

GIPPSLAND BASIN
HYDROCARBON REPORT

DEPT. NAT. RES & ENV



PE801637

WHITING A6 & A7 (BY PETROLAB) ESSO

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Reservoir Fluid and Core Services, Laboratory Consulting and Analysis

Adelaide, October 18 1989
P. O. Box 410
Magill
S. A. 5072

PETROLEUM DIVISION

Esso Australia Ltd.
Esso House
127 Kent Street
Sydney, N.S.W. 2000

Subject: Reservoir Fluid Study
Well : Whiting # A-6 / A-7
File : E - 89030

30 OCT 1989

Attention: Mr. David Braisted

Dear Sirs,

Please find enclosed results of reservoir fluid analyses performed on samples transferred from R F T tools ran in subject well.

R F T sample chamber # RFS - AD 1120 opened up @ 100 psig and room temperature and after transferring in single phase some 1800 cc's into three P V T storage cylinders approximately 1455 cc's of oil and 132 cc's of mud / water were recovered.

R F T sample chamber # RFS - AE 1116 opened up @ 1450 psig and room temperature and after transferring in single phase 1800 cc's into three P V T storage cylinders, approximately 740 cc's of oil and 340 cc's of mud / water were recovered.

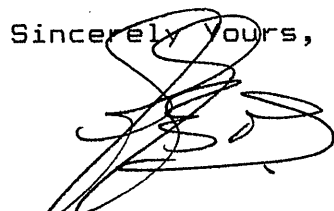
The validity of the samples was checked by determining the room temperature bubble points of the transferred samples.

We then proceeded with extended compositional analyses after which we introduced a portion of each bottom hole sample into a high pressure P V T cell where at the reservoir temperature a constant mass study was performed.

We finished the study with viscosity measurements of the reservoir oils at reservoir temperature.

It has been a pleasure to have performed this work for Esso Australia Ltd. If there are any questions or if we can assist you in any other way please do not hesitate to contact us.

Sincerely yours,



Jan G. Bon
Manager

P E T R O L A B

Company: Esso Australia Ltd.
 Well : Whiting # A-6 / A-7

File: E 89030

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P E T R O L A B

Company: Esso Australia Ltd.
Well : Whiting # A-6

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SUMMARY OF RESULTS

R F T CHAMBER RFS AD 1120

Depth (mRT):	1593
RT (m):	45.5
Capacity (Gal):	1
Reservoir Pressure (psia):	2057
Reservoir Temperature (°F):	199

CONSTANT MASS DATA:

Saturation Pressure (psig):	146 @ 199 °F
Thermal Expansion @ 5000 psig (1/°C):	0.000806
(1/°F):	0.000448
Compressibility of saturated oil @	199 °F
&	146 psig
(1/psi) * 10 ⁻⁶	15.28

ATMOSPHERIC FLASH DATA OF SATURATED OIL:

From P V T storage cylinder for compositional purposes.

Solution GOR (scf/bbl):	25
Formation Volume Factor (rbbl/stbbl):	1.1135
Molecular Weight:	124.9

RESIDUAL OIL:

API Gravity @ 60 °F:	52.9
Density @ 60 °F (gm/cc):	0.7667
Molecular Weight:	128.1
Oil Density (gm/cc @ PT):	0.7061 *
Specific Volume (ft ³ /lb @ PT):	0.02269 *

