

Denne rapport  
tilhører

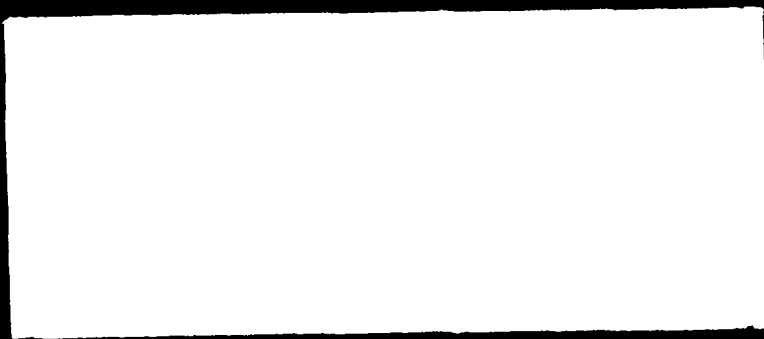


**L&U DOK. SENTER**

L. NR. 20088390067

KODE Well 31/2-2 nr 50

Returneres etter bruk



**CORE LABORATORIES UK LTD.**

*Petroleum Reservoir Engineering*

**ABERDEEN, SCOTLAND**

A/S NORSKE SHELL EXPLORATION & PRODUCTION  
Well: 31/2-2

RFLA: 80078A

Core Laboratories UK Limited  
Reservoir Fluid Analysis

A handwritten signature in black ink, appearing to read 'L.K. Sebborn', written in a cursive style.

Les K. Sebborn  
Laboratory Manager-RFL

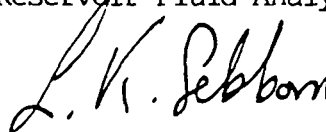
At conditions stipulated by A/S Norske Shell Exploration & Production, a series of flash separations were performed at laboratory temperature. The factors and data derived from these tests may be found on page twelve.

At each stage of separation, the gas evolved was collected and analysed for hydrocarbon composition. These compositions are presented on pages thirteen and fourteen.

It is a pleasure to be of service to A/S Norske Shell Exploration & Production. Should any questions arise concerning data presented in this report, or if we can be of further assistance, please do not hesitate to contact us.

Yours very truly

Core Laboratories UK Limited  
Reservoir Fluid Analysis



Les K. Sebborn  
Laboratory Manager

LKS/DT/STB  
10cc/Addressee

**CORE LABORATORIES UK LTD.**  
*Petroleum Reservoir Engineering*  
**ABERDEEN, SCOTLAND**

RESERVOIR FLUID STUDY

for

A/S Norske Shell Exploration & Production

Well: 31/2-2

North Sea, Norway.

**CORE LABORATORIES UK LTD.**

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ABERDEEN, SCOTLAND

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Company A/S Norske Shell Expl. & Prod. Date Sampled 14th April 1981

Well 31/2-2 State North Sea

Field \_\_\_\_\_ Country Norway

**FORMATION CHARACTERISTICS**

Formation Name	_____
Date First Well Completed	_____, 19__
Original Reservoir Pressure	_____ PSIG @ _____ M.
Original Produced Gas-Oil Ratio	_____ SCF/Bbl
Production Ratio	_____ Bbl/Day
Separator Pressure and Temperature	_____ PSIG _____ °F.
Oil Gravity at 60°F.	_____ °API
Datum	_____ M. Subsea
Original Gas Cap	_____

**WELL CHARACTERISTICS**

Elevation	_____	M.
Total Depth	_____	M.
Producing Interval	_____	M.
Tubing Size and Depth	_____ In. to _____	M.
Productivity Index	_____ Bbl/D/PSI @ _____	Bbl/Day
Last Reservoir Pressure	2287 _____ PSIG @ 1557 _____	M.
Date	_____, 19__	
Reservoir Temperature	160 _____ °F. @ _____	M.
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	1557 _____	M.
Status of Well	_____	
Gas-Oil Ratio	_____	SCF/Bbl
Separator Pressure and Temperature	_____ PSIG, _____	°F.
Tubing Pressure	_____	PSIG
Casing Pressure	_____	PSIG
Sampled by	Schlumberger	
Type Sampler	RFT	
Sampler Number	8.5*	

REMARKS: \*Transferred to cylinder numbers ss692 and ss837.

