

OILMIN N.L.

EAST MEREENIE NO:11

RESERVOIR FLUID STUDY

PR84/11 G

NORTHERN TERRITORY
GEOLOGICAL SURVEY

DEPT. OF MINES & ENERGY
DO NOT REMOVE

Reservoir Fluid Division



P00548



CORE LABORATORIES

Reservoir Fluid Division

24th May, 1984



Oilmin N.L.,
7th Floor,
27-35 Turbot Street,
BRISBANE, QLD. 4000

Attention: Mr. Bill Lawson

Subject : Reservoir Fluid Study
Well : East Mereenie No:11
File : AFL 84006

Dear Sir,

Subsurface samples were 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 Oilmin N.L.

As a quality check, the room temperature saturation pressure of the subsurface samples were initially determined. This result is reported on page two and depicted graphically on page sixteen.

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 heptanes plus properties are reported on page three.

The heptanes plus fraction was further broken down through hexadecanes plus. These results are obtained by high temperature fractional distillation and can be found on page four.

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

A portion of the reservoir fluid was charged to a high pressure visual cell and thermally expanded to the reported reservoir pressure of 146°F. This sample was then subjected to a constant composition expansion during which a bubble point pressure of 1730 psig was observed. The volumetric and pressure volume data is reported on page six and seven respectively and depicted graphically on page seventeen.

This fluid was then subjected to differential pressure depletion. During this test, the fluid was found to contain 811 cubic feet of gas per barrel of residual oil for a relative oil volume of 1.502 barrels of saturated oil

Oilmin N.L.
Well : East Mereenie No:11
File : AFL 84006

24th May, 1984

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 eighteen, nineteen and twenty.

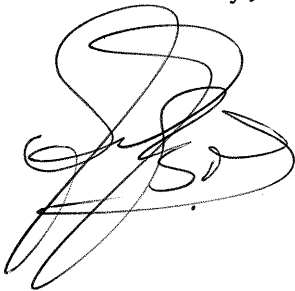
The viscosity of the reservoir fluid was measured over a wide range of pressures in a rolling ball viscosimeter at 146°F. The viscosity was found to vary from a minimum of 0.368 centipoise at saturation pressure to 1.519 centipoise at atmospheric pressure. This data is tabulated on page nine and is shown in graphic form on page twenty-one.

Four single-stage separator tests were performed at 85°F to determine the effects of separator pressure upon gas-oil ratio, stock tank oil gravity and formation volume factor. This data is reported on page ten. The gas evolved during each stage of separation was collected and analysed by chromatography. The compositions of the separator gases to heptanes plus are tabulated on pages eleven, twelve, thirteen and fourteen respectively.

Chemical analysis were then performed on the stock tank oil sample and this data is reported on page fifteen.

We thank Oilmin N.L. 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.

J. Bon,
Manager.

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Page : 1 of 21
File : AFL 84006

Company : Oilmin N.L. Date Sampled :
Well : East Mereenie No:11 State : Northern Territory
Field : Mereenie 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 :
 Reservoir Temperature : 146°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 :
Status of Well :
 Gas-Oil Ratio :
 Separator Pressure and Temperature :
 Tubing Pressure :
 Casing Pressure :
Sampled by :
Type Sampler :

REMARKS :

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Page : 2 of 21
 File : AFL 84006
 Well : East Mereenie No:11

QUALITY CHECK OF SAMPLES RECEIVED IN THE LABORATORY

CYLINDER NO: 259656 D 259670 D
OPENING PRESSURE: 700 psig @ 70°F 690 psig @ 70°F

<u>cm³ Hg Injected</u>	<u>Pressure, PSIG</u>	<u>cm³ Hg Injected</u>	<u>Pressure, PSIG</u>
4	1350	2	1315
6	1365	4	1330
8	1375	6	1345
10	1390	8	1360
12	1405	10	1375
14	1555	12	1390
15	1725	13	1475
16	1905	14	1750
		15	1830
		16	2005
		17	2190

Psat = 1412 psig @ 70°F

Psat = 1395 psig @ 70°F

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Petroleum Reservoir Engineering.