* P(ressure) 146 psig, T(emperature) 199 deg F

Stock Tank Oil Wax content U O P Method 46-64 (wt %): 0.72

Stock Tank Oil Pour Point A S T M Method D 97-66 (°C): < -12

Stock Tank Oil Cloud Point A S T M Method D 2500 (°C): < -16

P E T R O L A B

Company : Esso Australia Ltd.
 Well : Whiting # A-6
 File : E-89030

Sample # 1

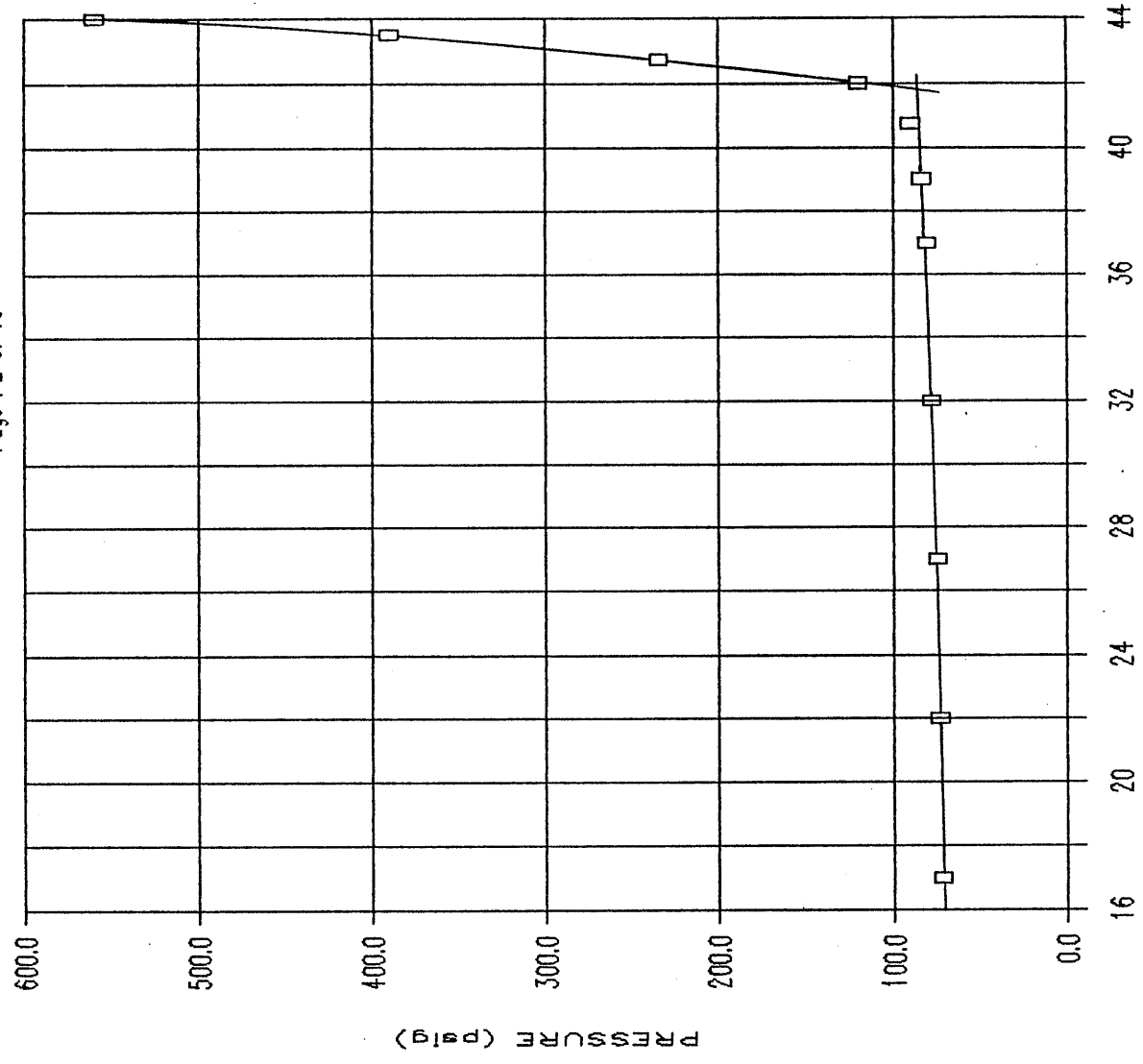
Sampling Conditions

Depth : 1593 mRT
 RT : 45.5 m
 R F T Chamber No : RFS AD 1120
 Capacity : 1 Gallon
 Res. Pressure : 2057 psia
 Res. Temperature : 199 deg F

Opening Pressure : 100 psig
 Temperature : 15 deg C.
 Transferred to : Cyl. No. 64

Volume (cc's)	Pressure (psig)
17.00	72
22.00	73
27.00	75
32.00	78
37.00	81
39.00	84
40.75	90
42.00	120
42.75	235
43.50	390
44.00	560

Saturation Pressure : 91 psig @ 19 deg C



VOLUME (cc's of Hg injected)