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Company A/S Norske Shell Expl. & Prod. Formation \_\_\_\_\_

Well 31/2-2 County North Sea

Field \_\_\_\_\_ State Norway

HYDROCARBON ANALYSIS OF RESERVOIR FLUID SAMPLE

COMPONENT	MOL PERCENT	WEIGHT PERCENT	DENSITY	API	MOL WEIGHT
Hydrogen Sulfide	NIL	NIL			
Carbon Dioxide	0.11	0.03			
Nitrogen	0.21	0.04			
Methane	36.81	3.75			
Ethane	3.33	0.64			
Propane	0.67	0.19			
iso-Butane	0.70	0.26			
n-Butane	0.18	0.07			
iso-Pentane	0.23	0.11			
n-Pentane	0.08	0.04			
Hexanes	0.39	0.21			
Heptanes plus	57.29	94.66	0.9038	24.9	260
	<u>100.00</u>	<u>100.00</u>			

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Petroleum Reservoir Engineering

ABERDEEN, SCOTLAND

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Well 31/2-2

VOLUMETRIC DATA OF RESERVOIR FLUID SAMPLE

1. Saturation pressure (bubble-point pressure) 2280 PSIG @ 160 °F.
2. Thermal expansion of saturated oil @ 5000 PSIG =  $\frac{V @ 160 \text{ °F.}}{V @ 63 \text{ °F.}} = \underline{1.04262}$
3. Compressibility of saturated oil @ reservoir temperature: Vol/Vol/PSI:  
From 5000 PSIG to 4000 PSIG =  $6.13 \times 10^{-6}$   
From 4000 PSIG to 3000 PSIG =  $6.61 \times 10^{-6}$   
From 3000 PSIG to 2500 PSIG =  $7.07 \times 10^{-6}$   
From 2500 PSIG to 2280 PSIG =  $7.14 \times 10^{-6}$
4. Specific volume at saturation pressure: ft<sup>3</sup>/lb 0.01976 @ 160 °F.

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Well 31/2-2

PRESSURE-VOLUME RELATIONS AT 160°F.

<u>Pressure</u> <u>PSIG</u>	<u>Relative</u> <u>Volume(1)</u>	<u>Y</u> <u>Function(2)</u>
5000	0.9823	
4000	0.9883	
3000	0.9949	
2700	0.9970	
2600	0.9977	
2500	0.9984	
2400	0.9992	
2300	0.9998	
<u>2280</u> Saturation Pressure	1.0000	
2253	1.0026	4.567
2243	1.0036	4.558
2158	1.0128	4.393
2077	1.0231	4.331
1922	1.0438	4.220
1692	1.0853	4.042
1447	1.1480	3.852
1226	1.2319	3.663
1036	1.3371	3.510
924	1.4214	3.426
799	1.5479	3.322
678	1.7168	3.224
573	1.9280	3.132
438	2.3480	3.013
324	2.9827	2.913
225	4.0391	2.820

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

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



DIFFERENTIAL VAPORISATION AT 160°F.

Pressure PSIG	Solution Gas/Oil Ratio(1)	Relative Oil Volume(2)	Relative Total Volume(3)	Oil Density gm/cc	Deviation Factor Z	Gas Formation Volume Factor(4)	Incremental Gas Gravity
2280	308	1.165	1.165	0.8109			
2000	271	1.152	1.202	0.8159	0.897	0.00782	0.603
1700	234	1.138	1.260	0.8212	0.910	0.00932	0.601
1400	196	1.125	1.351	0.8267	0.914	0.01134	0.600
1100	157	1.111	1.503	0.8325	0.926	0.01459	0.600
800	117	1.096	1.785	0.8386	0.937	0.02019	0.602
500	75	1.082	2.430	0.8446	0.953	0.03250	0.616
250	39	1.068	4.165	0.8508	0.974	0.06455	0.648
100	15	1.057	8.955	0.8561	0.990	0.15119	0.725
0	0	1.042		0.8643			1.143
		At 60°F = 1.000					

Gravity of Residual Oil = 25.4° API at 60°F.

- (1) Cubic feet of gas at 14.73 psia 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 14.73 psia and 60°F.