Page : 3 of 21
File : AFL 84006
Well : East Mereenie No:11

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	0.00	0.00			
Nitrogen	1.56	0.47			
Methane	26.47	4.53			
Ethane	14.48	4.65			
Propane	9.48	4.46			
iso-Butane	1.82	1.13			
n-Butane	5.77	3.58			
iso-Pentane	1.35	1.04			
n-Pentane	2.21	1.70			
Hexanes	4.48	4.10			
Heptanes plus	32.38	74.34	0.8085	43.3	215
	<u>100.00</u>	<u>100.00</u>			

* Cylinder Number 259656 D

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Page : 4 of 21
 File : AFL 84006
 Well : East Mereenie No:11

HIGH TEMPERATURE DISTILLATION OF
 HEPTANES PLUS FRACTION OF RESERVOIR FLUID SAMPLE*

<u>Component</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>
Heptanes	4.94	2.15	2.49	0.6975	71.2	94
Octanes	10.25	4.98	5.65	0.7136	66.6	105
Nonanes	10.48	5.67	6.27	0.7317	61.7	117
Decanes	9.96	6.08	6.60	0.7452	58.2	132
Undecanes	8.29	5.56	5.94	0.7576	55.1	145
Dodecanes	7.75	5.73	6.01	0.7713	51.8	160
Tridecanes	7.66	6.31	6.52	0.7819	49.3	178
Tetradecanes	3.89	3.51	3.59	0.7907	47.3	195
Pentadecanes	4.03	3.84	3.89	0.7995	45.3	206
Hexadecanes plus	32.75	56.17	53.04	0.8568	33.5	371
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>			

* Cylinder Number 259656 D

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Page : 5 of 21
File : AFL 84006
Well : East Mereenie No:11

HYDROCARBON ANALYSIS OF RESERVOIR FLUID SAMPLE TO HEXADECANES PLUS*

<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	0.00	0.00			
Nitrogen	1.56	0.47			
Methane	26.47	4.53			
Ethane	14.48	4.65			
Propane	9.48	4.46			
iso-Butane	1.82	1.13			
n-Butane	5.77	3.58			
iso-Pentane	1.35	1.04			
n-Pentane	2.21	1.70			
Hexanes	4.48	4.10			
Heptanes	1.60	1.60	0.6975	71.2	94
Octanes	3.32	3.70	0.7136	66.6	105
Nonanes	3.39	4.21	0.7317	61.7	117
Decanes	3.22	4.52	0.7452	58.2	132
Undecanes	2.69	4.13	0.7576	55.1	145
Dodecanes	2.51	4.26	0.7713	51.8	160
Tridecanes	2.48	4.69	0.7819	49.3	178
Tetradecanes	1.26	2.61	0.7907	47.3	195
Pentadecanes	1.31	2.85	0.7995	45.3	206
Hexadecanes plus	10.60	41.77	0.8568	33.5	371
	<u>100.00</u>	<u>100.00</u>			
 Heptanes plus properties			0.8085	43.3	215

* Cylinder Number 259656 D

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VOLUMETRIC DATA OF RESERVOIR FLUID SAMPLE

Saturation pressure (bubble point pressure) 1730 psig @ 146°F

Specific volume at saturation pressure : ft 3/lb 0.02467

Thermal expansion of saturated oil @ 5000 psig @ $\frac{145^{\circ}\text{F}}{73^{\circ}\text{F}}$ = 1.04904

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

From 5000 psig to 4000 psig = 10.92×10^{-6}

From 4000 psig to 3000 psig = 11.61×10^{-6}

From 3000 psig to 2000 psig = 13.76×10^{-6}

From 2000 psig to 1730 psig = 16.09×10^{-6}

CORE LABORATORIES
Petroleum Reservoir Engineering.

