

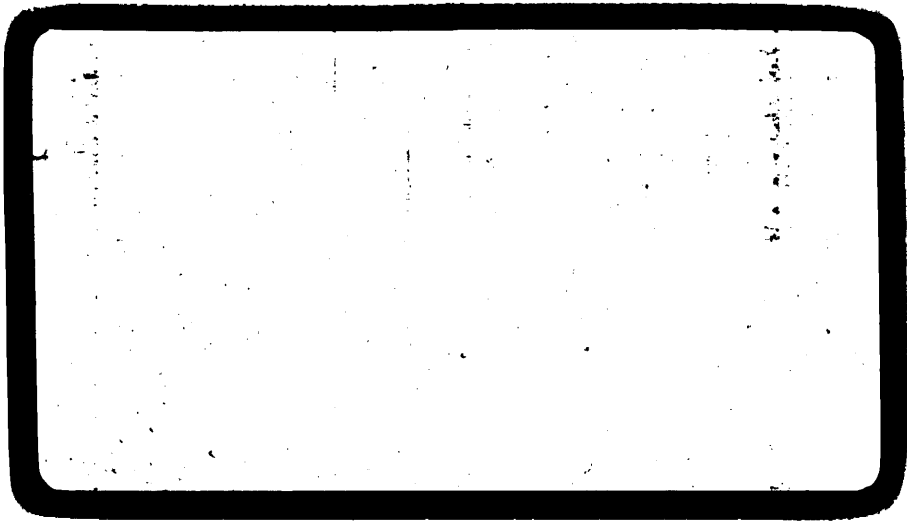
DEPT. NAT. RES & ENV



PE800701

GRIFFLAND BASIN
HYDROCARBON REPORT.

CORE LAB.
TUNA-4.



RESERVOIR FLUID ANALYSIS



H/c BOX

ESSO AUSTRALIA LIMITED

TUNA #4, RFT AE43

15 AUG 1985

RESERVOIR FLUID STUDY

OIL and GAS DIVISION



7th December, 1984

CORE LABORATORIES

Petroleum Reservoir Engineering



Esso Australia Limited,
Esso House,
127 Kent Street,
SYDNEY, N.S.W. 2000

Attention : A.K. Khurana/A.P. Whittle

Subject : Reservoir Fluid Study
Well : Tuna #4, RFT AE43
File : AFL 84024

Dear Sir,

A subsurface fluid sample was collected from the subject well and submitted to our laboratory for use in a reservoir fluid study. Presented in the following report are the results of this study as requested by Esso Australia Limited.

The sample was transferred out of Esso's RFT sampling chamber into special high pressure PVT cylinders in single phase.

As a quality check, the room temperature saturation pressures were initially determined. At 63°F the subsurface fluid samples were found to have bubble point pressures of 2604 psig and 2580 psig respectively. The results are reported on page two and depicted graphically on page fourteen. The sample contained in cylinder #259661D was used for this analysis.

The hydrocarbon composition of the subsurface fluid was measured through heptanes plus, utilizing low temperature fractional distillation and chromatography techniques. This compositional analysis, together with the hexanes plus properties, is reported on page three.

The hexanes plus fraction was then further broken down through undecanes plus. These results were obtained by high temperature distillation and can be found on page four.

A full hydrocarbon composition of the subsurface fluid through undecanes plus can be found on page five.

A portion of the fluid was charged to a high pressure visual cell and thermally expanded to the reported reservoir temperature of 252°F. This sample was then subjected to a constant composition expansion during which a bubble point pressure of 3540 psig was observed. The volumetric and pressure volume data is reported on page six and seven respectively and depicted graphically on page fifteen.

Page ii

This fluid was then subjected to differential pressure depletion. During this test, the fluid was found to contain 901 cubic feet of gas per barrel of residual oil for a relative oil volume of 1.494 barrels of saturated oil per barrel of residual oil. The results of the differential vaporization, together with the properties of the evolved gases, are presented on page eight and depicted graphically on pages sixteen, seventeen and eighteen.

The viscosity of the fluid was measured over a range of pressures in a rolling ball viscosimeter at 252°F. The viscosity was found to vary from a minimum of 0.412 centipoise at saturation pressure to 1.073 centipoise at atmospheric pressure. This data is tabulated on page nine and is shown in graphic form on page nineteen.

Two single-stage separator tests were performed to determine the effects of separator pressure upon gas-oil ratio, stock tank oil gravity and formation volume factor. Gases from the tests were collected and analysed by routine chromatography. This data is reported on pages ten, eleven and twelve respectively.

A pour point determination was performed on the stock tank oil and this data is reported on page thirteen.

We thank Esso for the opportunity to be of service. Please do not hesitate in contacting us should you require any further information.

