

**CORE LABORATORIES**  
*Petroleum Reservoir Engineering*  
**CCB, ÅGOTNES**

RESERVOIR FLUID STUDY

D-28

FOR

CONOCO NORWAY INC.

WELL: 7/8-3 DST No.1

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*Petroleum Reservoir Engineering*  
**CCB, ÅGOTNES**

16th. March 1984

Conoco Norway Inc.  
P.O.Box 488

4001 STAVANGER

Attention: Mr. Kurt O. Thomas

Subject: Reservoir Fluid Analysis  
Well: 7/8-3 DST No. 1  
Block 7/8  
North Sea, Norway  
Our File Number: RFLN 830009

Gentlemen,

Duplicate sets of separator liquid and vapor were collected from the subject well and forwarded to our Ågotnes Laboratory for use in a reservoir fluid study. Presented in the following report are the results of this study as requested by a representative of Conoco Norway Inc.

Upon receipt in the laboratory the room temperature saturation pressures of the separator oil samples were determined to be 31 PSIG at 62°F for both samples. The opening pressures of the gas cylinders were found to be 48 PSIG at 62°F in both cases. Using the factors shown on page one, the producing gas/oil ratio was calculated to be 175 cubic feet of gas at 14.696 PSIA and 60°F per barrel of separator oil at 45 PSIG and 56°F. The measured hydrocarbon compositions of the separator products were used in conjunction with the producing gas/oil ratio to calculate the hydrocarbon composition of the well stream material. These compositional data may be found on page two.

The separator products were then physically recombined in the above gas/oil ratio and the resulting recombined reservoir fluid was used for the entire study.

A small quantity of the recombined reservoir fluid was charged to a high pressure windowed cell and thermally expanded to the reservoir temperature of 310°F. During a constant composition expansion at this temperature, the fluid was found to have a bubble point pressure of 1274 PSIG. The results of the pressure-volume measurements at reservoir temperature may be found on page four.

When subjected to differential pressure depletion at the reservoir temperature, the fluid evolved a total of 434 cubic feet of gas at 14.696 psia and 60°F. per barrel of residual oil at 60°F. The resulting relative oil volume factor was 1.467 barrels of saturated fluid per barrel of residual oil at 60°F.

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Well: 7/8-3 DST No. 1

Page two

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 five.

The viscosity of the reservoir fluid was measured over a wide range of pressures at 310°F in a rolling ball viscosimeter. The viscosity of the fluid was found to vary from a minimum of 0.497 centipoise at the saturation pressure to a maximum of 1.163 centipoises at atmospheric pressure. The results of the viscosity measurements are tabulated on page six.

Thank you for the opportunity to be of service to Conoco Norway Inc.  
If you have any questions or if we may be of further assistance in any way, please feel free to call upon us.

Very truly yours

Core Laboratories Norsk



Duncan Thow  
Operations Supervisor  
Reservoir Fluid Laboratory

7 cc: Addressee



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Well 7/8-3 DST No. 1

HYDROCARBON ANALYSES OF SEPARATOR PRODUCTS AND CALCULATED WELL STREAM

<u>Component</u>	<u>Separator Liquid Mol Percent</u>	<u>Separator Gas + Mol Percent</u>	<u>GPM</u>	<u>Well Stream Mol Percent</u>
Hydrogen Sulfide	NIL	NIL		NIL
Carbon Dioxide	0.23	4.51		1.27
Nitrogen	Trace	3.06		0.74
Methane C-1	1.17	58.25		→ 15.03
Ethane C-2	2.61	18.93		> 6.57
Propane C-3	5.14	10.45	2.869	≥ 6.43
Iso-Butane C-4	1.07	0.91	0.297	1.03
n-Butane C-4	4.55	2.67	0.839	4.09
iso-Pentane C-5	1.77	0.44	0.161	1.45
n-Pentane C-5	3.45	0.55	0.199	2.75
Hexanes C-6	6.03	0.17	0.069	4.61
Heptanes plus 7	<u>73.98</u>	<u>0.06</u>	<u>0.027</u>	<u>56.03</u>
	<u>100.00</u>	<u>100.00</u>	<u>4.461</u>	<u>100.00</u>

Properties of Heptanes plus

API gravity at 60°F 28.9  
 Specific gravity at 60/60°F 0.882  
 Molecular weight 258      103 (assumed)      258

Calculated separator gas gravity (air= 1.000) = 0.880  
 Calculated gross heating value for separator gas = 1354 BTU  
 per cubic foot of dry gas at 14.696 psia and 60°F.

Primary separator gas collected at 45 psig and 56 °F.  
 Primary separator liquid collected at 45 psig and 56 °F.

