

CORE LABORATORIES UK LTD.
PETROLEUM RESERVOIR ENGINEERING
ABERDEEN, SCOTLAND

RESERVOIR FLUID STUDY

for

STATOIL A/S

Well: 34/10-5
North Sea,
Norway.

CORE LABORATORIES UK LTD.
PETROLEUM RESERVOIR ENGINEERING
ABERDEEN, SCOTLAND

28th June, 1980.

Statoil A/S
P.O. Box 300,
4001, Stavanger,
Norway.

Attention: Mr. Per Thomassen.

Subject: Reservoir Fluid Study
Well: 34/10-5
North Sea, Norway.
Our File Number:
RFLA: 80016

Gentlemen:

A fluid sample from the subject well was sent to our laboratory in Aberdeen for use in a Reservoir Fluid Study. The results of this study are presented in the following report.

A portion of the reservoir fluid was examined in a high pressure visual cell at the reported reservoir temperature of 73.7°C. During a constant composition expansion at this temperature a bubble point of 223.25 Bar G was observed. The results of the pressure/volume relations are found on page three and the associated compressibility data is tabulated on page two.

A differential vaporization was then performed at the reservoir temperature of 73.7°C. During the differential pressure depletion the fluid evolved a total of 87.45 standard cubic metres of gas per barrel of residual oil at 15°C. The resulting relative oil volume factor was 1.238 cubic metres of saturated oil per cubic metre of residual oil at 15°C. The oil density and the properties of the evolved gases were measured at each point during the differential pressure depletion and these data are included in the summary of the differential depletion data on page four.

The viscosity of the reservoir fluid was measured over a wide range of pressures at 73.7°C. in a rolling ball viscosimeter. The viscosity of the fluid was found to vary from a minimum of 0.00115 pascal/second at the saturation pressure to a maximum of 0.00338 pascal/second at atmospheric pressure. The results of the viscosity measurement are tabulated on page seven, and graphically represented on page eight.

Continued/.....

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Continued/.....

Page Two.

A zero Bar G. separator test was then performed at 20°C. The results of this test are presented on page nine. The associated gas and liquid from this separator test were analysed for hydrocarbon composition. The gas was analysed using chromatographic procedures to undecanes plus and this data is presented on page ten. The liquid sample was analysed for hydrocarbon composition by fractional distillation apparatus and the results of this test in terms of both mol percent and weight percent is presented on page eleven.

The composition of the reservoir fluid was then calculated utilizing the separator compositions and the gas/oil ratio. This composition may be found on page twelve.

As always, it is a pleasure to be of service to Statoil A/S. Should any questions arise concerning this study, please do not hesitate to contact us.

Very truly yours
Core Laboratories U.K. Limited



JDO/rmb:
10cc/Addressee:

John D. Owen.
Manager-RFL

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ABERDEEN, SCOTLAND

Page1..... of12.....

FileRFLA 80016.....

Company ..Statoil..... Date Sampled
 Well34/10-5..... 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 73.7°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 20475.67

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Page2..... of12.....

FileRFLA 80016.....

Well34/10-5.....

VOLUMETRIC DATA OF Reservoir Fluid.... SAMPLE

1. Saturation pressure (bubble-point pressure)223.25 BAR G @73.7°C

2. Specific volume at saturation pressure : L/Kg1.3192..... @73.7°C

3. Thermal expansion of saturated oil @ 344.74 Bar G $\frac{V @ 73.7^{\circ}\text{C}}{V @ 17^{\circ}\text{C}} = 1.04572$

4. Compressibility of saturated oil @ reservoir temperature : Vol/Vol/PSI :

From 344.74 BAR G to 310.26 BAR G = 7.46×10^{-6}

From 310.26 BAR G to 275.79 BAR G = 7.86×10^{-6}

From 275.79 BAR G to 241.32 BAR G = 8.21×10^{-6}

From 241.32 BAR G to 223.25 BAR G = 9.28×10^{-6}

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Page3..... of12.....