Page : 7 of 21
File : AFL 84006
Well : East Mereenie No:11

PRESSURE - VOLUME RELATIONS AT 146°F

<u>Pressure,</u> PSIG	<u>Relative</u> <u>Volume (1)</u>	<u>Compressibility</u> <u>x10⁻⁶ (2)</u>	<u>Y</u> <u>Function (3)</u>
5000	0.9598	10.70	
4500	0.9650	10.88	
4000	0.9704	11.21	
3500	0.9759	11.71	
3000	0.9818	12.47	
2500	0.9883	13.62	
2200	0.9925	14.68	
2100	0.9940	15.14	
2000	0.9955	15.66	
1900	0.9971	16.34	
1800	0.9988	17.25	
1730 *	1.0000	18.16	
1713	1.0040		
1680	1.0122		
1641	1.0224		
1571	1.0427		2.349
1454	1.0832		2.259
1275	1.1647		2.141
1091	1.2873		2.011
894	1.4918		1.870
674	1.9005		1.702
503	2.5145		1.564
360	3.5353		1.441

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

DIFFERENTIAL VAPORIZATION AT 146°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
1730	811	1.502	1.502	0.6492			
1500	722	1.463	1.606	0.6571	0.798	0.00902	0.762
1250	636	1.424	1.770	0.6652	0.820	0.01110	0.771
1000	553	1.385	2.039	0.6731	0.844	0.01424	0.786
750	466	1.347	2.542	0.6805	0.869	0.01945	0.816
500	369	1.303	3.651	0.6891	0.897	0.02983	0.878
250	251	1.245	7.240	0.7010	0.930	0.06010	0.991
0	0	1.048		0.7499			1.584

At 60°F = 1.000

Gravity of Residual Oil = 48.4°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.

CORE LABORATORIES
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Page : 9 of 21
File : AFL 84006
Well : East Mereenie No:11

VISCOSITY DATA AT 146°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	0.480		
4000	0.445		
3000	0.411		
2500	0.394		
2200	0.384		
2000	0.377		
<u>1730</u> *	0.368		
1500	0.385	0.0158	24.4
1250	0.414	0.0147	28.2
1000	0.453	0.0138	32.8
750	0.502	0.0130	38.6
500	0.559	0.0121	46.2
250	0.719	0.0112	64.2
0	1.519		

* Bubble Point Pressure.

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

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>
200	85	465	545			1.171	0.801*
to							
0	85	235	238	49.3	1.463	1.014	1.410*
150	85	519	589			1.134	0.827*
to							
0	85	182	185	49.5	1.455	1.014	1.437*
100	85	590	644			1.092	0.870*
to							
0	85	120	122	49.7	1.447	1.014	1.457*
50	85	670	706			1.053	0.945*
to							
0	85	60	61	49.7	1.448	1.014	1.459*

* 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 1730 psig and 146°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.

HYDROCARBON ANALYSES OF SEPARATOR GAS SAMPLES

<u>Component</u>	<u>200 PSIG, 85°F</u>		<u>0 PSIG, 85°F</u>	
	<u>Mol Percent</u>	<u>GPM</u>	<u>Mol Percent</u>	<u>GPM</u>
Hydrogen Sulphide	0.00		0.00	
Carbon Dioxide	0.00		0.00	
Nitrogen	4.38		0.40	
Methane	65.09		21.47	
Ethane	20.34	5.425	28.48	7.597
Propane	6.53	1.792	21.98	6.033
iso-Butane	0.64	0.209	3.94	1.285
n-Butane	1.61	0.506	11.71	3.682
iso-Pentane	0.27	0.099	2.91	1.062
n-Pentane	0.36	0.130	3.90	1.409
Hexanes	0.12	0.049	2.03	0.826
Heptanes plus	0.66	0.299	3.18	1.440
	<u>100.00</u>	<u>8.509</u>	<u>100.00</u>	<u>23.334</u>
Gas gravity (Air = 1.000):	0.801		1.410	
Gross heating value (BTU per cubic foot of dry gas at 14.696 psia and 60°F):	1323		2332	

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HYDROCARBON ANALYSES OF SEPARATOR GAS SAMPLES

<u>Component</u>	150 PSIG, 85°F		0 PSIG, 85°F	
	Mol Percent	GPM	Mol Percent	GPM
Hydrogen Sulphide	0.00		0.00	
Carbon Dioxide	0.00		0.00	
Nitrogen	4.05		0.32	
Methane	62.76		20.03	
Ethane	21.40	5.708	26.98	7.197
Propane	7.41	2.034	24.01	6.590
iso-Butane	0.76	0.248	4.29	1.400
n-Butane	1.92	0.604	12.21	3.839
iso-Pentane	0.35	0.128	2.97	1.084
n-Pentane	0.44	0.159	3.98	1.438
Hexanes	0.14	0.057	2.05	0.834
Heptanes plus	0.77	0.349	3.16	1.431
	100.00	9.287	100.00	23.813
Gas gravity (Air = 1.000):	0.827		1.437	
Gross heating value (BTU per cubic foot of dry gas at 14.696 psia and 60°F):	1368		2375	