Primary separator gas/separator liquid ratio 175 SCF/Bbl at 56°F.

Cylinder Number: 83081909  
 Cylinder Number: A14741

**VOLUMETRIC DATA OF .....RESERVOIR FLUID..... SAMPLE**

1. Saturation pressure (bubble-point pressure) .....1274..... PSIG @ 310 ..... °F.
2. Specific volume at saturation pressure : ft<sup>3</sup>/lb .....0.02244..... @ 310 ..... °F.
3. Thermal expansion of saturated oil @ .....2000..... PSI =  $\frac{V @ 310}{V @ 59} \frac{°F}{°F} = 1.13895$
4. Compressibility of saturated oil @ reservoir temperature : Vol/Vol/PSI :

From..8602.....PSI to...7000.....PSI =...7.40 x 10<sup>-6</sup> ✓  
 From...7000.....PSI to...5000.....PSI = 8.68 x 10<sup>-6</sup>  
 From...5000.....PSI to...3000.....PSI = 10.75 x 10<sup>-6</sup>  
 From...3000.....PSI to...2000.....PSI = 12.94 x 10<sup>-6</sup>  
 From...2000.....PSI to...1274.....PSI = 14.88 x 10<sup>-6</sup>

$$868 + \frac{2000}{5000} (10.75 - 8.68)$$

$$15.5 \times 10^{-6}$$

**Pressure-Volume Relations at ...310.... °F.**

<u>Pressure PSIG</u>	<u>Relative Volume (1)</u>	<u>Y Function (2)</u>
8602	0.9278	
8000	0.9316	
7500	0.9352	
7000	0.9388	
6500	0.9427	
6000	0.9467	
5500	0.9509	
5000	0.9554	
4500	0.9601	
4000	0.9651	
3500	0.9705	
3000	0.9764	
2500	0.9828	
2000	0.9892	
1600	0.9950	
1500	0.9964	
1400	0.9980	
1300	0.9997	
<u>1274</u> Saturation Pressure	1.0000	
1266	1.0027	2.343
1231	1.0150	2.306
1182	1.0339	2.267
1117	1.0631	2.198
1043	1.1026	2.128
953	1.1618	2.050
861	1.2389	1.974
758	1.3590	1.859
660	1.5171	1.759
574	1.7777	1.663 - 1.528
464	2.1067	1.529
369	2.6728	1.410
280	3.6706	1.263

*Spurious  
Data Point.*

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

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

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Differential Vaporization at 310 °F.

<u>Pressure PSIG</u>	<u>Solution Gas/Oil Ratio (1)</u>	<u>Relative Oil Volume (2)</u>	<u>Relative Total Volume (3)</u>	<u>Oil Density gm/cc</u>	<u>Deviation Factor Z</u>	<u>Gas Formation Volume Factor (4)</u>	<u>Incremental Gas Gravity</u>
1274	434	1.467	1.467	0.7137			
1100	397	1.445	1.569	0.7176	0.961	0.01876	1.039
900	353	1.422	1.753	0.7230	0.964	0.02293	1.051
700	308	1.397	2.058	0.7283	0.967	0.02944	1.101
500	259	1.367	2.649	0.7347	0.973	0.04114	1.200
300	202	1.326	4.126	0.7451	0.980	0.06777	1.402
200	166	1.297	6.067	0.7520	0.986	0.09994	1.587
141	138	1.272	8.559	0.7574	0.989	0.13823	1.754
105	118	1.251	11.401	0.7624	0.992	0.18035	1.889
0	0	1.117		0.7894			2.802

Gravity of residual oil = .....28.9.....° API @ 60°F.

- (1) Cubic feet of gas at 14.696 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 14.696 psia and 60°F.



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Viscosity Data at 310 °F.