File RFLA 80016

Well 34/10-5

Pressure-Volume Relations at 73.7°C

Pressure BAR G		Relative Volume (1)	Y Function (2)
344.74		0.9859	
310.26		0.9896	
275.79		0.9935	
241.32		0.9976	
234.42		0.9985	
227.53		0.9994	
<u>223.25</u>	Saturation pressure	1.0000	
219.25		1.0041	4.462
207.67		1.0170	4.393
187.95		1.0438	4.260
166.03		1.0837	4.092
145.07		1.1361	3.933
123.07		1.2151	3.754
103.90		1.3191	3.564
84.81		1.4755	3.392
68.40		1.6931	3.218
56.61		1.9328	3.099
47.64		2.1994	3.008
36.27		2.7347	2.890
28.20		3.3761	2.808

(1) Relative Volume : V/V_{sat} is barrels at indicated pressure per barrel at saturation pressure.

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

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Differential Vaporization at 73.7 °C

Pressure BAR G	Solution Gas/Oil Ratio (1)	Relative Oil Volume (2)	Relative Total Volume (3)	Oil Density Kg _m /m ³	Deviation Factor Z	Gas Formation Volume Factor (4)	Incremental Gas Gravity
223.25	87.45	1.238	1.238	0.7697			
206.84	80.50	1.224	1.260	0.7740	0.884	0.00519	0.661
179.26	69.64	1.200	1.308	0.7815	0.894	0.00604	0.638
151.68	58.78	1.179	1.385	0.7897	0.905	0.00722	0.625
124.11	48.62	1.157	1.504	0.7975	0.916	0.00894	0.621
96.53	38.47	1.136	1.705	0.8054	0.928	0.01161	0.623
68.95	28.14	1.115	2.087	0.8136	0.943	0.01642	0.628
41.37	17.99	1.095	3.012	0.8216	0.961	0.02760	0.653
13.79	6.41	1.068	7.634	0.8328	0.984	0.08103	0.707
0.00	0.00	1.046		0.8432			0.939