P E T R O L A B

Company : Esso Australia Ltd.
 Well : Whiting # A-6
 File : E-89030

Sample # 2

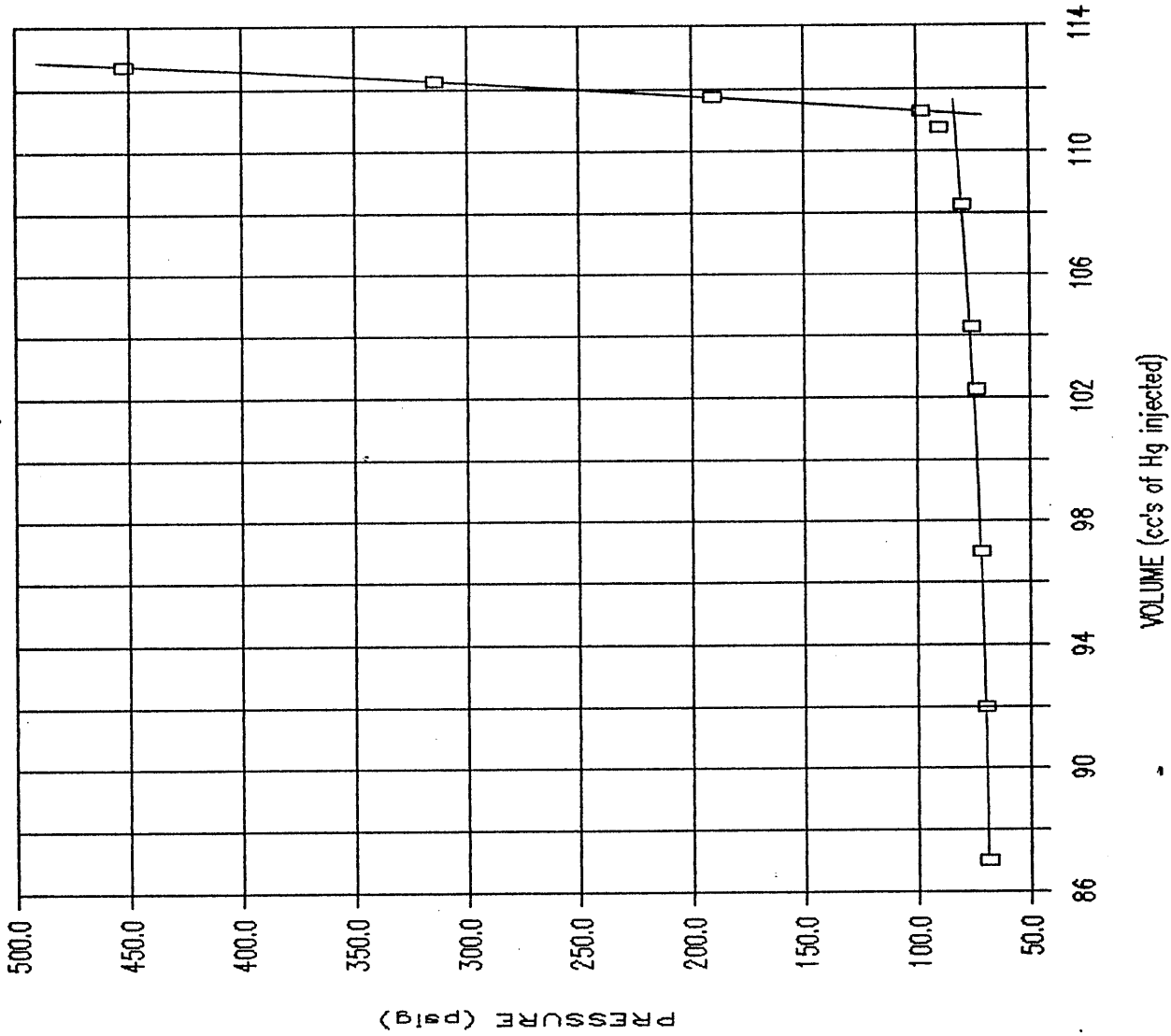
Sampling Conditions

Depth : 1593 mRT
 RT : 45.5 m
 R F T Chamber No : RFS AD 1120
 Capacity : 1 Gallon
 Res. Pressure : 2057 psia
 Res. Temperature : 199 deg F

Opening Pressure : 100 psig
 Temperature : 15 deg C.
 Transferred to : Cyl. No. 42

Volume (cc's)	Pressure (psig)
87.00	69
92.00	70
97.00	72
102.25	74
104.25	76
108.25	80
110.75	90
111.25	98
111.75	191
112.25	314
112.75	452