Yours sincerely,

A handwritten signature in black ink, appearing to be 'J. Bon', written in a cursive style with several loops and a long horizontal stroke at the bottom.

J. Bon,
Manager.

JB/rsm/dc

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Page : 1 of 19
File : AFL 84024

Company : Esso Australia Limited Date Sampled : 10th June, 1984
Well : Tuna #4, RFT AE43 State : Victoria
Field : Tuna Country : Australia

FORMATION CHARACTERISTICS

Formation Name :
Date First Well Completed :
Original Reservoir Pressure :
Original Produced Gas-Oil Ratio :
 Production Ratio :
 Separator Pressure and Temperature :
 Oil Gravity at 60°F :
Datum :
Original Gas Cap :

WELL CHARACTERISTICS

Elevation :
Total Depth :
Producing Interval :
Tubing Size and Depth :
Productivity Index :
Last Reservoir Pressure :
 Date : 10th June, 1984
 Reservoir Temperature : 252°F
 Status of Well :
 Pressure Gauge :
Normal Production Rate :
 Gas-Oil Ratio :
 Separator Pressure and Temperature :
 Base Pressure :
Well Making Water :

SAMPLING CONDITIONS

Sampled at : 2550.0 m MD
Sampling Pressure : 3704.4 psia

Sampling Temperature : 232°F
Estimated Reservoir Temperature : 252°F

Sampled by :
Type Sampler : (Ex) RFS AE43

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Well : Tuna #4, RFT AE43

QUALITY CHECK OF SAMPLES RECEIVED IN THE LABORATORY

<u>Cylinder No:</u>	259661D	259656D
<u>Opening Pressure:</u>	2550 psig @ 63°F	2539 psig @ 63°F
<u>Sample No:</u>	1	2

<u>cm³ Mercury Injected</u>	<u>Pressure, psig</u>	<u>cm³ Mercury Injected</u>	<u>Pressure, psig</u>
0	2350	0	2350
2	2385	2	2380
4	2420	4	2420
6	2460	6	2465
8	2500	8	2510
10	2550	10	2560
12	2600	12	2610
14	2700	14	2690
16	3000	16	3040
18	3360	18	3410
20	3735	20	3785

Psat = 2604 psig @ 63°F

Psat = 2580 psig @ 63°F

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Well : Tuna #4, RFT AE43

HYDROCARBON ANALYSIS OF RESERVOIR FLUID SAMPLE

<u>Component</u>	<u>Mol Percent</u>	<u>Weight Percent</u>	<u>Density, Gm/Cc @ 60°F</u>	<u>°API @ 60°F</u>	<u>Molecular Weight</u>
Hydrogen Sulphide	0.00	0.00			
Carbon Dioxide	17.03	8.24			
Nitrogen	0.05	0.01			
Methane	37.62	6.64			
Ethane	4.54	1.51			
Propane	3.36	1.63			
iso-Butane	0.51	0.33			
n-Butane	1.32	0.85			
iso-Pentane	0.54	0.43			
n-Pentane	0.59	0.47			
Hexanes plus	34.44	79.89	0.8341	38.0	211
	<u>100.00</u>	<u>100.00</u>			

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File : AFL 84024
Well : Tuna #4, RFT AE43

HIGH TEMPERATURE DISTILLATION OF
HEXANES PLUS FRACTION OF RESERVOIR FLUID SAMPLE
TO UNDECANES PLUS

<u>Component</u>	<u>Cut Temp °C</u>	<u>Mol Percent</u>	<u>Weight Percent</u>	<u>Volume Percent</u>	<u>Density, Gm/Cc@60°F</u>	<u>°API @60°F</u>	<u>Molecular Weight</u>
	IBP 49						
Hexanes	84	5.64	2.33	2.77	0.7116	67.2	87
Heptanes	112	3.53	1.69	1.98	0.7285	62.5	101
Octanes	138	6.62	3.25	3.72	0.7438	58.6	104
Nonanes	162	5.39	2.99	3.32	0.7589	54.8	117
Decanes	185	3.84	2.38	2.61	0.7750	50.9	131
Undecanes plus	FBP 185	74.98	87.36	85.60	0.8694	31.1	246
		<u>100.00</u>	<u>100.00</u>	<u>100.00</u>			

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HYDROCARBON ANALYSIS OF RESERVOIR FLUID SAMPLE TO UNDECANES PLUS

<u>Component</u>	<u>Mol Percent</u>	<u>Weight Percent</u>
Hydrogen Sulphide	0.00	0.00
Carbon Dioxide	17.03	8.24
Nitrogen	0.05	0.01
Methane	37.62	6.64
Ethane	4.54	1.51
Propane	3.36	1.63
iso-Butane	0.51	0.33
n-Butane	1.32	0.85
iso-Pentane	0.54	0.43
n-Pentane	0.59	0.47
Hexanes	1.94	1.85
Heptanes	1.22	1.35
Octanes	2.28	2.60
Nonanes	1.86	2.39
Decanes	1.32	1.90
Undecanes plus	25.82	69.80
	<u>100.00</u>	<u>100.00</u>