At 15°C = 1.000

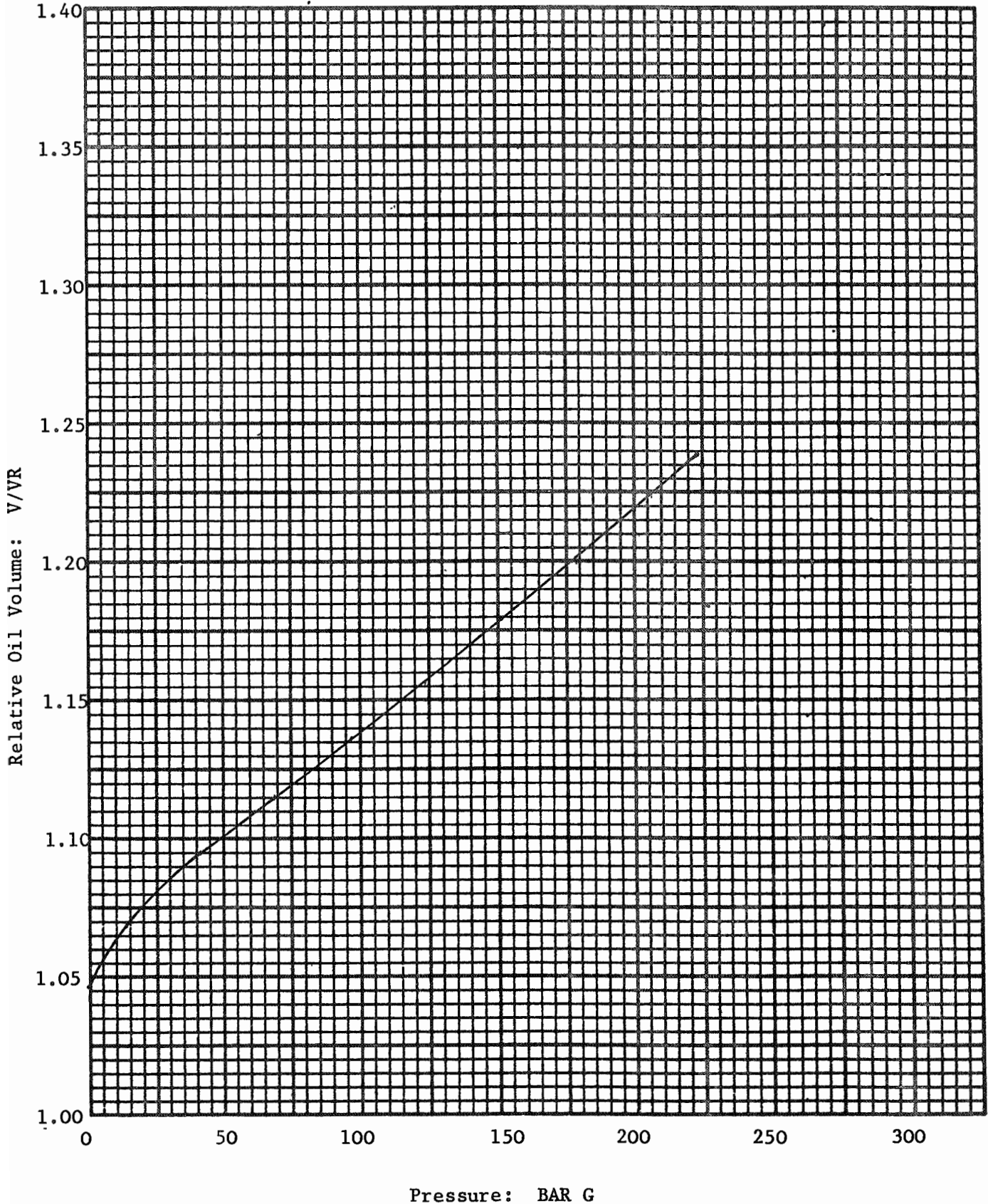
Gravity of residual oil = .28.9 ° API @ 15°C

- (1) Cubic metres of gas at 1.013 BAR Absolute and 15°C per barrel of residual oil at 15°C.
- (2) Cubic metres of oil at indicated pressure and temperature per cubic metre of residual oil at 15°C.
- (3) Cubic metres of oil plus liberated gas at indicated pressure and temperature per cubic metre of residual oil at 15°C.
- (4) Cubic metres of gas at indicated pressure and temperature per cubic metre at 1.013 BAR Absolute and 15°C.