Saturation Pressure : 90 psig @ 19 deg C



P E T R O L A B

Company : Esso Australia Ltd.
 Well : Whiting # R-6
 File : E-89030

Sample # 3

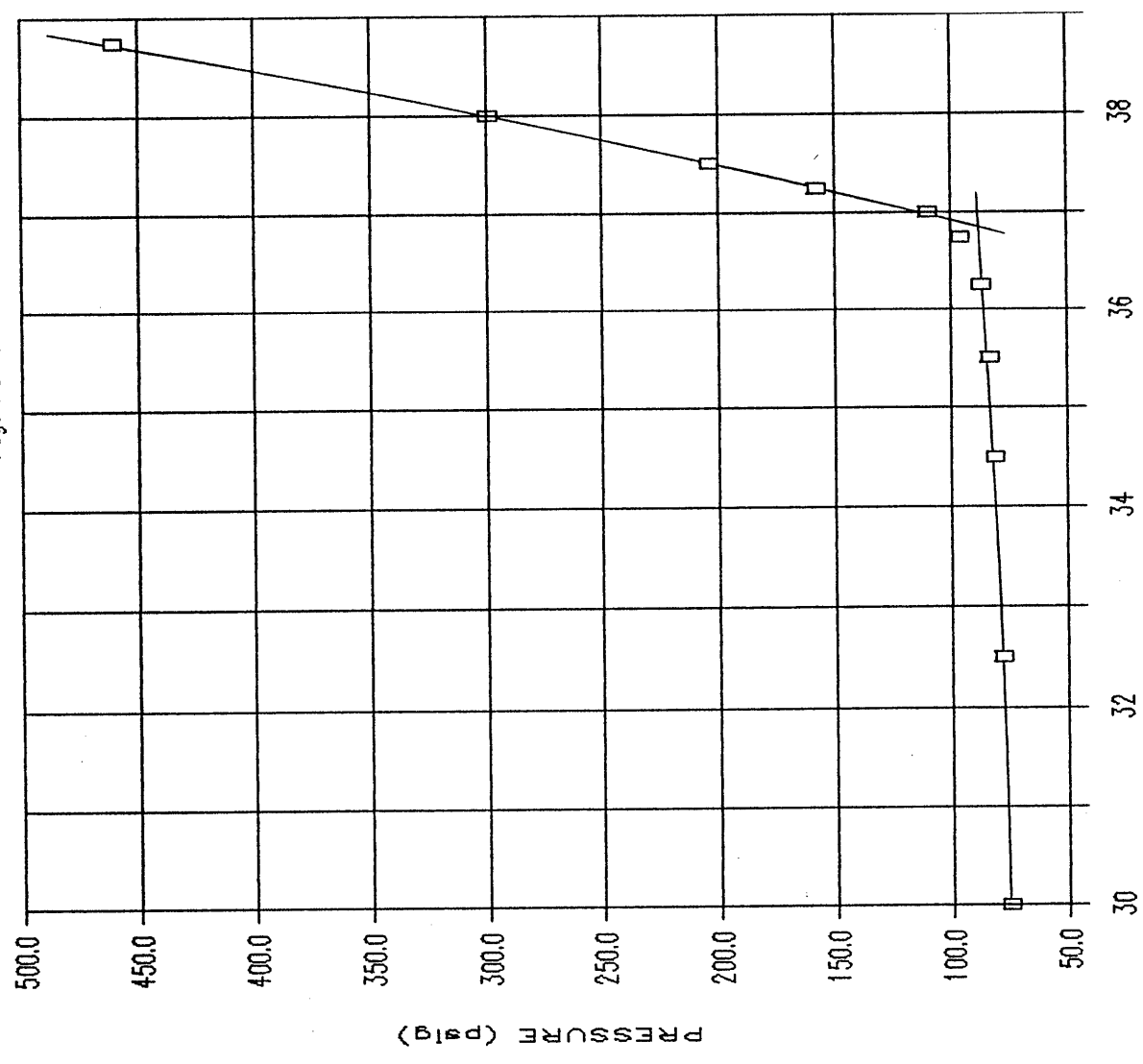
Sampling Conditions

Depth : 1593 mRT
 RT : 45.5 m
 R F T Chamber No : RFS RD 1120
 Capacity : 1 Gallon
 Res. Pressure : 2057 psia
 Res. Temperature : 199 deg F

Opening Pressure : 100 psig
 Temperature : 15 deg C.
 Transferred to : Cyl. No. 67

Volume (cc's)	Pressure (psig)
30.00	75
32.50	78
34.50	81
35.50	83
36.25	87
36.75	96
37.00	110
37.25	158
37.50	204
38.00	299
38.75	460

Saturation Pressure : 88 psig @ 21 deg C



VOLUME (cc's of Hg injected)

P E T R O L A B

Company: Esso Australia Ltd.
Well : Whiting # A-6

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COMPOSITIONAL ANALYSIS OF
RESERVOIR FLUID SAMPLE

Ex R F T Chamber RFS AD 1120.