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Well : Tuna #4, RFT AE43

VOLUMETRIC DATA OF RESERVOIR FLUID SAMPLE

Saturation pressure (bubble point pressure) 3540 psig @ 252 °F

Specific volume at saturation pressure : ft 3/lb 0.02336 @ 252°F

Thermal expansion of saturated oil @ 5000 psig @ $\frac{252^{\circ}\text{F}}{64^{\circ}\text{F}}$ = 1.13369

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

From 5000 psig to 4500 psig = 14.37×10^{-6}

From 4500 psig to 4000 psig = 15.73×10^{-6}

From 4000 psig to 3800 psig = 16.73×10^{-6}

From 3800 psig to 3600 psig = 17.38×10^{-6}

From 3600 psig to 3540 psig = 17.87×10^{-6}

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Well : Tuna #4, RFT AE43

PRESSURE - VOLUME RELATIONS AT 252°F

<u>Pressure, psig</u>	<u>Relative Volume (1)</u>	<u>Compressibility x10⁻⁶ (2)</u>	<u>Y Function (3)</u>
5000	0.9773	13.73	
4500	0.9844	15.03	
4100	0.9905	16.15	
4000	0.9921	16.44	
3900	0.9938	16.73	
3800	0.9955	17.07	
3700	0.9972	17.38	
3600	0.9990	17.76	
<u>3540 *</u>	1.0000	17.98	
3535	1.0012		
3530	1.0022		
3525	1.0031		
3510	1.0040		2.130
3490	1.0062		2.290
3350	1.0210		2.693
3200	1.0386		2.738
2990	1.0669		2.734
2765	1.1040		2.681
2495	1.1601		2.600
2225	1.2343		2.506
1970	1.3278		2.413
1710	1.4590		2.311
1505	1.5982		2.238
1390	1.6978		2.193
1020	2.1906		2.045
790	2.7492		1.953
580	3.6720		1.862

* Bubble Point Pressure.

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

(2) Compressibility = $-\frac{dV}{VdP}$

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

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Well : Tuna #4, RFT AF43

DIFFERENTIAL VAPORIZATION AT 252°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
3540 *	901	1.494	1.494	0.6858			
3200	787	1.441	1.551	0.6950	0.869	0.00544	0.919
2800	677	1.393	1.640	0.7039	0.867	0.00620	0.898
2400	574	1.347	1.770	0.7131	0.874	0.00728	0.887
2000	478	1.304	1.970	0.7218	0.885	0.00884	0.899
1600	385	1.263	2.294	0.7306	0.901	0.01123	0.912
1200	299	1.226	2.863	0.7386	0.922	0.01527	0.935
800	215	1.189	4.039	0.7469	0.945	0.02334	0.974
400	130	1.149	7.621	0.7553	0.972	0.04713	1.063
0	0	1.098		0.7655			1.386
		At 60°F = 1.000					

Gravity of Residual Oil = 37.2°API @ 60°F.
Density of Residual Oil = 0.8378 gm/cc @ 60°F.

* Bubble Point Pressure.

- (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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Well : Tuna #4, RFT AE43

VISCOSITY DATA AT 252°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	0.493		
4500	0.465		
4000	0.432		
3800	0.427		
3700	0.421		
3600	0.417		
<u>3540 *</u>	0.412		
3200	0.431	0.0247	17.41
2800	0.454	0.0220	20.66
2400	0.482	0.0199	24.17
2000	0.516	0.0182	28.28
1600	0.558	0.0166	33.52
1200	0.615	0.0153	40.10
800	0.691	0.0141	48.86
400	0.805	0.0130	61.92
0	1.073		

* Bubble Point Pressure.

** Calculated from correlation of Lee, Gonzales and Eakin.
Journal of Petroleum Technology, 1966 Vol:18, page 997.

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Well : Tuna #4, AE43

SEPARATOR TESTS OF RESERVOIR FLUID SAMPLE

<u>Separator Pressure, psig</u>	<u>Temp. °F</u>	<u>Gas/Oil Ratio (1)</u>	<u>Gas/Oil Ratio (2)</u>	<u>Tank Oil Gravity, °API@60°F</u>	<u>Formation Volume Factor(3)</u>	<u>Separator Volume Factor(4)</u>	<u>Gas Gravity</u>
500	100	597	660			1.107	0.890 *
to							
0	100	194	198	39.1	1.474	1.019	1.281 *
1000	100	411	481			1.171	0.851 *
to							
0	100	349	356	38.6	1.483	1.019	1.228 *

* These gases were collected and analysed by gas chromatography.

