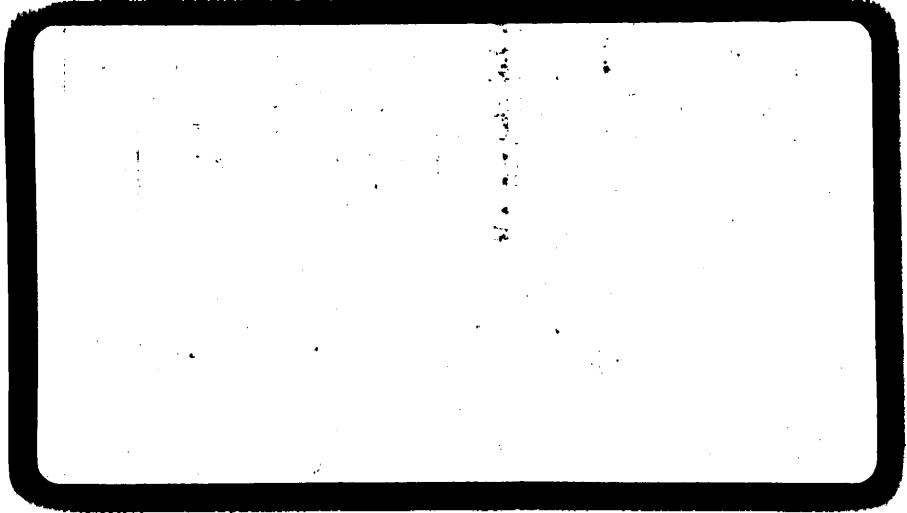


DEPT. NAT. RES & ENV
PE800668

GIPPSLAND BASIN.
HYDRONOR BAY REPORT.

CONELAB.
FORTESCUE - A13.



RESERVOIR FLUID ANALYSIS



H/c Box

OIL and GAS DIVISION

MS

23 AUG 1985 ESSO AUSTRALIA LIMITED

FORTESCUE A13

RESERVOIR FLUID STUDY

Petroleum Reservoir Engineering



CORE LABORATORIES

Petroleum Reservoir Engineering



22nd June, 1985

ESSO AUSTRALIA LIMITED,
127 Kent Street,
SYDNEY, N.S.W. 2000

Attention : Mr. R.S.W. Neil

Subject : Reservoir Fluid Study
Well : Fortescue A13
File : AFL 85027

Dear Sir,

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

The sample was transferred out of Esso's storage cylinder into special high pressure PVT cylinder in single phase.

As a quality check, the room temperature saturation pressure of the transferred sample was initially determined. At 65°F the subsurface fluid sample in cylinder ADL-10-022 (Welker #2718) was found to have a bubble point pressure of 293 psig. The result is reported on page two and depicted graphically on page twelve.

The hydrocarbon composition of the subsurface fluid was measured through hexanes plus by low temperature fractional distillation along with gas chromatography. 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 by high temperature fractional distillation. These results may be found on page four.

A full hydrocarbon composition of the subsurface fluid through undecanes plus is reported on page five.

A portion of the reservoir fluid was charged to a high pressure visual cell and thermally expanded to the reported reservoir temperature of 220°F. This sample was then subjected to a constant composition expansion during which a bubble point pressure of 364 psig was observed. The volumetric and pressure-volume data are reported on pages six and seven respectively and depicted graphically on pages thirteen and fourteen.

Page ii

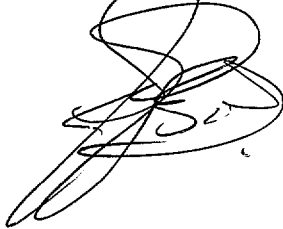
The viscosity of the fluid was measured over a range of pressures in a rolling ball viscosimeter at 220°F. The viscosity was found to vary from a minimum of 0.525 centipoise at saturation pressure to 0.853 centipoise at atmospheric pressure. This data is tabulated on page eight and is shown in graphic form on page fifteen.

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 150 psig separator test were collected and analysed by routine chromatography. This data is reported on pages nine and ten respectively.