HYDROCARBON ANALYSES OF SEPARATOR GAS SAMPLES

<u>Component</u>	<u>100 PSIG, 85°F</u>		<u>0 PSIG, 85°F</u>	
	<u>Mol</u>		<u>Mol</u>	
<u>Component</u>	<u>Percent</u>	<u>GPM</u>	<u>Percent</u>	<u>GPM</u>
Hydrogen Sulphide	0.00		0.00	
Carbon Dioxide	0.00		0.00	
Nitrogen	3.72		0.27	
Methane	59.69		18.69	
Ethane	21.99	5.866	26.52	7.074
Propane	8.69	2.385	25.02	6.867
iso-Butane	0.97	0.317	4.48	1.462
n-Butane	2.53	0.795	12.77	4.015
iso-Pentane	0.50	0.183	2.99	1.092
n-Pentane	0.63	0.228	4.05	1.463
Hexanes	0.19	0.077	2.06	0.838
Heptanes plus	1.09	0.494	3.15	1.426
	<u>100.00</u>	<u>10.345</u>	<u>100.00</u>	<u>24.237</u>
Gas gravity (Air = 1.000):		0.870		1.457
Gross heating value (BTU per cubic foot of dry gas at 14.696 psia and 60°F):		1440		2407

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HYDROCARBON ANALYSES OF SEPARATOR GAS SAMPLES

<u>Component</u>	<u>50 PSIG, 85°F</u>		<u>0 PSIG, 85°F</u>	
	<u>Mol</u>		<u>Mol</u>	
	<u>Percent</u>	<u>GPM</u>	<u>Percent</u>	<u>GPM</u>
Hydrogen Sulphide	0.00		0.00	
Carbon Dioxide	0.00		0.00	
Nitrogen	3.41		0.25	
Methane	55.26		18.32	
Ethane	22.04	5.879	26.88	7.170
Propane	10.38	2.849	24.96	6.851
iso-Butane	1.31	0.427	4.45	1.452
n-Butane	3.61	1.135	12.93	4.065
iso-Pentane	0.81	0.296	2.98	1.088
n-Pentane	1.01	0.365	4.01	1.449
Hexanes	0.29	0.118	2.05	0.834
Heptanes plus	1.88	0.851	3.17	1.436
	<u>100.00</u>	<u>11.920</u>	<u>100.00</u>	<u>24.345</u>
Gas gravity (Air = 1.000):	0.945		1.459	
Gross heating value (BTU per cubic foot of dry gas at 14.696 psia and 60°F):	1562		2411	