- (1) Gas/Oil Ratio in cubic feet of gas at 14.696 psia and 60°F per barrel of oil at indicated pressure and temperature.
- (2) Gas/Oil Ratio in cubic feet of gas at 14.696 psia and 60°F per barrel of stock tank oil at 60°F.
- (3) Formation Volume Factor is barrels of saturated oil at psig and °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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HYDROCARBON ANALYSES OF SEPARATOR GAS SAMPLES

<u>Component</u>	500 psig, 100°F		0 PSIG, 100°F	
	Mol Percent	GPM	Mol Percent	GPM
Hydrogen Sulphide	0.00		0.00	
Carbon Dioxide	26.38		29.90	
Nitrogen	0.15		0.04	
Methane	64.32		32.84	
Ethane	5.64	1.504	12.98	3.462
Propane	1.95	0.535	10.95	3.005
iso-Butane	0.24	0.078	2.15	0.701
n-Butane	0.38	0.120	4.01	1.261
iso-Pentane	0.09	0.033	1.35	0.493
n-Pentane	0.09	0.033	1.40	0.506
Hexanes	0.04	0.016	0.81	0.330
Heptanes plus	0.72	0.326	3.57	1.617
	100.00	2.645	100.00	11.375
Gas gravity (Air = 1.000):		0.890		1.281
Gross heating value (BTU per cubic foot of dry gas at 14.696 psia and 60°F):		868		1387

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File : AFL 84024
Well : Tuna #4, RFT AE43

HYDROCARBON ANALYSES OF SEPARATOR GAS SAMPLES

<u>Component</u>	1000 psig, 100°F		0 PSIG, 100°F	
	Mol Percent	GPM	Mol Percent	GPM
Hydrogen Sulphide	0.00		0.00	
Carbon Dioxide	24.45		28.82	
Nitrogen	0.12		0.00	
Methane	68.32		39.66	
Ethane	4.67	1.246	10.63	2.835
Propane	1.30	0.357	7.93	2.176
iso-Butane	0.19	0.062	2.00	0.653
n-Butane	0.29	0.091	3.73	1.173
iso-Pentane	0.08	0.029	1.27	0.464
n-Pentane	0.07	0.025	1.32	0.477
Hexanes	0.03	0.012	0.79	0.322
Heptanes plus	0.48	0.217	3.85	1.743
	100.00	2.039	100.00	9.841
Gas gravity (Air = 1.000):	0.851		1.228	
Gross heating value (BTU per cubic foot of dry gas at 14.696 psia and 60°F):	856		1333	

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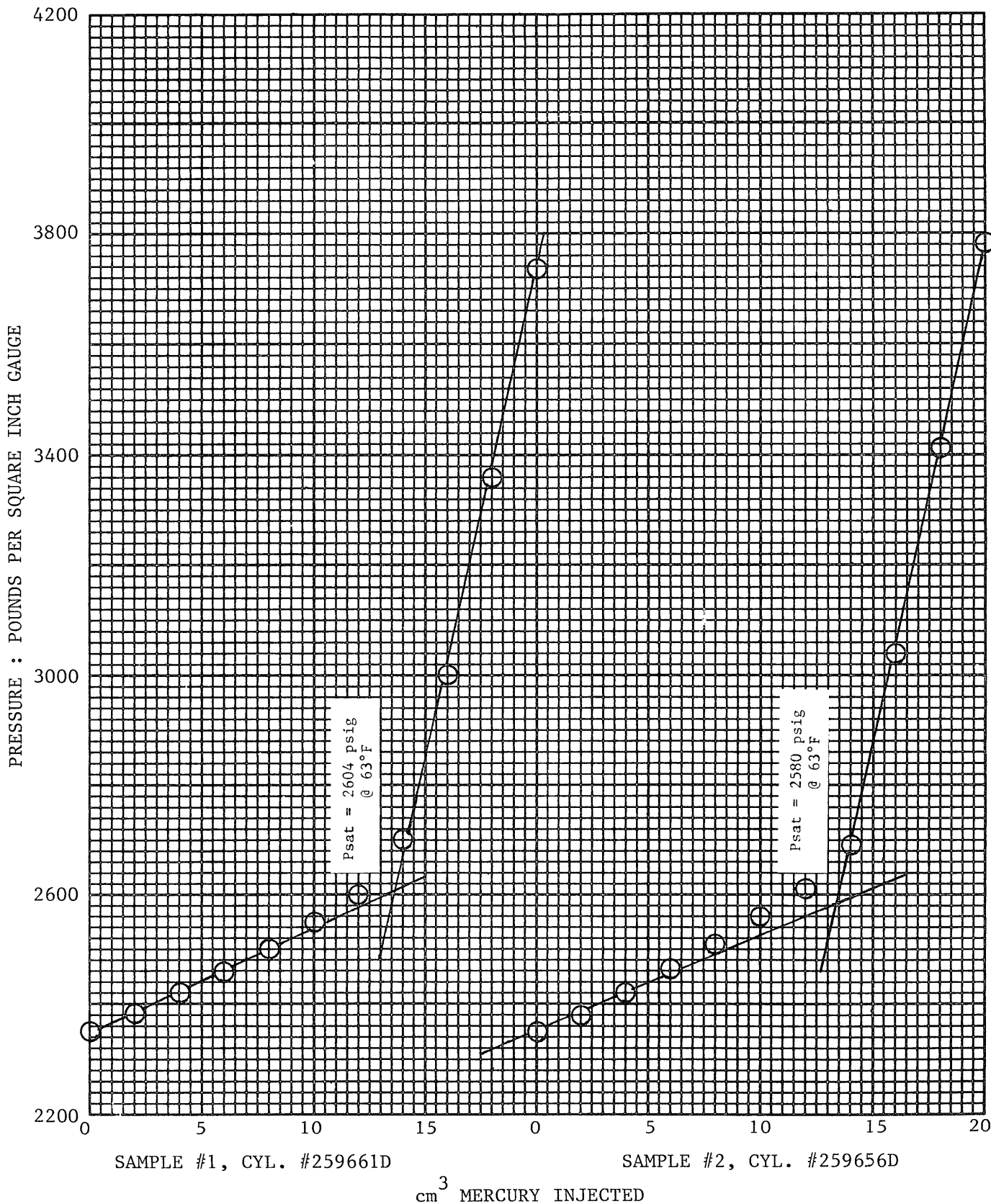
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Well : Tuna #4, RFT AE43