Basic crude tests were performed on the stock tank oil and this data is reported on page eleven.

We thank you for the opportunity to be of service. Should you have any questions concerning the data, please do not hesitate to contact us.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Jan Bon', written in a cursive style with several loops and flourishes.

Jan Bon,
Manager.

JB/bkn/dc

QUALITY CHECK OF SAMPLE RECEIVED IN THE LABORATORY

Cylinder #: ADL-10-022 (Welker #2718)

Opening Pressure: 230 psig @ 65°F

<u>cm³ Mercury Injected</u>	<u>Pressure, psig</u>
0	200
1	210
2	220
3	225
4	235
5	245
6	250
7	260
8	270
9	295
10	330
11	420
12	810
13	1215
14	1620
15	2030

Psat = 293 psig @ 65°F

HYDROCARBON ANALYSIS OF RESERVOIR FLUID SAMPLE

<u>Cylinder #:</u>	ADL-10-022 (Welker #2718)	
<u>Component</u>	<u>Mol Percent</u>	<u>Weight Percent</u>
Hydrogen Sulphide	0.00	0.00
Carbon Dioxide	0.61	0.18
Nitrogen	0.16	0.03
Methane	3.20	0.35
Ethane	1.80	0.37
Propane	5.18	1.57
iso-Butane	3.53	1.41
n-Butane	5.34	2.13
iso-Pentane	3.70	1.83
n-Pentane	3.54	1.75
Hexanes plus	72.94	90.38
	<u>100.00</u>	<u>100.00</u>

Properties of Hexanes plus

API gravity @ 60°F	39.7
Density, gm/cc @ 60°F	0.8259
Molecular weight	180

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Petroleum Reservoir Engineering

Page : 4 of 15
File : AFL 85027
Well : Fortescue A13

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

<u>Component</u>	<u>Cut</u> <u>Temp °C</u>	<u>Mol</u> <u>Percent</u>	<u>Weight</u> <u>Percent</u>	<u>Volume</u> <u>Percent</u>	<u>Density,</u> <u>gm/cc @ 60°F</u>	<u>°API</u> <u>@ 60°F</u>	<u>Mol</u> <u>Weight</u>
	IBP 49						
Hexanes	84	7.08	3.41	4.09	0.6889	73.7	87
Heptanes	112	13.25	6.83	7.73	0.7296	62.3	93
Octanes	138	13.56	8.19	8.93	0.7580	55.0	109
Nonanes	162	6.09	4.01	4.28	0.7754	50.8	119
Decanes	185	6.24	4.53	4.76	0.7859	48.4	131
Undecanes plus	FBP 185	53.78	73.03	70.21	0.8589	33.1	245
		<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

Cylinder #:

ADL-10-022 (Welker #2718)

<u>Component</u>	<u>Mol Percent</u>	<u>Weight Percent</u>
Hydrogen Sulphide	0.00	0.00
Carbon Dioxide	0.61	0.18
Nitrogen	0.16	0.03
Methane	3.20	0.35
Ethane	1.80	0.37
Propane	5.18	1.57
iso-Butane	3.53	1.41
n-Butane	5.34	2.13
iso-Pentane	3.70	1.83
n-Pentane	3.54	1.75
Hexanes	5.16	3.08
Heptanes	9.67	6.17
Octanes	9.89	7.40
Nonanes	4.44	3.63
Decanes	4.55	4.09
Undecanes plus	39.23	66.01
	<u>100.00</u>	<u>100.00</u>

VOLUMETRIC DATA OF RESERVOIR FLUID SAMPLE

Saturation pressure (bubble point pressure): 364 psig @ 220°F

Specific volume @ saturation pressure, ft 3/lb: 0.02252 @ 220°F

Thermal expansion of saturated oil @ 5000 psig @ $\frac{220^{\circ}\text{F}}{66^{\circ}\text{F}} = 1.08845$