DIFFERENTIAL VAPORISATION OF RESERVOIR FLUID AT 160°F.

Component	Pressure - PSIG.								
	2000	1700	1400	1100	800	500	250	100	0*
Carbon Dioxide	0.25	0.24	0.23	0.22	0.23	0.26	0.32	0.39	0.59
Nitrogen	1.82	1.40	1.06	0.76	0.50	0.29	0.15	0.08	0.04
Methane	93.47	93.77	93.86	93.78	93.64	91.71	87.80	78.86	35.55
Ethane	3.22	3.38	3.66	3.98	4.24	5.95	8.87	14.86	36.77
Propane	0.35	0.37	0.39	0.43	0.50	0.67	1.11	2.20	10.63
iso-Butane	0.27	0.27	0.26	0.30	0.34	0.45	0.74	1.57	8.66
n-Butane	0.05	0.05	0.05	0.05	0.06	0.08	0.13	0.29	1.87
iso-Pentane	0.05	0.05	0.05	0.05	0.05	0.07	0.11	0.25	1.43
n-Pentane	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.08	0.51
Hexanes	0.13	0.12	0.12	0.12	0.12	0.13	0.19	0.36	1.21
Heptanes plus	0.37	0.33	0.30	0.29	0.30	0.37	0.55	1.06	2.74
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Calculated gas gravity (air = 1.000):

0.603      0.601      0.600      0.600      0.602      0.616      0.648      0.725      1.144