Component	Stock Tank Liquid Mol %	Stock Tank Gas Mol %	Reservoir Fluid Mol %
Hydrogen Sulphide H2S	0.00	0.00	0.00
Carbon Dioxide CO2	0.03	1.96	0.09
Nitrogen N2	0.01	6.96	0.22
Methane C1	0.38	64.56	2.36
Ethane C2	0.47	12.76	0.85
Propane C3	0.98	7.26	1.17
Iso-Butane iC4	0.60	1.73	0.63
N-Butane nC4	0.84	1.68	0.87
Iso-Pentane iC5	0.74	0.55	0.73
N-Pentane nC5	0.72	0.41	0.71
Hexanes C6	8.18	1.15	7.96
Heptanes C7	19.50	0.84	18.92
Octanes C8	19.44	0.10	18.84
Nonanes C9	9.92	0.03	9.61
Decanes C10	9.86	0.01	9.56
Undecanes C11	7.24	0.00	7.02
Dodecanes Plus C12+	21.09	0.00	20.46
<hr/>			
TOTAL	100.00	100.00	100.00
<hr/>			
<u>Ratios</u>			
Molar Ratio :	0.9691	0.0309	1.0000
Mass Ratio :	0.9939	0.0061	1.0000
Liquid Ratio (bbl/bbl):	1.0000 @ SC	--	1.1135 @ PT*
Gas Liquid Ratio :	1.0000 bbl @ SC	25 SCF	--
<hr/>			
<u>Stream Properties</u>			
Molecular Weight :	128.1	24.81	124.9
Density obs. (gm/cc) :	0.7667 @ 60 F	--	0.6928 @ PT*
Gravity (AIR = 1.000) :	--	0.859	--
GHV (BTU/scf) :	--	1324.0	--
<hr/>			
<u>Hexanes Plus Properties</u>			
Mol % :	95.23	2.13	92.37
Molecular Weight :	131.9	90.6	131.8
Density (gm/cc @ 60 F):	0.7728	0.6760	0.7727
Gravity (API @ 60 F):	51.4	77.6	51.4
<hr/>			
<u>Heptanes Plus Properties</u>			
Mol % :	87.05	0.98	84.41
Molecular Weight :	136.4	98.3	136.3
Density (gm/cc @ 60 F):	0.7802	0.6868	0.7802
Gravity (API @ 60 F):	49.7	74.3	49.7
<hr/>			
<u>Decanes Plus Properties</u>			
Mol % :	38.19	0.01	37.04
Molecular Weight :	175.9	134.0	175.8
Density (gm/cc @ 60 F):	0.8135	0.7278	0.8135
Gravity (API @ 60 F):	42.3	62.7	42.3
<hr/>			
<u>Undecanes Plus Properties</u>			
Mol % :	28.33	0.00	27.48
Molecular Weight :	190.5	--	190.3
Density (gm/cc @ 60 F):	0.8226	--	0.8226
Gravity (API @ 60 F):	40.3	--	40.3
<hr/>			
<u>Dodecanes Plus Properties</u>			
Mol % :	21.09	0.00	20.46
Molecular Weight :	205.4	--	205.2
Density (gm/cc @ 60 F):	0.8313	--	0.8313
Gravity (API @ 60 F):	38.5	--	38.5

* (P)ressure 146 psig, (T)emperature 199 deg.F

P E T R O L A B

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CONSTANT MASS STUDY
@ 199 deg F

ON BOTTOM HOLE SAMPLE EX RFS AD 1120

Thermal Expansion of reservoir fluid at 5000 psig
= Volume at 199 deg.F/Volume at 72 deg.F = 1.057054

Pressure (psig)	Relative Volume (V/Vsat) (1)	Oil Compressibility (x 10 ⁻⁶)(psig ⁻¹) (2)	Y Function (3)	Oil Viscosity
5000	0.9523	7.78		0.571
4000	0.9603	8.27		0.540
3000	0.9689	8.85		0.510
2042 *	0.9778	9.59		0.481
1500	0.9832	10.12		0.465
1000	0.9887	11.08		0.450
600	0.9936	12.26		0.437
400	0.9962	13.27		0.431
200	0.9992	14.77		0.425
146 **	1.0000	15.28		0.423
139	1.0281		1.790	0.426
131	1.0672		1.705	0.430
118	1.1492		1.590	0.434
102	1.2957		1.459	0.438
86	1.5250		1.329	0.442
70	1.8770		1.238	0.446
52	2.6271		1.111	0.449
0				0.460

* Reservoir pressure
** Saturation pressure

(1) Barrels at indicated pressure per barrel at saturation pressure.