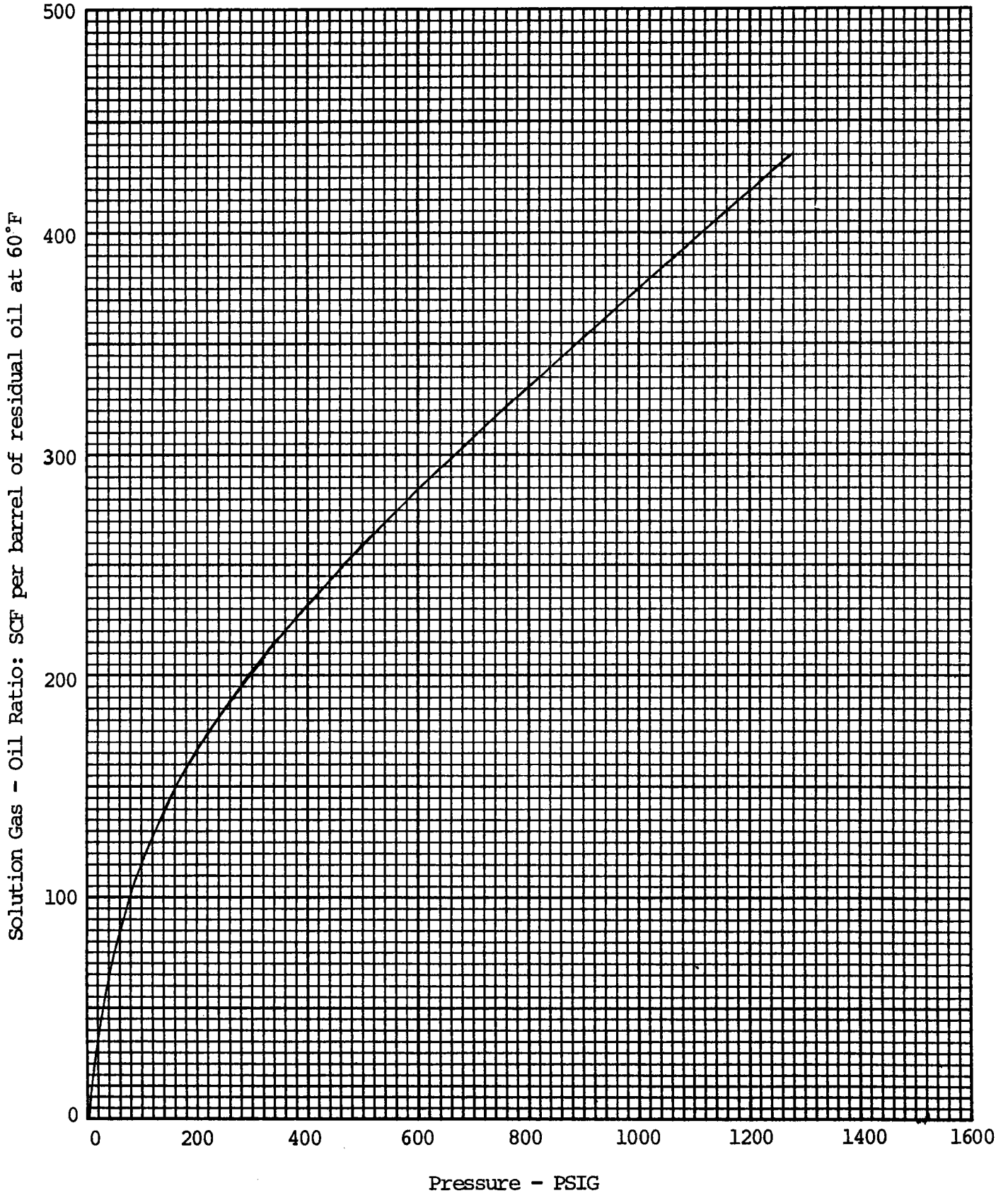
Pressure PSIG	Oil Viscosity Centipoise	Calculated Gas Viscosity Centipoise	Oil/Gas Viscosity Ratio
✓8602 1247.61	0.947		
✓8000 1160.30	0.908		
✓7500 1087.78	0.878		
✓7000 1015.26	0.847		
✓6500 942.74	0.816		
✓6000 870.22	0.785		
✓5500 797.70	0.755		
✓5000 725.15	0.725		
✓4500 652.67	0.693		
✓4000 580.15	0.662		
✓3500 507.63	0.633		
✓3000 435.11	0.602		
2500 362.59	0.571		
2000 290.00	0.540		
<u>1274</u> Saturation 184.77	0.497		
<u>Pressure</u>			
1100 159.54 ✓	0.516	0.0153	33.7
900 130.53 ✓	0.552	0.0145	38.1
700 101.52 ✓	0.599	0.0137	43.7
500 72.51 ✓	0.661	0.0131	46.6
300 43.51 ✓	0.733	0.0125	58.6
200 29.00 ✓	0.782	0.0120	65.2
141 20.45 ✓	0.840	0.0115	73.0
105 15.22 ✓	0.891	0.0112	79.6
0 8	1.163		

Disse analysene, eller tolkningene baseres på observasjoner og materiell skaffet til veie av klienter, som denne rapporten eksklusivt og fortrolig er laget for. Det utførte arbeidet representerer de beste tolkninger Core Laboratories Norsk er i stand til å gi, (med forbehold om feil og utelatelser). Likevel frasier Core Laboratories Norsk og Deres personell seg alt ansvar og gir derfor ingen overtag på grunnlag av disse data, som f.eks produktivitet, aktuelle operasjoner, og lønsomhet fra en hver olje, gas eller mineral brønn eller sand, som en slik rapport er basert på.

