28			
Hexanes	6 0.76	0.57			
Heptanes	7 2.65	1.98	0.7407		93
Octanes	8 3.72	3.17	0.7609		106
Nonanes	9 3.51	3.36	0.7856		119
Decanes	10 2.32	2.48	0.7981		133
Undecanes Plus	32.79	78.59	0.9044	24.8	298
	100.00	100.00			

44.99

$$M_{zt} = 247.6$$

$$P_{zt} = 0.868$$

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Petroleum Reservoir Engineering

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CompanySTATOIL..... Date Sampled

Well34/10-4 DST.2..... CountyNORTH SEA.....

Field StateNORWAY.....

HYDROCARBON ANALYSIS OF ...RESERVOIR..FLUID. SAMPLE

COMPONENT	Mol Percent
Hydrogen Sulphide	Nil
Carbon Dioxide	1.35
Nitrogen	0.59
Methane	45.03
Ethane	3.49
Propane	1.16
iso-Butane	0.62
n-Butane	0.95
iso-Pentane	0.62
n-Pentane	0.44
Hexanes	0.76
Methyl Cyclopentane	0.52
Benzene	0.08
Cyclohexane	0.62
Heptanes	1.43
Methyl Cyclohexane	1.07
Toluene	0.83
Octanes	1.82
Ethyl Benzene	0.36
Meta + Para Xylene	1.05
Ortho Xylene	0.13
Nonanes	1.97
1,2,4 Trimethyl Benzene	0.19
Decanes	2.13
Undecanes Plus	32.79
	100.00

Component

Boiling Range

Hexanes	36.5 to 69.2 °C
Heptanes	69.2 to 98.9 °C
Octanes	98.9 to 126.1 °C
Nonanes	126.1 to 151.3 °C
Decanes	151.3 to 174.6 °C

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Well34/10-4 DST 2.....

SEPARATOR TESTS OF ..RESERVOIR..FLUID..... SAMPLE

SEPARATOR PRESSURE Bar G	SEPARATOR TEMPERATURE ° C	Separator GAS/OIL RATIO (1)	Stock Tank GAS/OIL RATIO (1)	STOCK TANK GRAVITY ° API @ 60° F.	Shrinkage factor VR/VSAT (2)	VOLUME FACTOR (3)	SPECIFIC GRAVITY OF FLASHED GAS
0	18.3	101		28.9	0.790	1.266	0.700

- (1) Separator and Stock tank Gas/Oil Ratio in Cubic metre of gas @ 15°C and 1.013 bar absolute per cubic metre of stock tank oil @ 15°C.
- (2) Shrinkage factor: Vr/Vsat. is cubic metres of stock tank oil @ 15°C per cubic metre of saturated oil @ 243.73 Bar g and 71.7°C.
- (3) Formation Volume factor: Vsat/Vr is cubic metres of saturated oil @ 243.73 Bar g and 71.7°C per Cubic metre of stock tank oil @ 15°C

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Company STATOIL Date Sampled _____
 Well 34/10-4 DST.2 County NORTH.SEA
 Field _____ State NORWAY

HYDROCARBON ANALYSIS OF SEPARATOR GAS SAMPLE

Component	Mol Percent	T/MMm ³
Hydrogen Sulfide	Nil	
Carbon Dioxide	2.55	
Nitrogen	1.10	
Methane	84.32	
Ethane	6.46	
Propane	2.11	39.27
iso-Butane	0.75	18.40
n-Butane	1.02	24.02
iso-Pentane	0.48	14.62
n-Pentane	0.31	9.44
Hexanes	0.44	15.93
Heptanes	0.37	20.00 *
Octanes	0.08	
Nonanes	0.01	
Decanes	trace	
Undecanes Plus	<u>trace</u>	
	100.00	<u>141.68</u>

Calculated Gas Gravity = 0.700

(Air = 1.000)

Calculated Gross heating value = 291.06

K Cal per cubic foot of dry gas
14 Bar g and 15 Deg C.

Collected at 0
and 16 Deg.

* T/MMm³ for Heptanes plus fraction

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Company ...STATOIL..... Date Sampled
 Well34/10-4 DST.2..... CountyNORTH SEA.....
 Field StateNORWAY.....

HYDROCARBON ANALYSIS OF STOCK TANK OIL..... SAMPLE

COMPONENT	MOL PERCENT	WEIGHT PERCENT	DENSITY @ 60° F. GRAMS PER CUBIC CENTIMETER	° API @ 60° F.	MOLECULAR WEIGHT
Hydrogen Sulfide	Nil	Nil			
Carbon Dioxide	0.04	0.01			
Nitrogen	Nil	Nil			
Methane	0.50	0.04			
Ethane	0.24	0.03			
Propane	0.22	0.04			
iso-Butane	0.49	0.12			
n-Butane	0.88	0.22			
iso-Pentane	0.76	0.24			
n-Pentane	0.57	0.18			
Hexanes	1.21	0.45			
Heptanes plus	95.09	98.67	0.8870	27.9	237
	<u>100.00</u>	<u>100.00</u>			

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ABERDEEN, SCOTLAND

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Company ..STATOIL..... Date Sampled ..
Well34/10-4 DST 2..... County NORTH SEA.....
Field StateNORWAY.....

HYDROCARBON ANALYSIS OF ...RESERVOIR FLUID.... SAMPLE

CALCULATED

COMPONENT	Mol Percent
Hydrogen Sulfide	Nil
Carbon Dioxide	1.36
Nitrogen	0.58
Methane	44.56
Ethane	3.51
Propane	1.23
iso-Butane	0.63
n-Butane	0.95
iso-Pentane	0.61
n-Pentane	0.43
Hexanes	0.81
Heptanes plus	45.33
	100.00

Core Laboratories U.K. Limited
Reservoir Fluid Analysis

John D. Owen

John D. Owen.
Supervisor.

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