Calculated gross heating value - BTU per cubic foot of dry gas at 14.73 psia and 60°F.

1053      1056      1061      1067      1074      1099      1148      1268      1915

\* Gas evolved between 100 psig and 0 psig.

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G.P.M. VALUES FOR PRODUCED GASES.

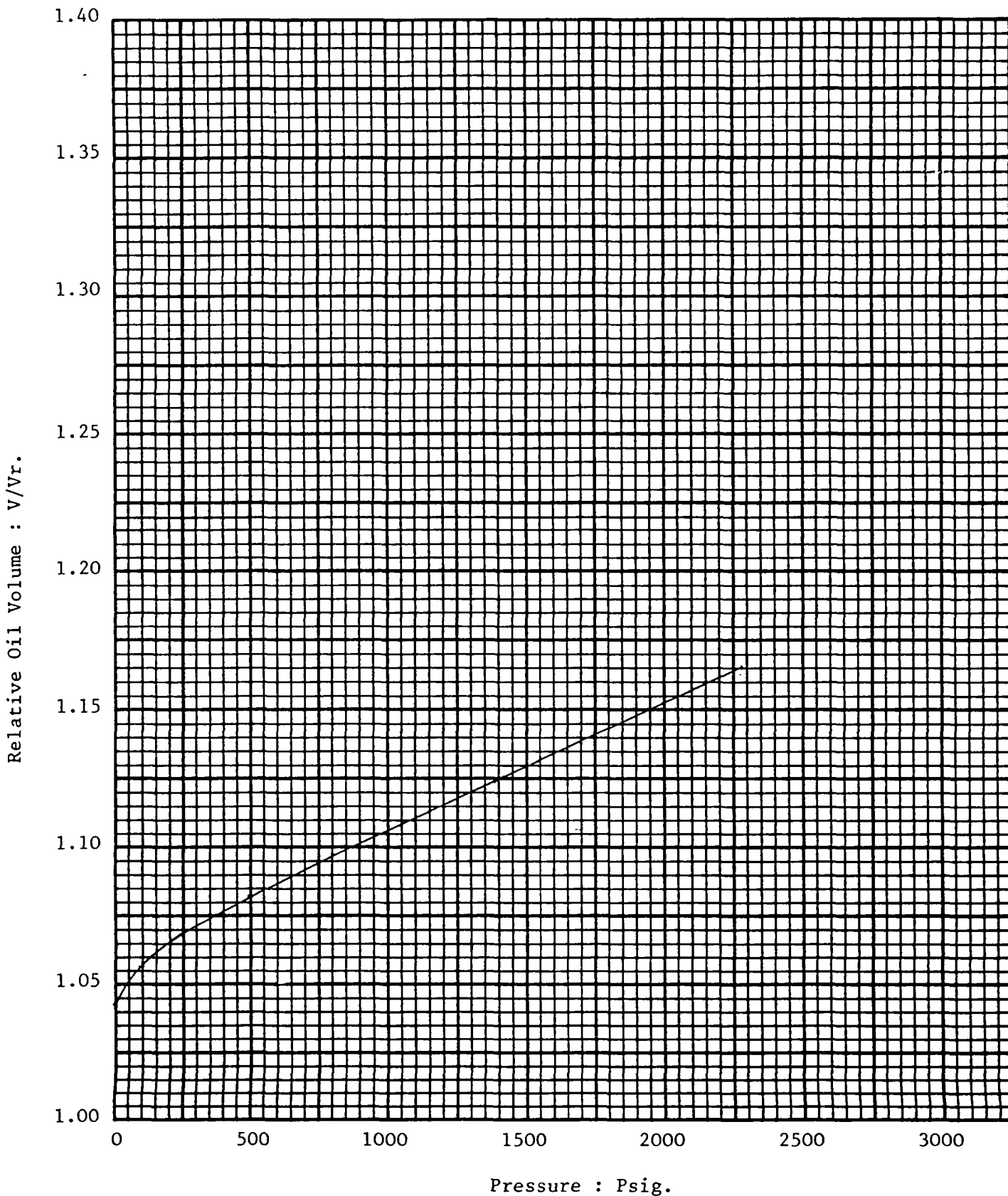
Component	Pressure - PSIG.								
	2000	1700	1400	1100	800	500	250	100	0*
Propane	0.096	0.102	0.107	0.118	0.138	0.184	0.305	0.605	2.924
iso-Butane	0.088	0.088	0.085	0.098	0.111	0.147	0.242	0.513	2.832
n-Butane	0.016	0.016	0.016	0.016	0.019	0.025	0.041	0.091	0.589
iso-Pentane	0.018	0.018	0.018	0.018	0.018	0.026	0.040	0.092	0.523
n-Pentane	0.007	0.007	0.007	0.007	0.007	0.007	0.011	0.029	0.185
Hexanes	0.053	0.049	0.049	0.049	0.049	0.053	0.078	0.147	0.494
Heptanes plus	0.168	0.150	0.136	0.132	0.136	0.168	0.250	0.481	1.244
	<u>0.446</u>	<u>0.430</u>	<u>0.418</u>	<u>0.438</u>	<u>0.478</u>	<u>0.610</u>	<u>0.967</u>	<u>1.958</u>	<u>8.791</u>