CHEMICAL ANALYSIS OF STOCK TANK OIL SAMPLE

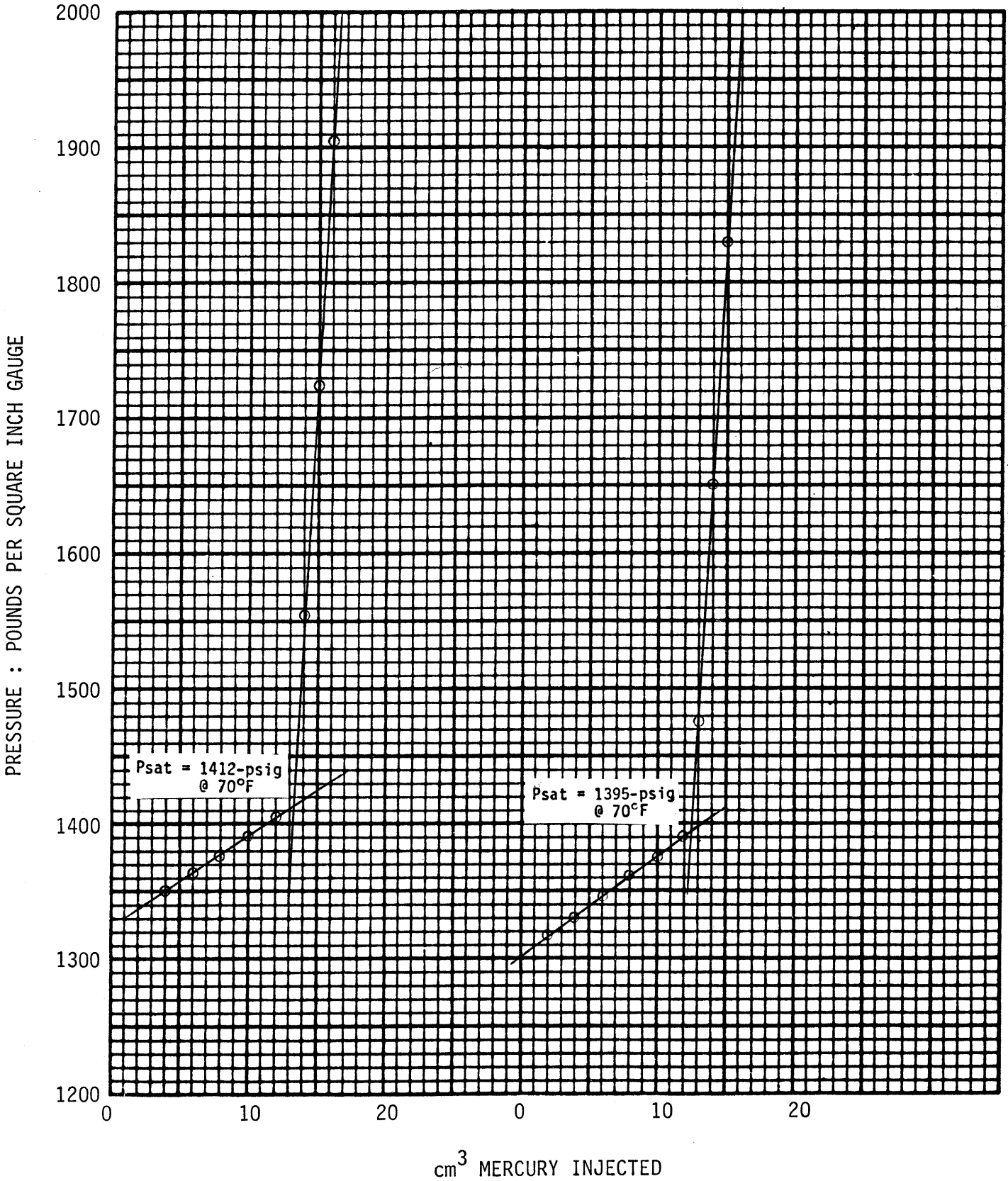
Trace Metals Determination by Atomic Absorption:-

<u>Component</u>	<u>Concentration (ppm)</u>
Iron (Fe)	<1
Aluminium (Al)	<1
Chromium (Cr)	<0.5
Lead (Pb)	<1
Copper (Cu)	<1
Silicon (Si)	<1
Sodium (Na)	8
Vanadium (V)	<1
Cadmium (Cd)	<1
Calcium (Ca)	<1
Molybdenum (Mo)	<1
Barium (Ba)	<1
Nickel (Ni)	3
Titanium (Ti)	<1
Phosphorus (P)	3
Manganese (Mn)	<1
Boron (B)	<1
Sulphur (S)	710
Conradson Carbon Residue [*] on hexadecane plus fraction	0.46 % by weight