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

From 5000 psig to 4000 psig = 7.88×10^{-6}

From 4000 psig to 3000 psig = 8.74×10^{-6}

From 3000 psig to 2000 psig = 9.64×10^{-6}

From 2000 psig to 1000 psig = 10.66×10^{-6}

From 1000 psig to 364 psig = 11.75×10^{-6}

PRESSURE - VOLUME RELATIONS @ 220°F

<u>Pressure,</u> <u>psig</u>	<u>Relative</u> <u>Volume (1)</u>	<u>Compressibility</u> <u>x 10⁻⁶ (2)</u>	<u>Y</u> <u>Function (3)</u>
5000	0.9566	7.45	
4500	0.9603	7.88	
4000	0.9641	8.31	
3500	0.9683	8.74	
3000	0.9726	9.18	
2500	0.9772	9.63	
2000	0.9820	10.11	
1500	0.9871	10.64	
1000	0.9926	11.25	
700	0.9960	11.70	
600	0.9972	11.87	
500	0.9983	12.04	
400	0.9996	12.24	
<u>364</u> *	1.0000	12.31	
357	1.0063		2.970
350	1.0111		3.450
340	1.0193		3.502
327	1.0312		3.463
305	1.0566		3.257
273	1.1067		2.962
238	1.1890		2.635
203	1.3201		2.307
173	1.5005		2.030
150	1.7126		1.820
121	2.1528		1.550
92	2.9860		1.280
73	3.9980		1.103

* Saturation Pressure

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

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

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

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VISCOSITY DATA @ 220°F

<u>Pressure,</u> <u>psig</u>	<u>Oil Viscosity,</u> <u>Centipoise</u>
5000	0.746
4500	0.723
4000	0.698
3500	0.675
3000	0.650
2500	0.628
2000	0.603
1500	0.580
1000	0.555
500	0.532
<u>364</u> *	0.525
250	0.555
150	0.593
50	0.667
0	0.853

* Saturation Pressure.

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>
150	195	28	35			1.255	1.156 *
to							
0	195	204	218	41.4	1.305	1.069	2.144 *
250	195	8	10			1.295	1.027 *
to							
0	195	242	259	41.1	1.332	1.069	2.238 *

* These gases were collected and analysed by gas chromatography.

- (1) Gas/Oil Ratio in cubic feet of gas @ 14.696 psia and 60°F per barrel of oil @ indicated pressure and temperature.
- (2) Gas/Oil Ratio in cubic feet of gas @ 14.696 psia and 60°F per barrel of stock tank oil @ 60°F.
- (3) Formation Volume Factor is barrels of saturated oil @ 364 psig and 220°F per barrel of stock tank oil @ 60°F.
- (4) Separator Volume Factor is barrels of oil @ indicated pressure and temperature per barrel of stock tank oil @ 60°F.

HYDROCARBON ANALYSIS OF SEPARATOR GAS SAMPLES

<u>Component</u>	150 psig, 195°F			
	<u>Separator Gas</u>		<u>Stock Tank Gas</u>	
	<u>Mol Percent</u>	<u>GPM</u>	<u>Mol Percent</u>	<u>GPM</u>
Hydrogen Sulphide	0.00		0.00	
Carbon Dioxide	6.06		1.59	
Nitrogen	4.31		0.28	
Methane	45.66		6.69	
Ethane	10.88	2.902	5.66	1.510
Propane	14.55	3.993	17.17	4.713
iso-Butane	4.98	1.625	10.34	3.374
n-Butane	6.12	1.924	16.04	5.043
iso-Pentane	2.34	0.855	9.84	3.593
n-Pentane	1.89	0.683	9.32	3.369
Hexanes	1.24	0.505	11.22	4.565
Heptanes plus	1.97	0.892	11.85	5.366
	<u>100.00</u>	<u>13.379</u>	<u>100.00</u>	<u>31.533</u>
Gas gravity (Air = 1.000):		1.156		2.144
Gross heating value (BTU per cubic foot of dry gas @ 14.696 psia and 60°F):		1721		3425