\* Gas evolved between 100 psig and 0 psig.

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Differential Vaporisation of Reservoir Fluid at 160°F.

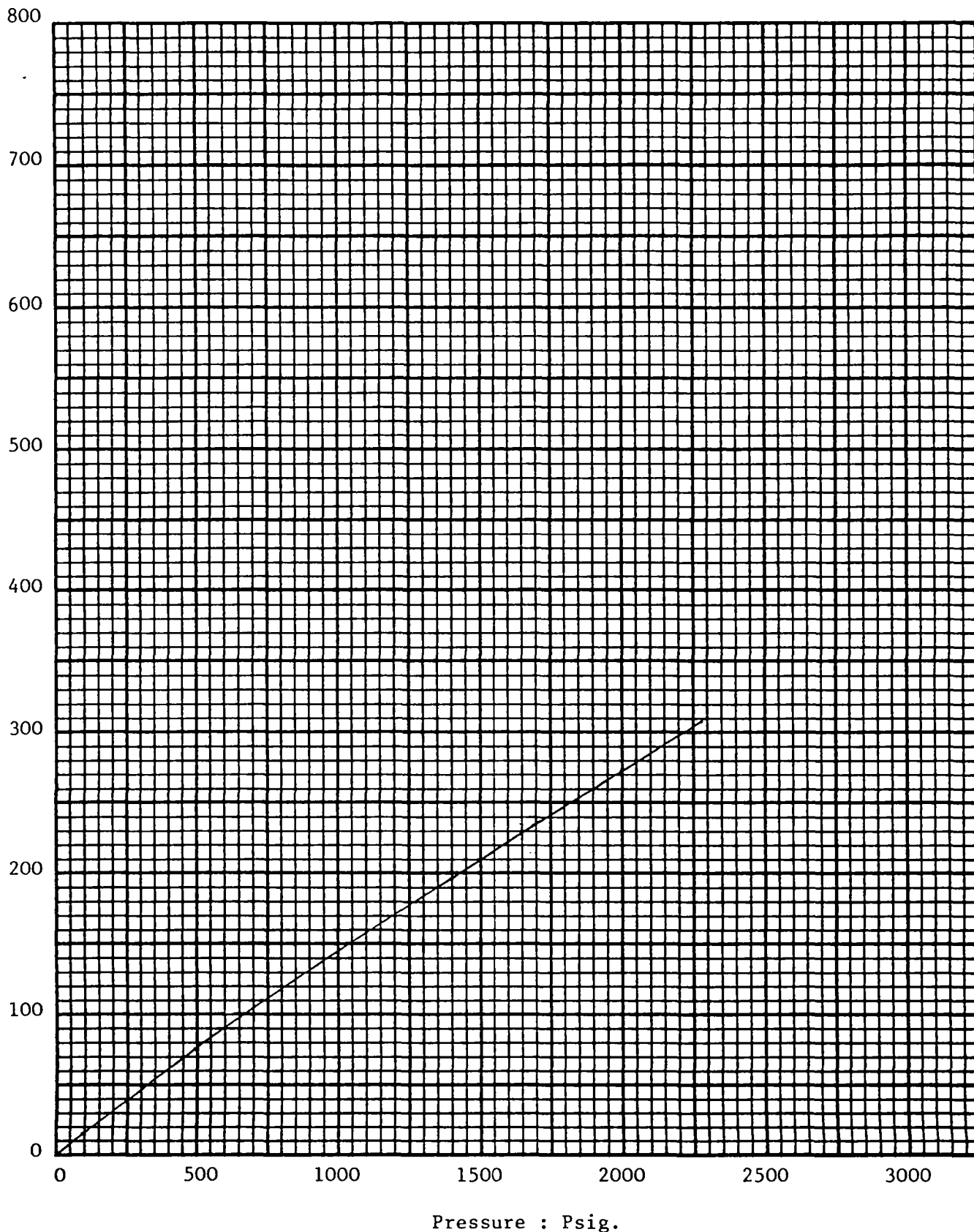
Company A/S Norske Shell Expl. & Prod. Formation \_\_\_\_\_  
Well 31/2-2 County North Sea  
Field \_\_\_\_\_ State Norway



Differential Vaporisation of Reservoir Fluid at 160°F.

Company A/S Norske Shell Expl. & Prod. Formation \_\_\_\_\_  
Well 31/2-2 County North Sea  
Field \_\_\_\_\_ State Norway

Solution Gas-Oil Ratio : Standard Cubic Feet of Gas per Barrel of Residual Oil.