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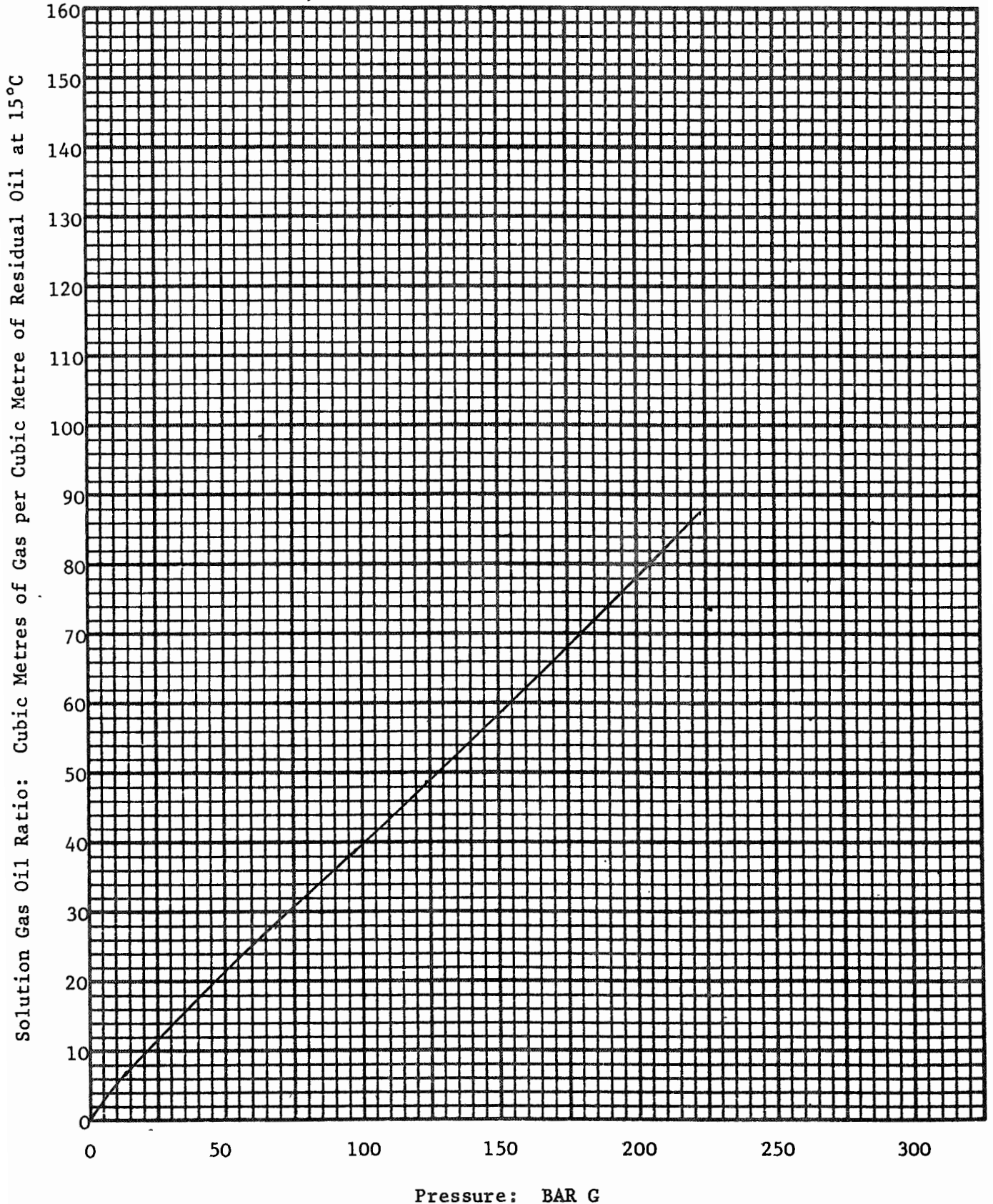
Differential Vaporization of Reservoir Fluid at 73.7°C

Company Statoil Formation _____
Well 34/10-5 County North Sea
Field _____ State Norway



Differential Vaporization of Reservoir Fluid at 73.7°C

Company Statoil Formation _____
Well 34/10-5 County North Sea
Field _____ State Norway



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ABERDEEN, SCOTLAND

Page7..... of12.....

FileRFLA 80016.....

Well34/10-5.....