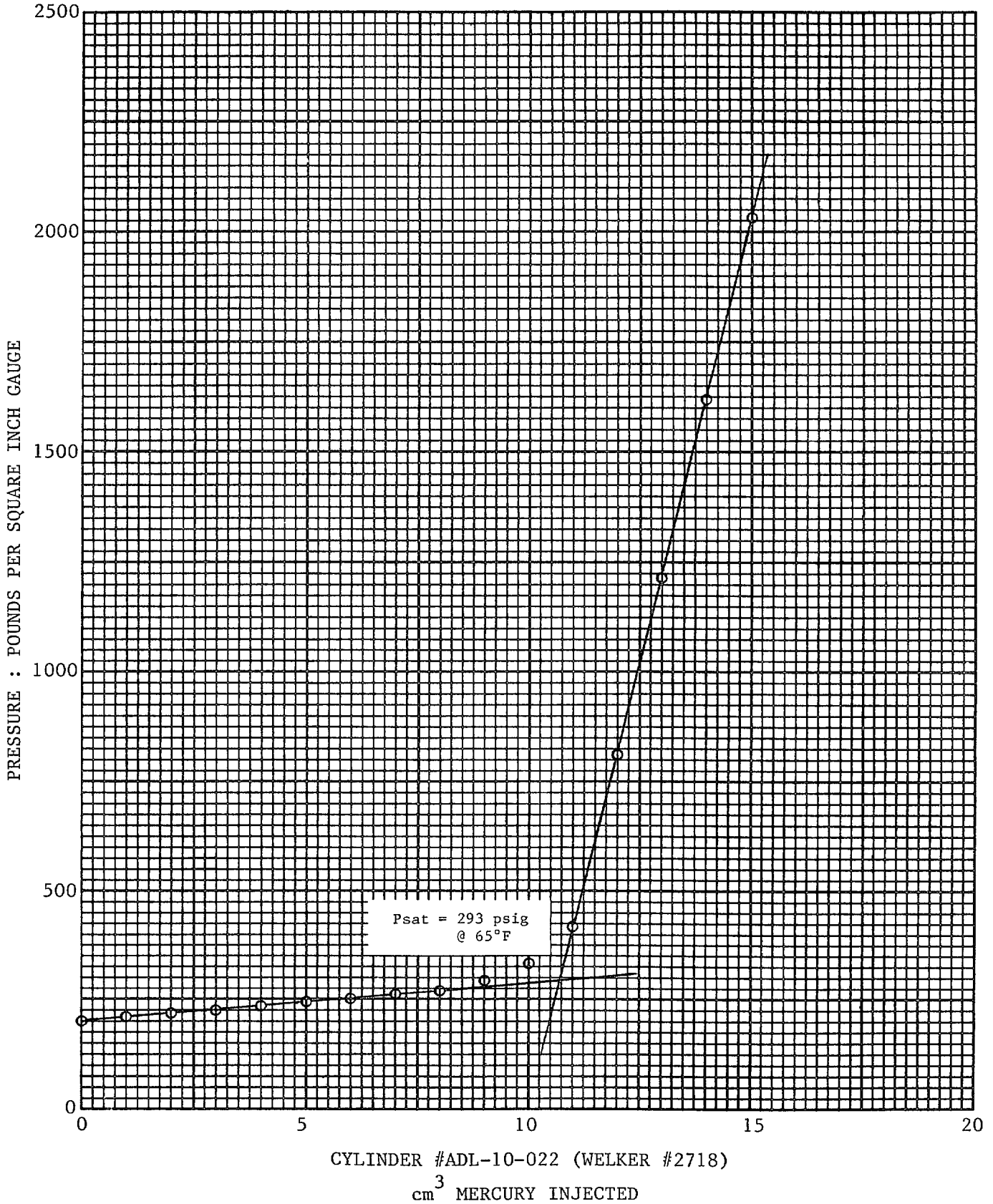
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BASIC CRUDE TESTS ON STOCK TANK OIL