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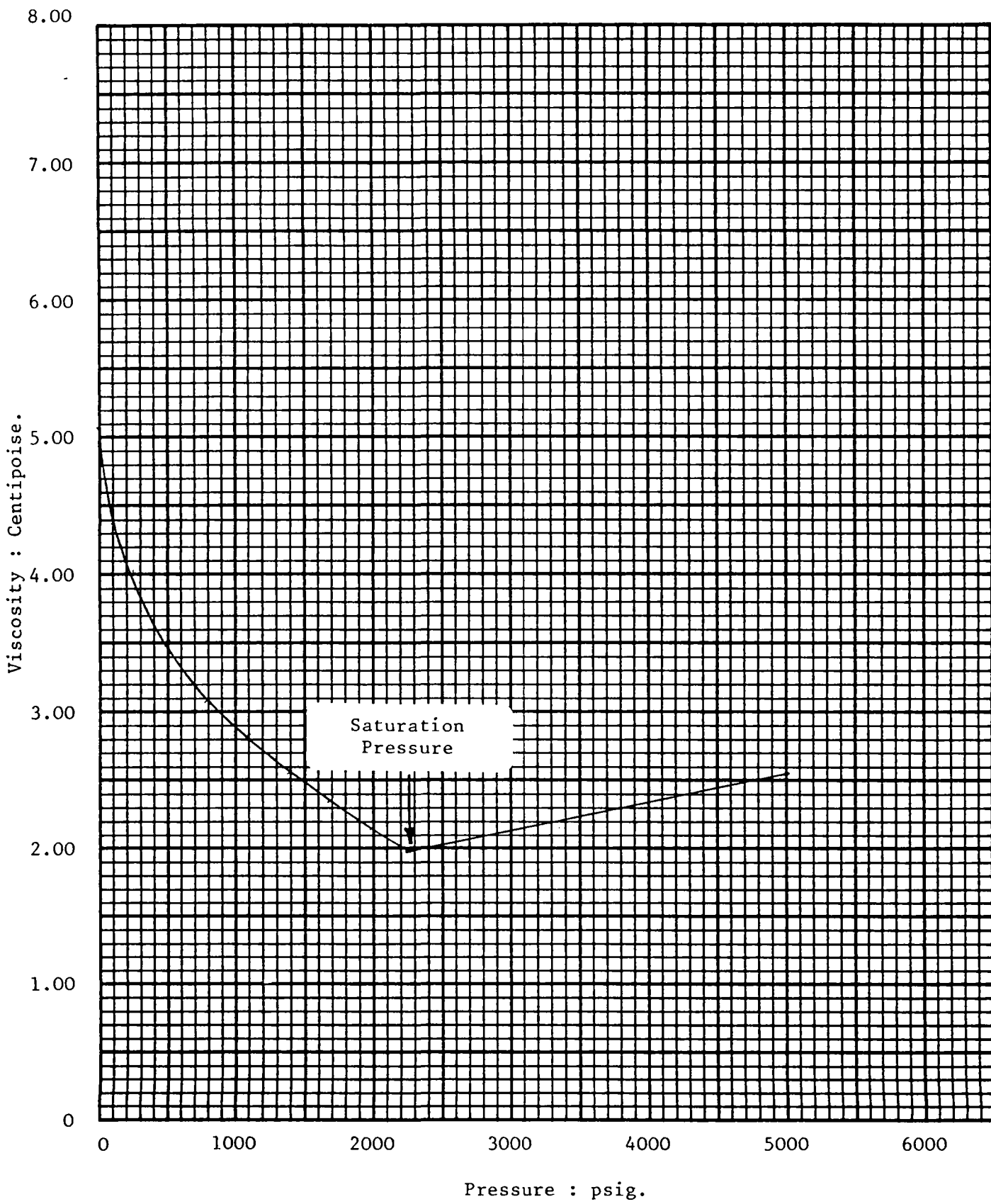
Well 31/2-2

VISCOSITY DATA AT 160°F.

<u>Pressure</u> <u>PSIG</u>	<u>Oil Viscosity</u> <u>Centipoise</u>	<u>Calculated</u> <u>Gas Viscosity</u> <u>Centipoise</u>	<u>Oil/Gas</u> <u>Viscosity</u> <u>Ratio</u>
5000	2.53		
4000	2.33		
3000	2.14		
2700	2.08		
2400	2.01		
<u>2280</u> Saturation Pressure	1.99		
2000	2.16	0.0164	131
1700	2.36	0.0156	151
1400	2.56	0.0149	171
1100	2.81	0.0143	196
800	3.10	0.0138	225
500	3.50	0.0133	264
250	4.00	0.0128	313
100	4.39	0.0122	359
0	5.06		

Viscosity of Reservoir Fluid at 160°F.

Company A/S Norske Shell Expl. & Prod. Formation \_\_\_\_\_  
Well 31/2-2 County North Sea  
Field \_\_\_\_\_ State Norway



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Well 31/2-2

SEPARATOR TESTS OF RESERVOIR FLUID SAMPLE

Separator Pressure PSI Gauge	Separator Temperature °F.	Gas/Oil Ratio (1)	Gas/Oil Ratio (2)	Stock Tank Gravity °API @ 60°F.	Formation Volume Factor(3)	Separator Volume Factor(4)	Specific Gravity of Flashed Gas
450 to 0	62	206	214			1.040	0.591*
	62	93	93	25.6	1.164	1.001	0.730*
250 to 0	62	240	246			1.025	0.596*
	62	55	55	26.1	1.162	1.001	0.756*
150 to 0	62	265	269			1.017	0.605*
	62	33	33	26.1	1.162	1.001	0.799*
50 to 0	62	293	295			1.007	0.634*
	62	10	10	26.1	1.163	1.001	+

\* Gas collected and analysed for hydrocarbon composition.