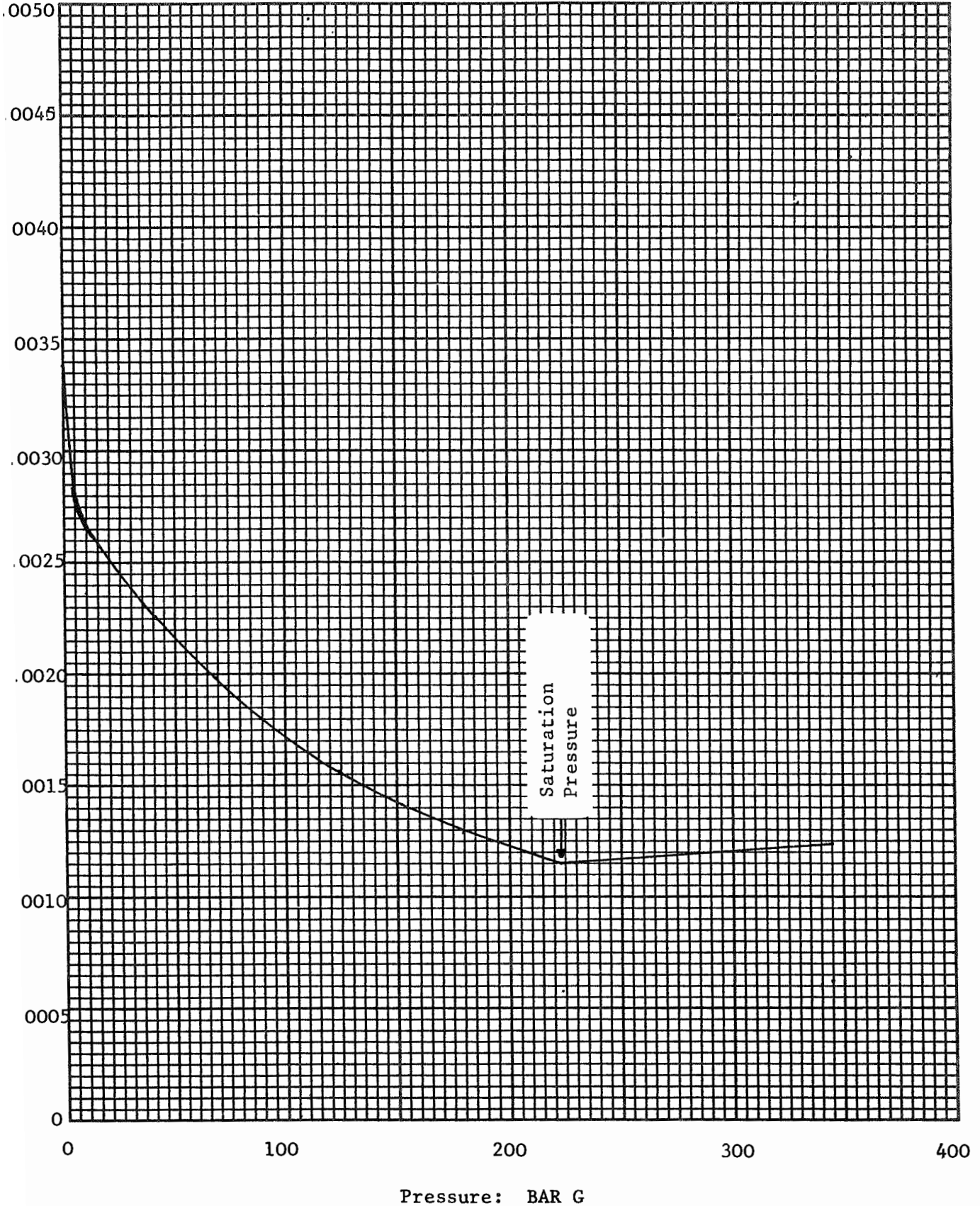
Viscosity Data at 73.7°C

Pressure BAR G	Oil Viscosity Pascal - Second	Calculated Gas Viscosity Pascal - Second	Oil/Gas Viscosity Ratio
344.74	0.00124		
310.26	0.00121		
275.79	0.00118		
241.32	0.00116		
223.25	0.00115		
206.84	0.00120	0.0000203	59.11
179.26	0.00129	0.0000185	69.73
151.68	0.00141	0.0000170	82.94
124.11	0.00156	0.0000159	98.11
96.53	0.00175	0.0000149	117.45
68.95	0.00199	0.0000141	141.13
41.37	0.00226	0.0000133	169.92
13.79	0.00261	0.0000125	208.80
0.00	0.00338		

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Viscosity of Reservoir Fluid at 73.7°C

Company Statoil Formation _____
Well 34/10-5 County North Sea
Field _____ State Norway