* Method of analysis is as in ASTM D49

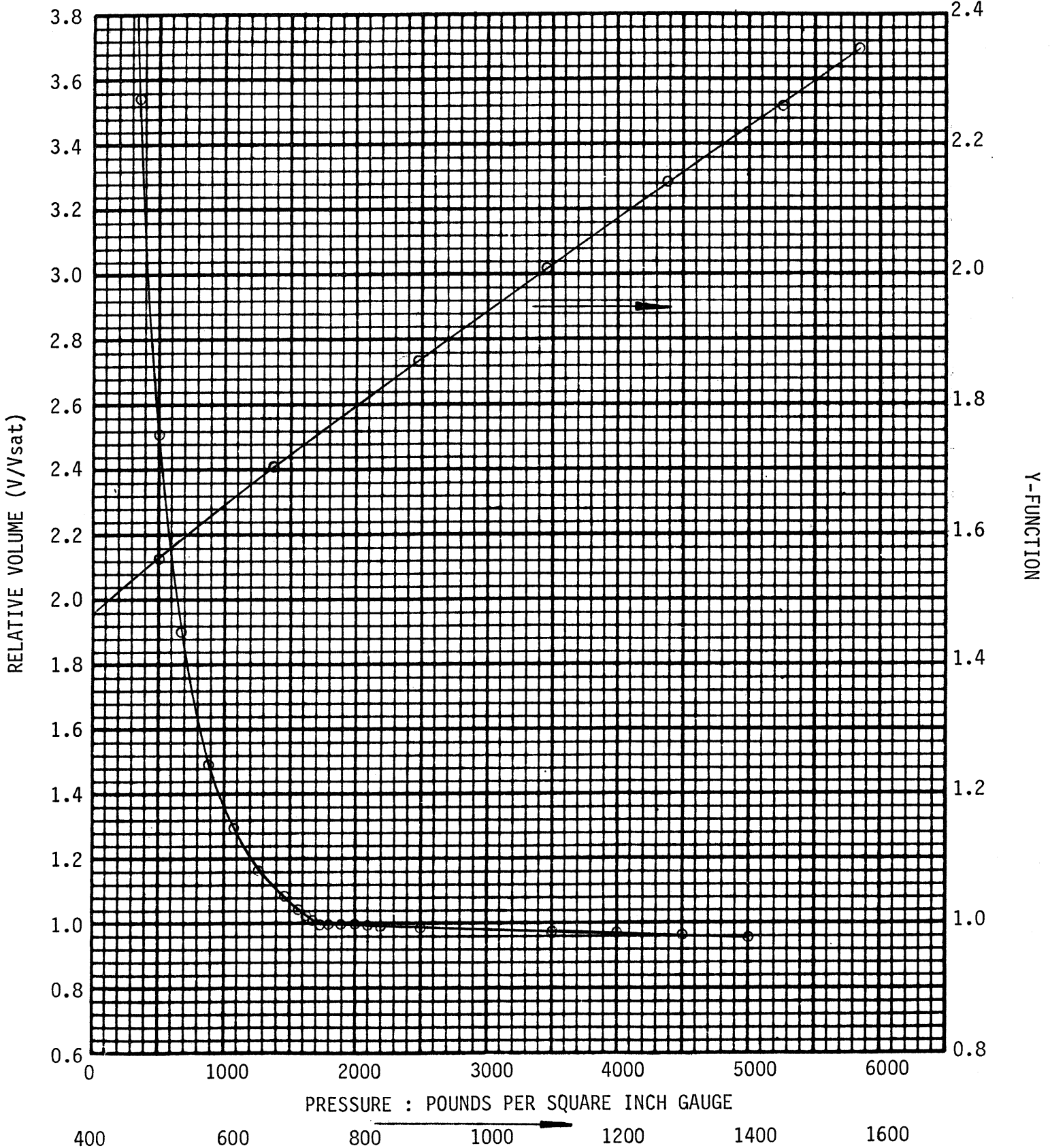
SATURATION PRESSURES OF RESERVOIR FLUID SAMPLES AT ROOM TEMPERATURE

Company Oilmin N.L. Formation _____
Well East Mereenie No:11 State Northern Territory
Field Mereenie Country Australia