BASIC CRUDE TESTS ON STOCK TANK OIL

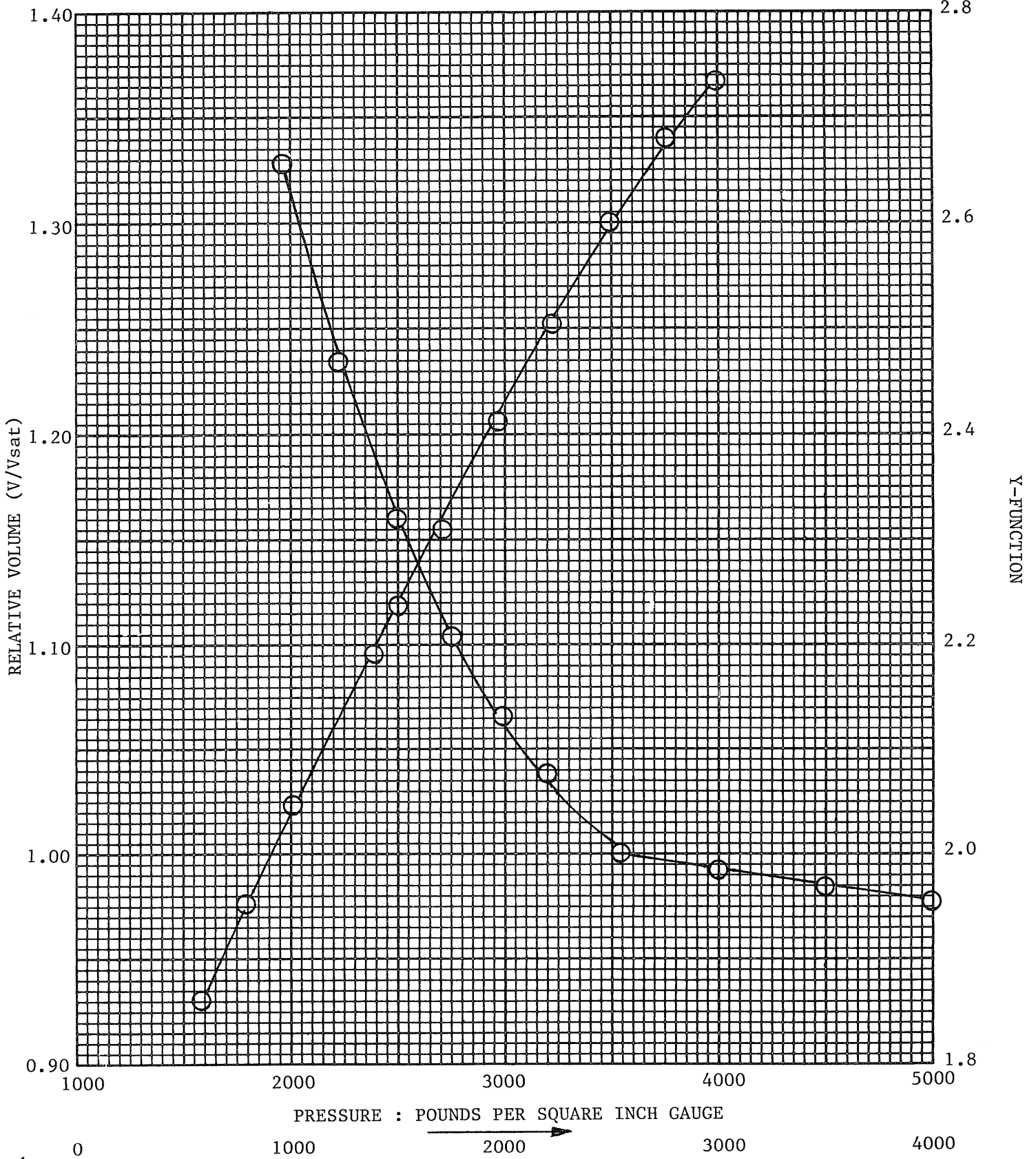
POUR POINT : 92°F (33.3°C)