+ Insufficient gas for analysis.

- (1) Gas/Oil Ratio in cubic feet of gas at 14.73 psia and 60°F. per barrel of oil at indicated pressure and temperature.
- (2) Gas/Oil Ratio in cubic feet of gas at 14.73 psia and 60°F. per barrel of stock tank oil at 60°F.
- (3) Formation Volume Factor is barrels of saturated oil at 2280 psig and 160°F. per barrel of stock tank oil at 60°F.
- (4) Separator Volume Factor is barrels of oil at indicated pressure and temperature per barrel of stock tank oil at 60°F.



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 Well 31/2-2

HYDROCARBON ANALYSES OF SEPARATOR GAS SAMPLES

<u>Separator Conditions:</u>	<u>450 PSIG @ 62°F.</u>	<u>0 PSIG @ 62°F.</u>	<u>250 PSIG @ 62°F.</u>	<u>0 PSIG @ 62°F.</u>
<u>Component</u>	<u>Mol Percent</u>	<u>GPM</u>	<u>Mol Percent</u>	<u>GPM</u>
Hydrogen Sulfide	NIL		NIL	
Carbon Dioxide	0.21		0.21	0.36
Nitrogen	1.08		0.93	0.10
Methane	94.08		93.24	74.01
Ethane	3.87		4.63	17.63
Propane	0.33	0.091	0.46	3.40
iso-Butane	0.18	0.059	0.24	2.42
n-Butane	0.06	0.019	0.08	0.56
iso-Pentane	0.03	0.011	0.04	0.37
n-Pentane	0.02	0.007	0.03	0.21
Hexanes	0.05	0.020	0.05	0.42
Heptanes	0.05	)	0.05	0.39
Octanes	0.02	) 0.041	0.02	) 0.041
Nonanes	0.01	)	0.01	) 0.02
Decanes plus	0.01	)	0.01	) 0.01
	<u>100.00</u>	<u>0.248</u>	<u>100.00</u>	<u>0.318</u>
Calculated gas gravity (Air=1.000):	0.591	0.730	0.596	0.756
Calculated gross heating value (BTU per cubic foot of dry gas at 14.73 psia and 60°F.):	1047	1276	1058	1317
		<u>2.126</u>		<u>2.521</u>

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Well 31/2-2

HYDROCARBON ANALYSES OF SEPARATOR GAS SAMPLES

<u>Separator Conditions:</u>	<u>150 PSIG @ 62°F.</u>		<u>0 PSIG @ 62°F.</u>		<u>50 PSIG @ 62°F.</u>	
<u>Component</u>	<u>Mol Percent</u>	<u>GPM</u>	<u>Mol Percent</u>	<u>GPM</u>	<u>Mol Percent</u>	<u>GPM</u>
Hydrogen Sulfide	NIL		NIL		NIL	
Carbon Dioxide	0.23		0.34		0.27	
Nitrogen	0.88		0.10		0.80	
Methane	92.18		70.84		89.13	
Ethane	5.41		18.44		7.16	
Propane	0.60	0.165	3.91	1.076	1.06	0.292
iso-Butane	0.33	0.108	2.74	0.896	0.74	0.242
n-Butane	0.10	0.032	1.14	0.359	0.20	0.063
iso-Pentane	0.05	0.018	0.61	0.223	0.13	0.048
n-Pentane	0.04	0.015	0.57	0.207	0.08	0.029
Hexanes	0.07	0.029	0.63	0.257	0.19	0.078
Heptanes	0.07	)	0.52	)	0.16	)
Octanes	0.02	) 0.050	0.13	) 0.309	0.06	) 0.109
Nonanes	0.01	)	0.02	)	0.01	)
Decanes plus	0.01	)	0.01	)	0.01	)
	<u>100.00</u>	<u>0.417</u>	<u>100.00</u>	<u>3.327</u>	<u>100.00</u>	<u>0.861</u>

Calculated gas gravity (Air=1.000):	0.605	0.799	0.634
--	-------	-------	-------

Calculated gross heating value (BTU per cubic foot of dry gas at 14.73 psia and 60°F.):	1072	1385	1118
---	------	------	------