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ABERDEEN, SCOTLAND

Page 9 of 12

File RFLA 80016

Well 34/10-5

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 (2)	Formation VOLUME FACTOR (3)	SPECIFIC GRAVITY OF FLASHED GAS
0	20	89.4		28.6	0.801	1.248	0.672

- (1) Gas/oil ratio in cubic metres of gas at 15°C. and 1.013 Bar Absolute per cubic metre of oil at 15°C.
- (2) Shrinkage factor : V_r/V_{sat} is cubic metres of stock tank oil at 15°C. per cubic metre of saturated oil at 223.25 Bar G and 73.7°C.
- (3) Formation Volume Factor is cubic metres of saturated oil at 223.25 Bar G and 73.7°C. per cubic metre of stock tank oil at 15°C.

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ABERDEEN, SCOTLAND

Page 10 of 12

File RFLA 80016

Company STATOIL Date Sampled _____
 Well 34/10-5 County NORTH SEA
 Field _____ State NORWAY

HYDROCARBON ANALYSIS OF STOCK TANK GAS SAMPLE

Component	Mol Percent	GPM
Hydrogen Sulfide	Nil	
Carbon Dioxide	0.91	
Nitrogen	1.10	
Methane	86.62	
Ethane	7.09	
Propane	1.20	0.329
iso-Butane	0.65	0.212
n-Butane	0.92	0.289
iso-Pentane	0.40	0.146
n-Pentane	0.26	0.094
Hexanes	0.39	0.159
Heptanes	0.36)
Octanes	0.08)
Nonanes	0.01) 0.208
Decanes	0.01)
Undecanes Plus	<u>Trace</u>)
	100.00	<u>1.437</u>

Calculated Gas Gravity = 0.672 (Air = 1.000)
 Calculated Gross heating value = 1153 BTU per cubic foot of dry gas at
 14.73 psia and 60 Deg F.

Collected at 0 Bar G
 and 20 Deg. C.

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Petroleum Reservoir Engineering

ABERDEEN, SCOTLAND

Page 11 of 12

File RFLA 80016

Company STATOIL Date Sampled _____
 Well 34/10-5 County NORTH SEA
 Field _____ State NORWAY

HYDROCARBON ANALYSIS OF STOCK TANK SAMPLE

COMPONENT	MOL PERCENT	WEIGHT PERCENT	DENSITY @ 60° F. GRAMS PER CUBIC CENTIMETER	° API @ 60° F.	MOLECULAR WEIGHT
Hydrogen Sulfide	Nil	Nil			
Carbon Dioxide	0.01	Trace			
Nitrogen	Nil	Nil			
Methane	0.52	0.03			
Ethane	0.26	0.03			
Propane	0.16	0.03			
iso-Butane	0.22	0.05			
n-Butane	0.46	0.11			
iso-Pentane	0.54	0.16			
n-Pentane	0.46	0.14			
Hexanes	1.32	0.47			
Heptanes plus	<u>96.05</u>	<u>98.98</u>	0.8863	28.0	248
	100.00	100.00			

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Petroleum Reservoir Engineering
ABERDEEN, SCOTLAND

Page 12 of 12

File RFLA 80016

Company STATOIL Date Sampled
Well 34/10-5 County NORTH SEA
Field State NORWAY

CALCULATED
HYDROCARBON ANALYSIS OF WELLSTREAM GAS SAMPLE

Component	Mol Percent
Hydrogen Sulfide	Nil
Carbon Dioxide	0.47
Nitrogen	0.56
Methane	44.32
Ethane	3.73
Propane	0.69
iso-Butane	0.44
n-Butane	0.69
iso-Pentane	0.47
n-Pentane	0.36
Hexanes	0.85
Heptanes plus	<u>47.42</u>
	100.00

Core Laboratories U.K. Limited
Reservoir Fluid Analysis.

John D. Owen

John D. Owen.
Manager-RFL

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