QUALITY CHECK OF SAMPLES RECEIVED IN THE LABORATORY

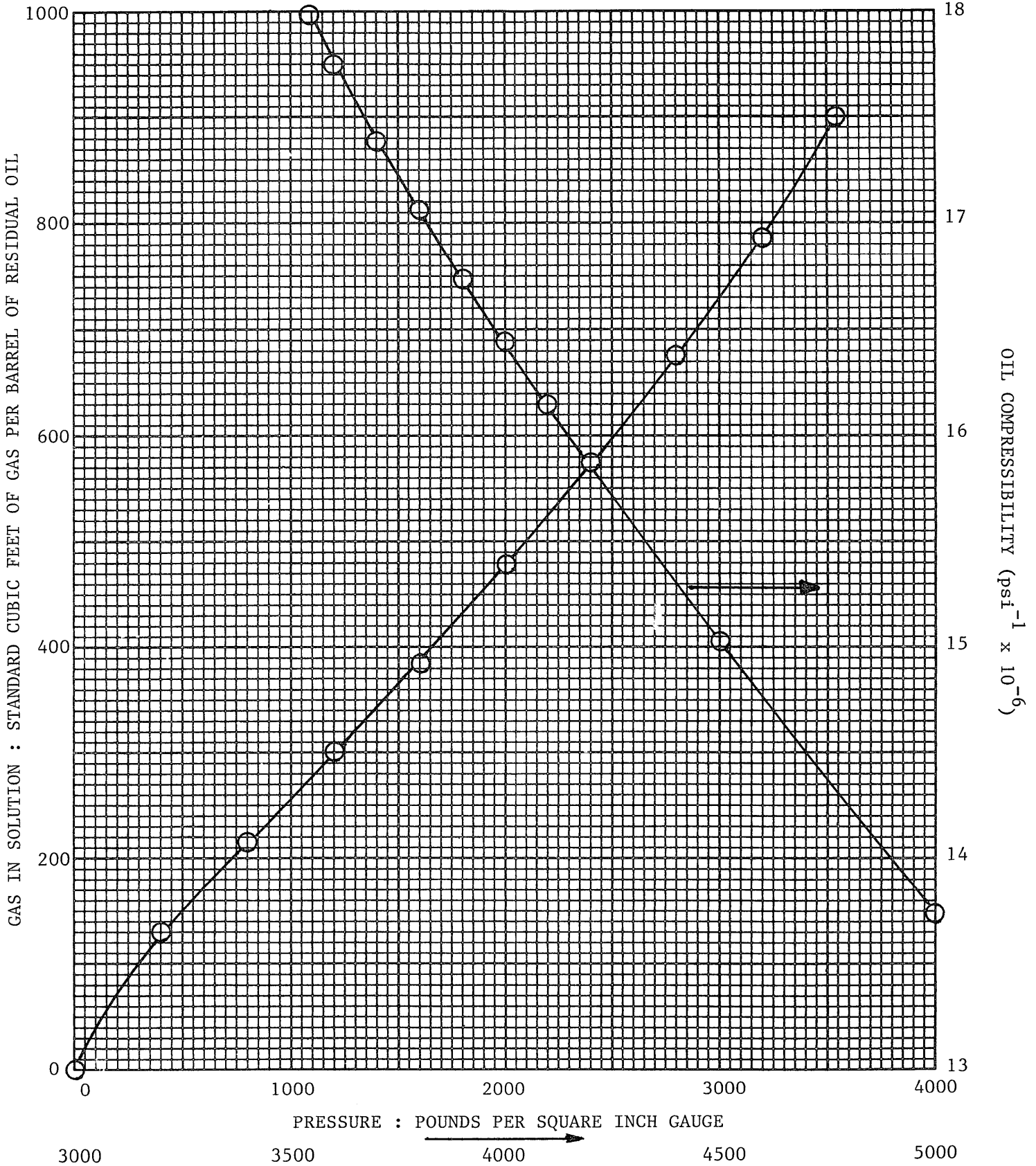
Company Esso Australia Limited Formation _____
Well Tuna #4, RFT AE43 State Victoria
Field Tuna Country Australia