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Differential Vapourization at 310°F

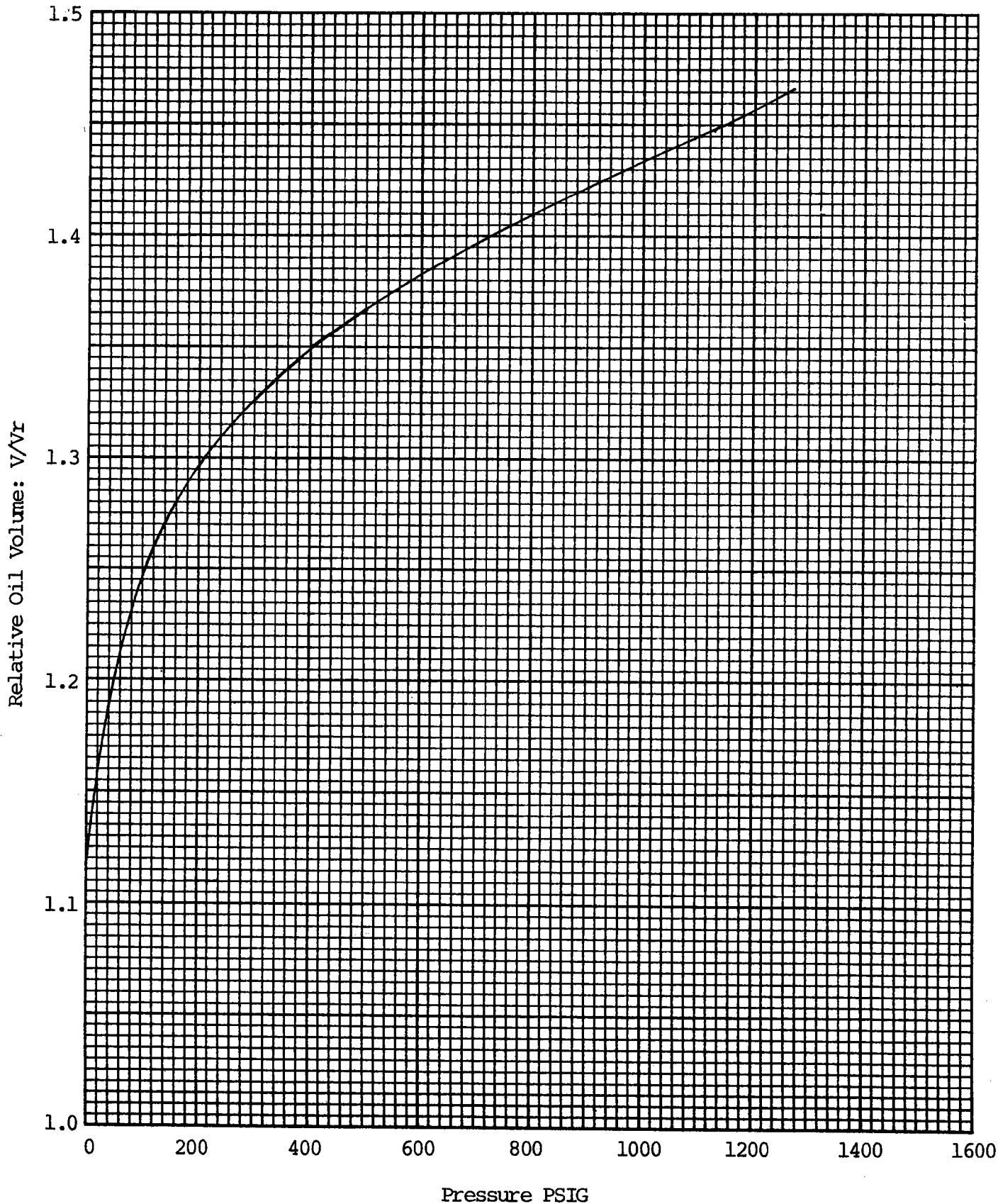
Company	<u>Conoco Norway Inc.</u>	Formation	<u></u>
Well	<u>7/8-3 DST No. 1</u>	Province	<u>North Sea</u>
Field	<u>Block 7/8</u>	Country	<u>Norway</u>



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Differential Vapourization at 310°F

Company	Conoco Norway Inc.	Formation	
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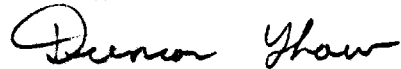


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Conoco Norway Inc.  
Well: 7/8-3 DST No. I

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Core Laboratories Norsk  
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Duncan Thow  
Operations Supervisor