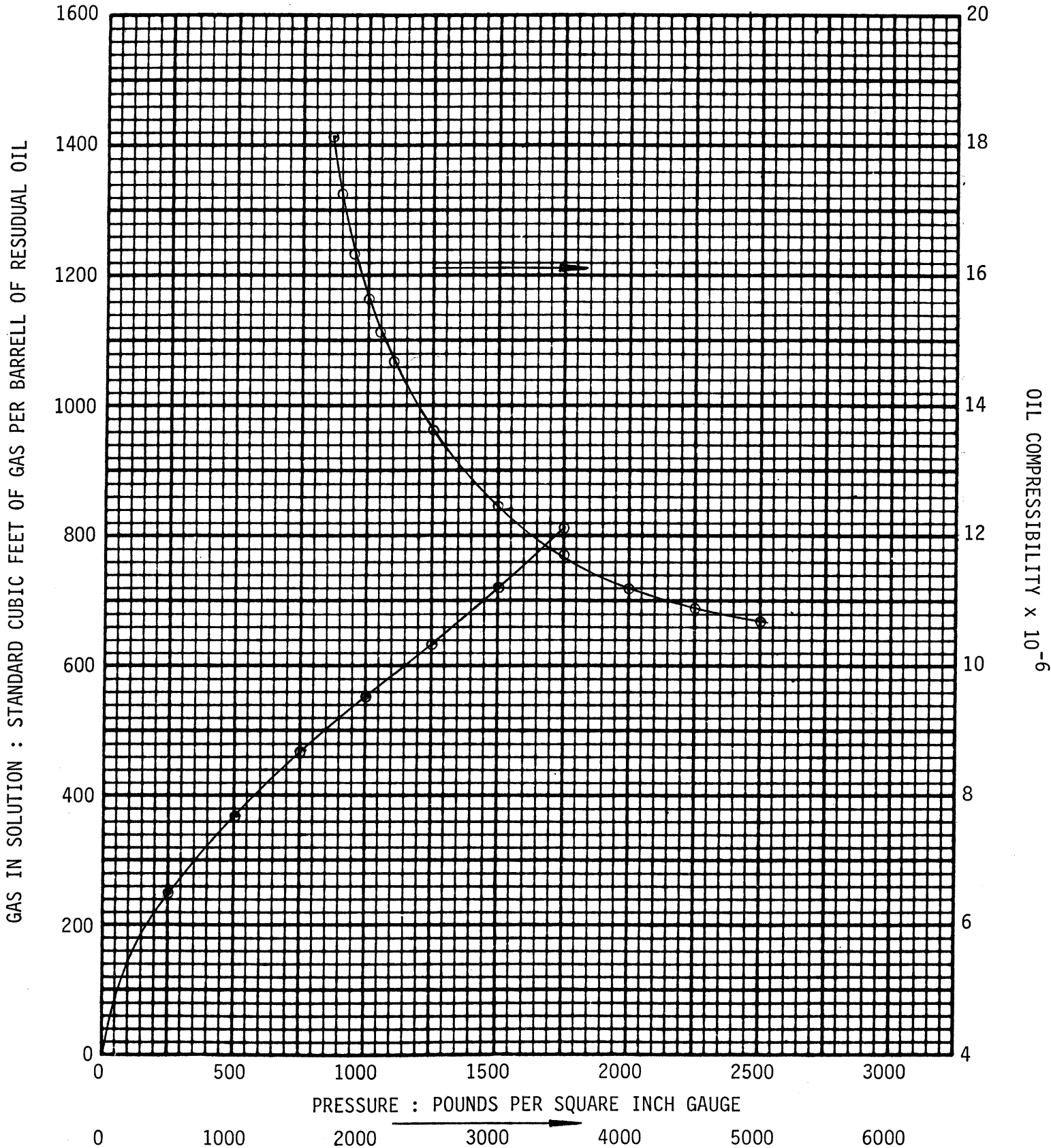
PRESSURE VOLUME RELATIONS OF RESERVOIR FLUID AT 146°F

Company	<u>Oilmin N.L.</u>	Formation	_____
Well	<u>East Mereenie No:11</u>	State	<u>Northern Territory</u>
Field	<u>Mereenie</u>	Country	<u>Australia</u>