Company Esso Australia Limited Formation _____
Well Tuna #4, RFT AE43 State Victoria
Field Tuna Country Australia

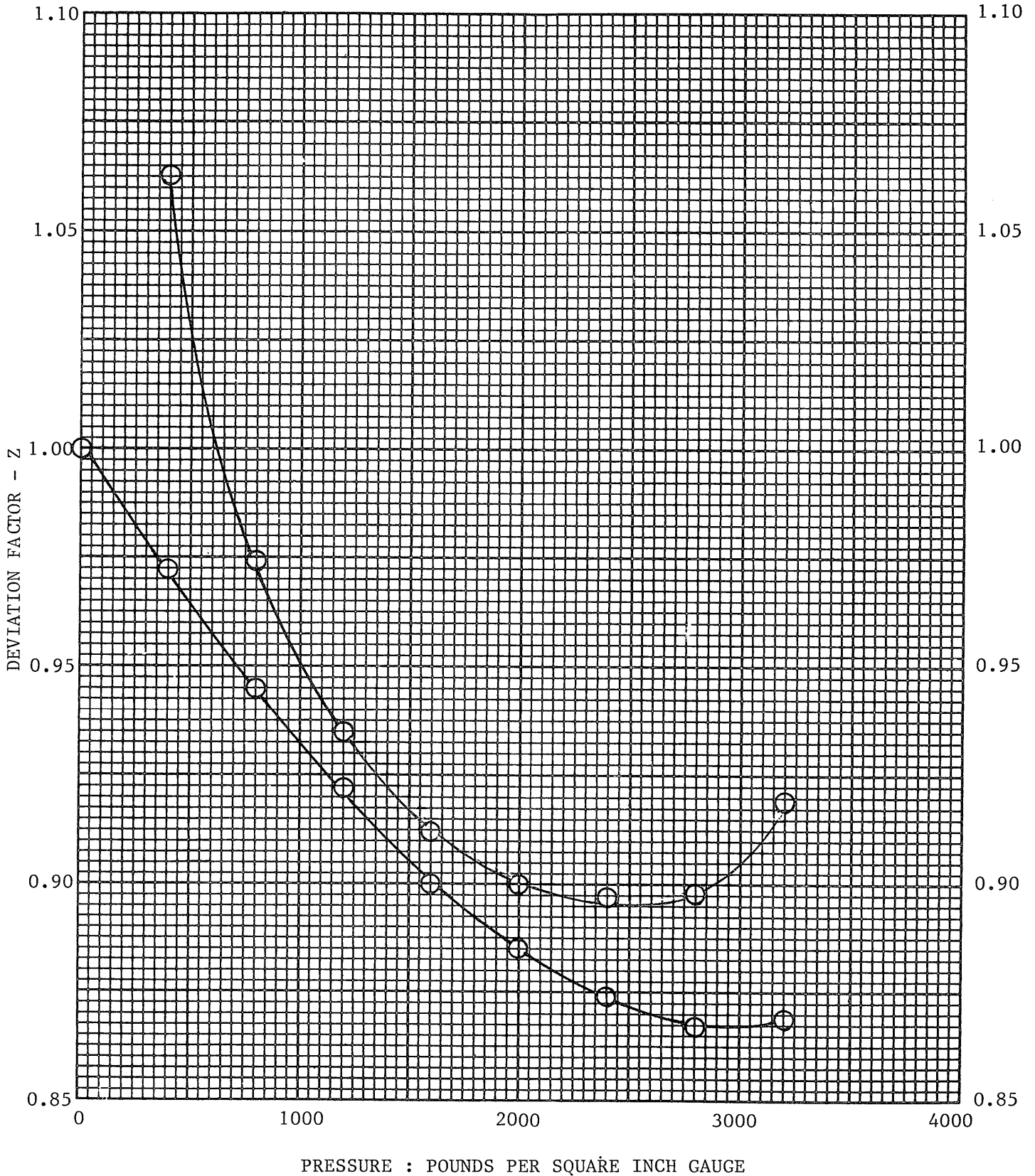


Company Esso Australia Limited Formation _____
 Well Tuna #4, RFT AE43 State Victoria
 Field Tuna Country Australia