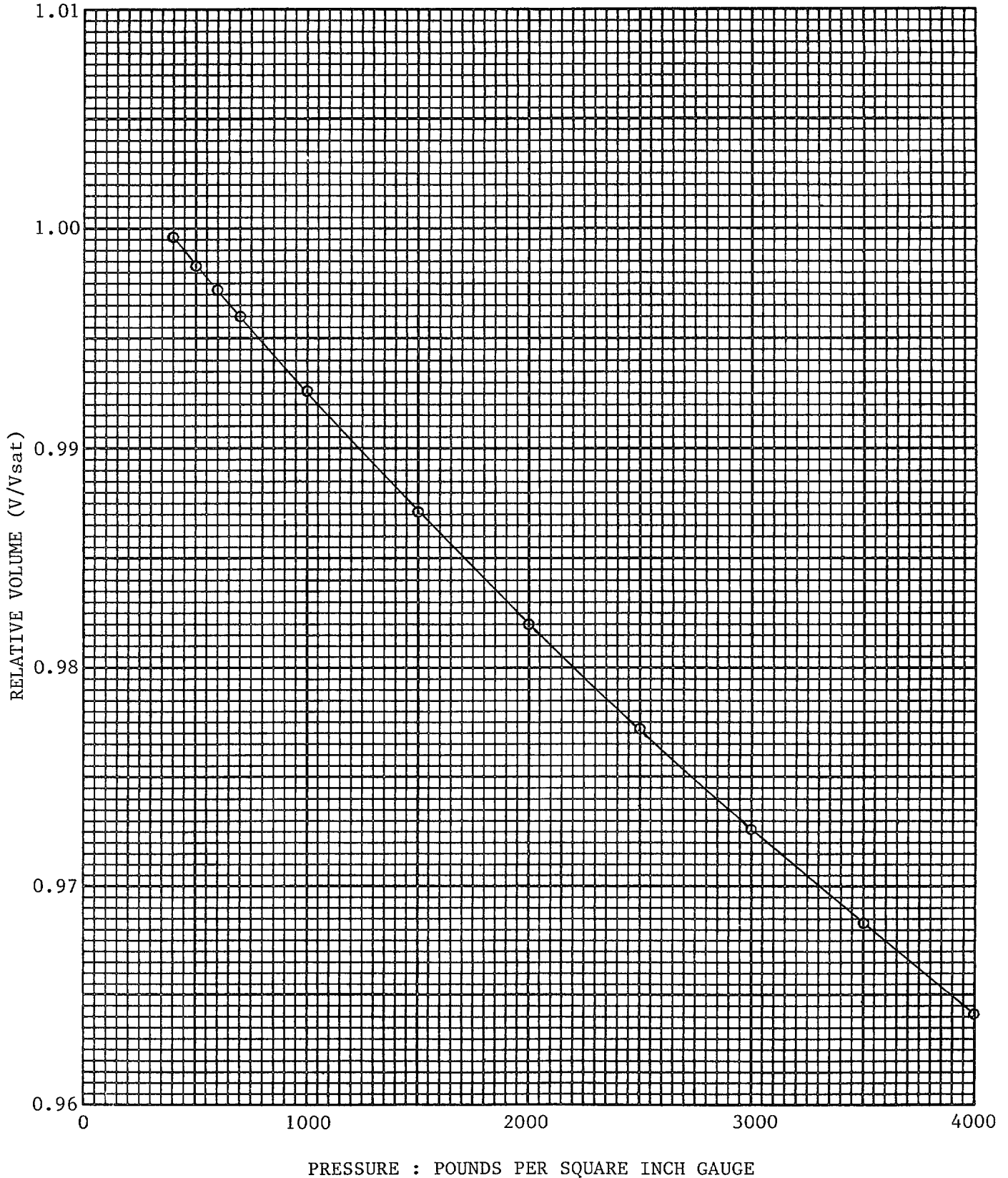
POUR POINT : 45°F

WAX CONTENT : 4.762%

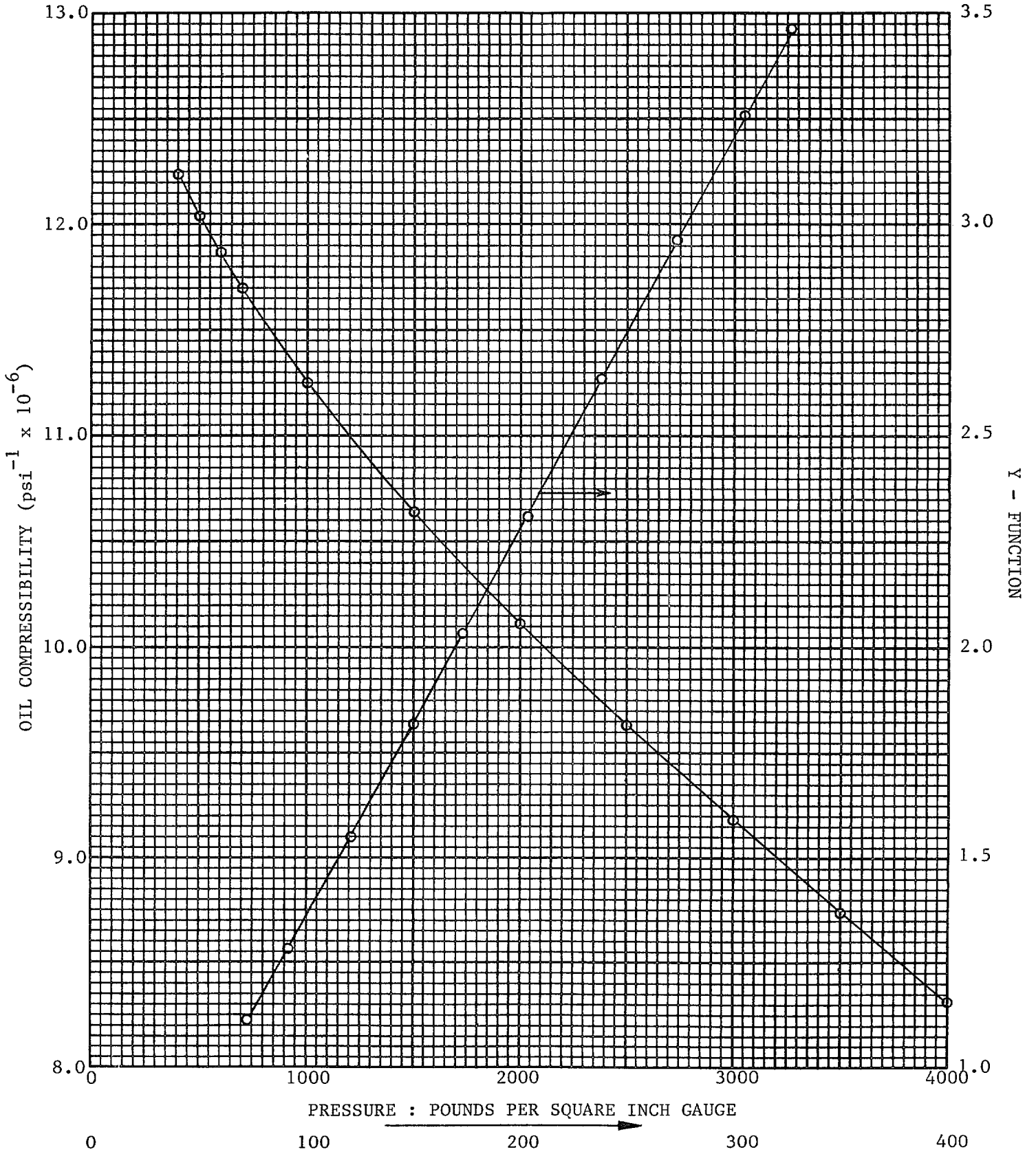
Company Esso Australia Limited Formation _____
Well Fortescue A13 State Victoria
Field Fortescue Country Australia



Company Esso Australia Limited Formation _____
Well Fortescue A13 State Victoria
Field Fortescue Country Australia



Company Esso Australia Limited Formation _____
 Well Fortescue A13 State Victoria
 Field Fortescue Country Australia



Company Esso Australia Limited Formation _____
Well Fortescue A13 State Victoria
Field Fortescue Country Australia