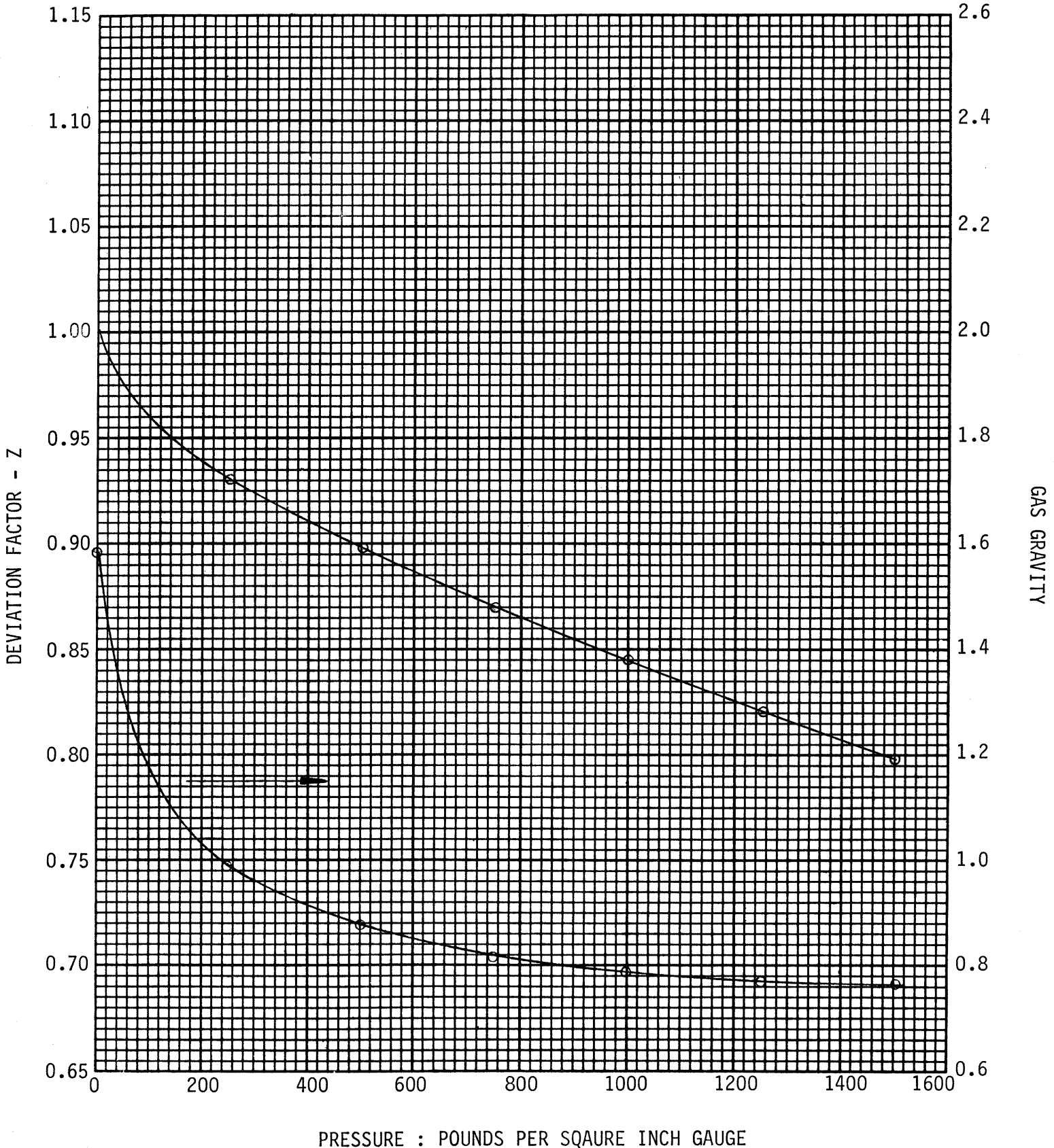
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 146°F

Company	<u>Oilmin N.L.</u>	Formation	_____
Well	<u>East Mereenie No:11</u>	State	<u>Northern Territory</u>
Field	<u>Mereenie</u>	Country	<u>Australia</u>



DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 146°F

Company	<u>Oilmin N.L.</u>	Formation	_____
Well	<u>East Mereenie No:11</u>	State	<u>Northern Territory</u>
Field	<u>Mereenie</u>	Country	<u>Australia</u>



VISCOSITY OF RESERVOIR FLUID AT 146°F

Company	<u>Oilmin N.L.</u>	Formation	_____
Well	<u>East Mereenie No:11</u>	State	<u>Northern Territory</u>
Field	<u>Mereenie</u>	Country	<u>Australia</u>