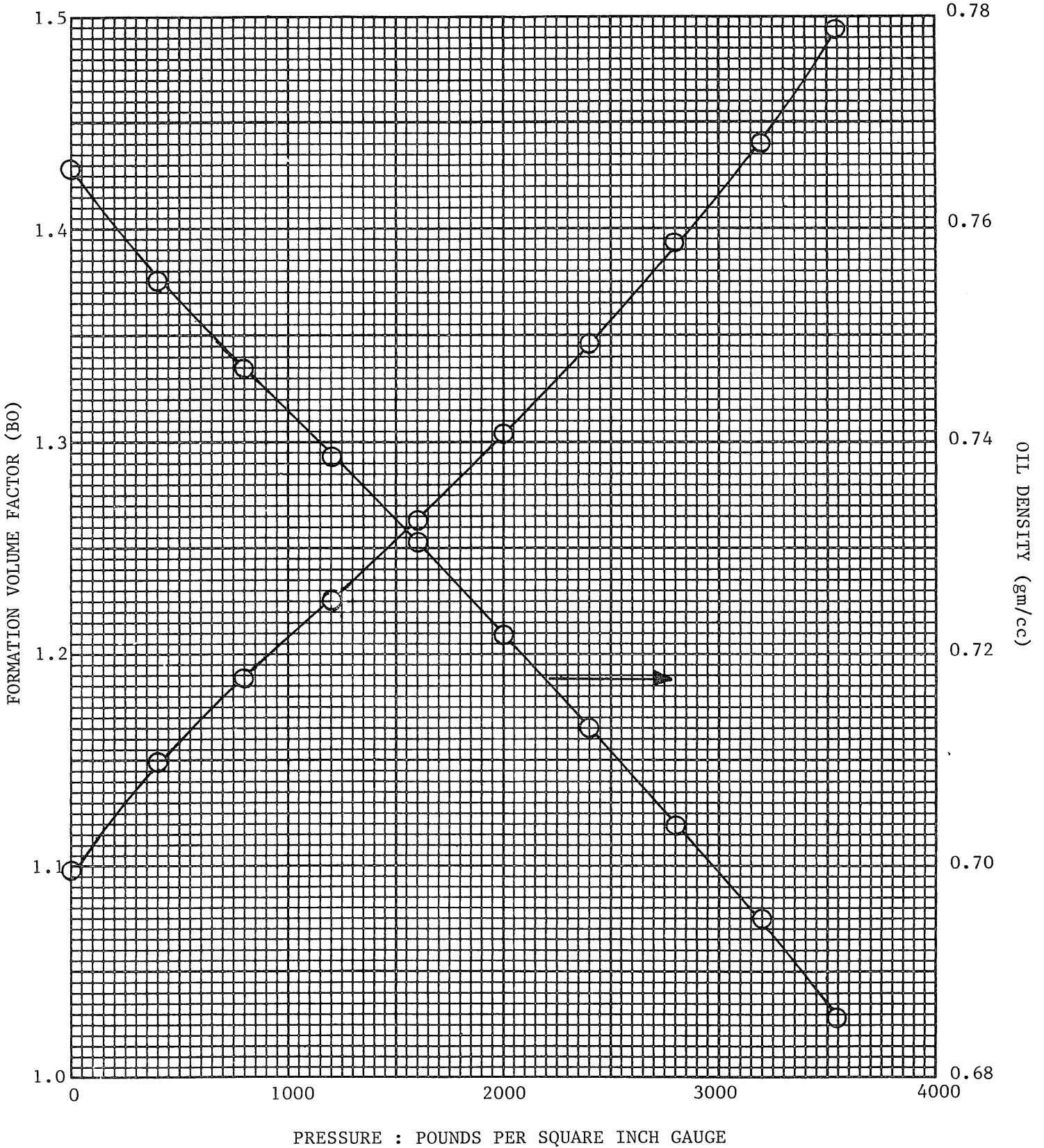


GAS PROPERTIES

Company	<u>Esso Australia Limited</u>	Formation	<u></u>
Well	<u>Tuna #4, RFT AE43</u>	State	<u>Victoria</u>
Field	<u>Tuna</u>	Country	<u>Australia</u>



Company Esso Australia Limited Formation _____
Well Tuna #4, RFT AE43 State Victoria
Field Tuna Country Australia



VISCOSITIES AT 252°F

Company	<u>Esso Australia Limited</u>	Formation	<u>Victoria</u>
Well	<u>Tuna #4, RFT AE43</u>	State	<u>Victoria</u>
Field	<u>Tuna</u>	Country	<u>Australia</u>