(2) Oil Compressibility = - (1/V) * (dV/dP)

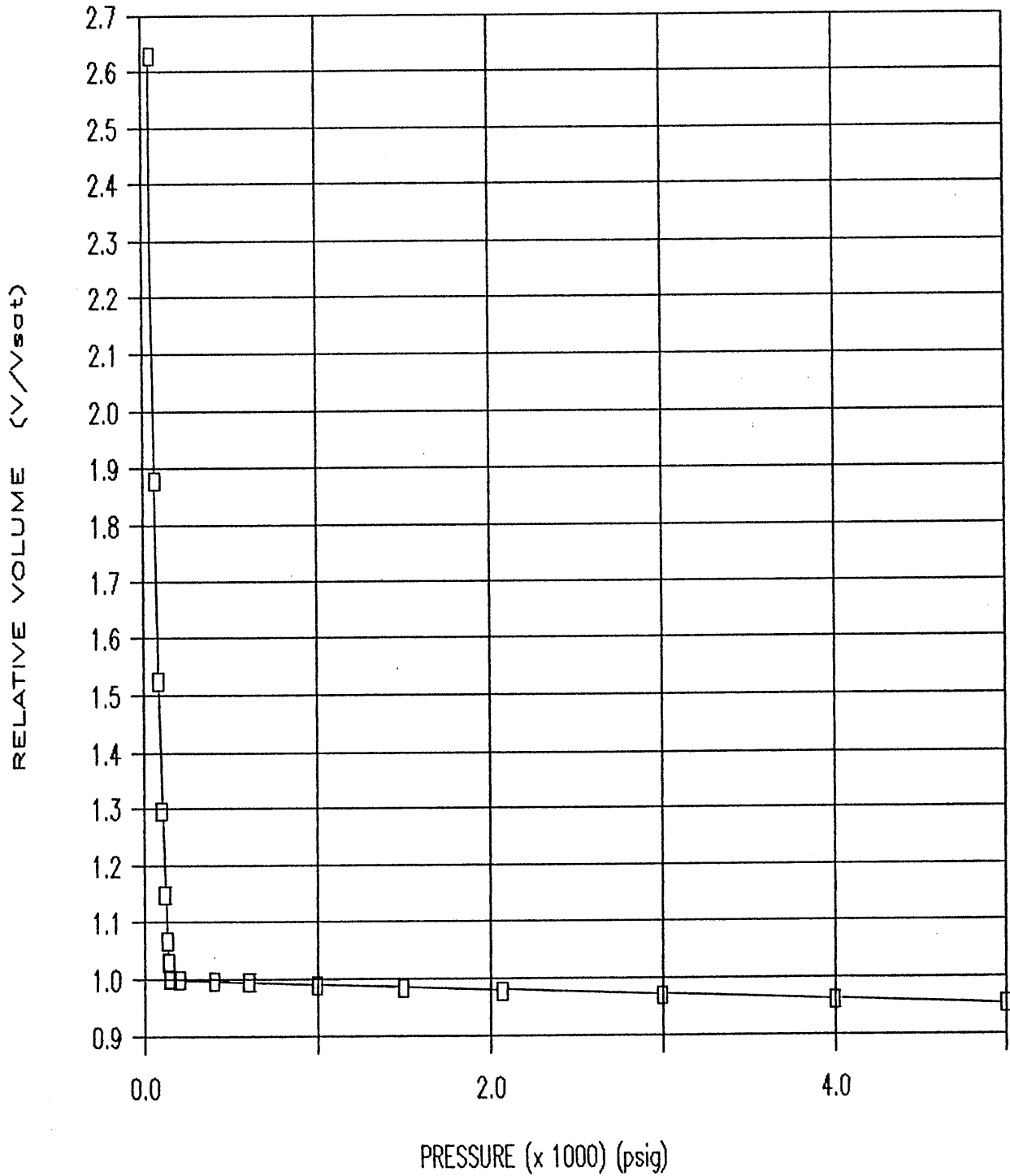
(3) Y Function = (Psat - P) / (P)*(V/Vsat-1)

P E T R O L A B

Company: Esso Australia Ltd.
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RELATIVE VOLUME

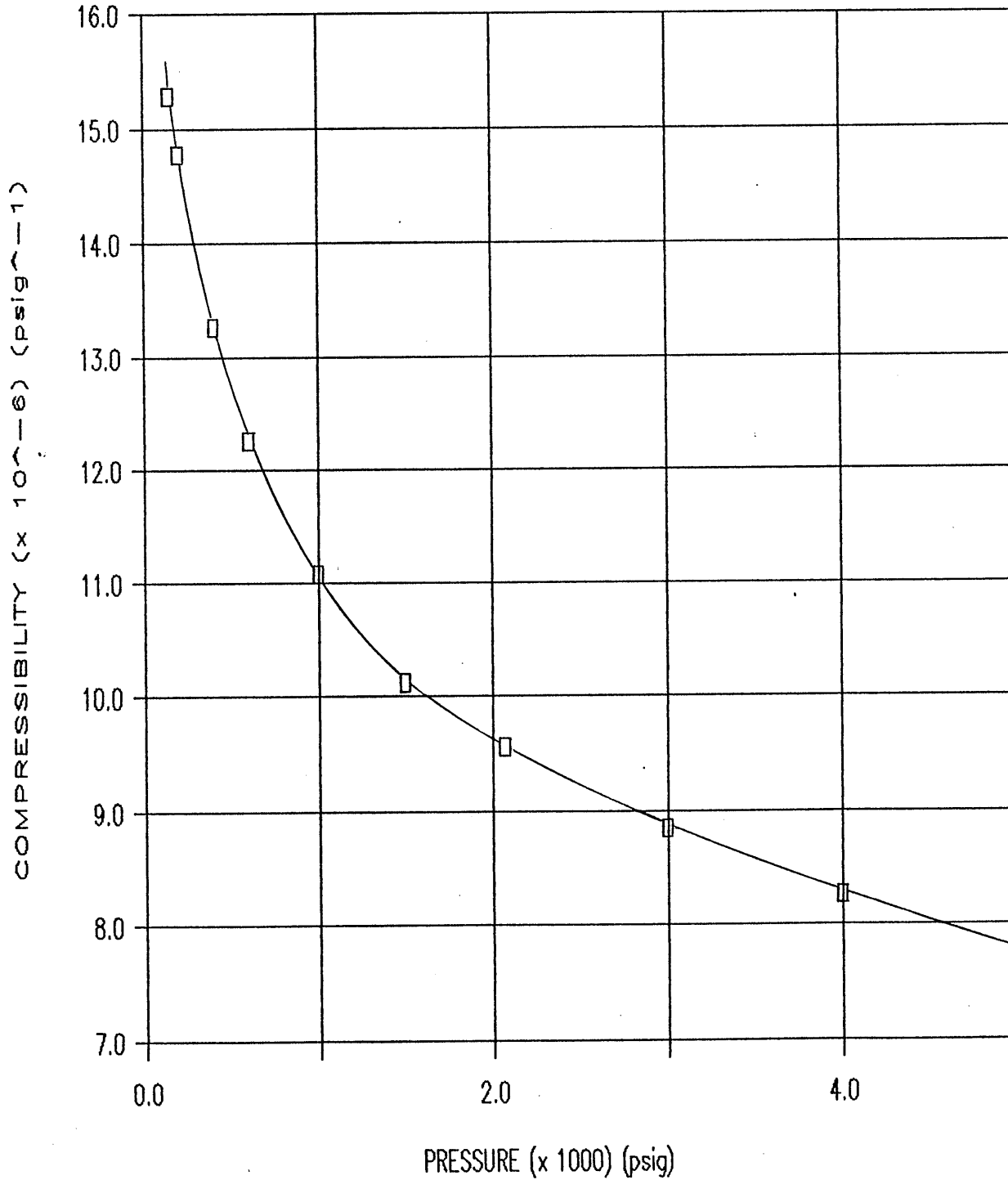


P E T R O L A B

Company: Esso Australia Ltd.
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OIL COMPRESSIBILITY

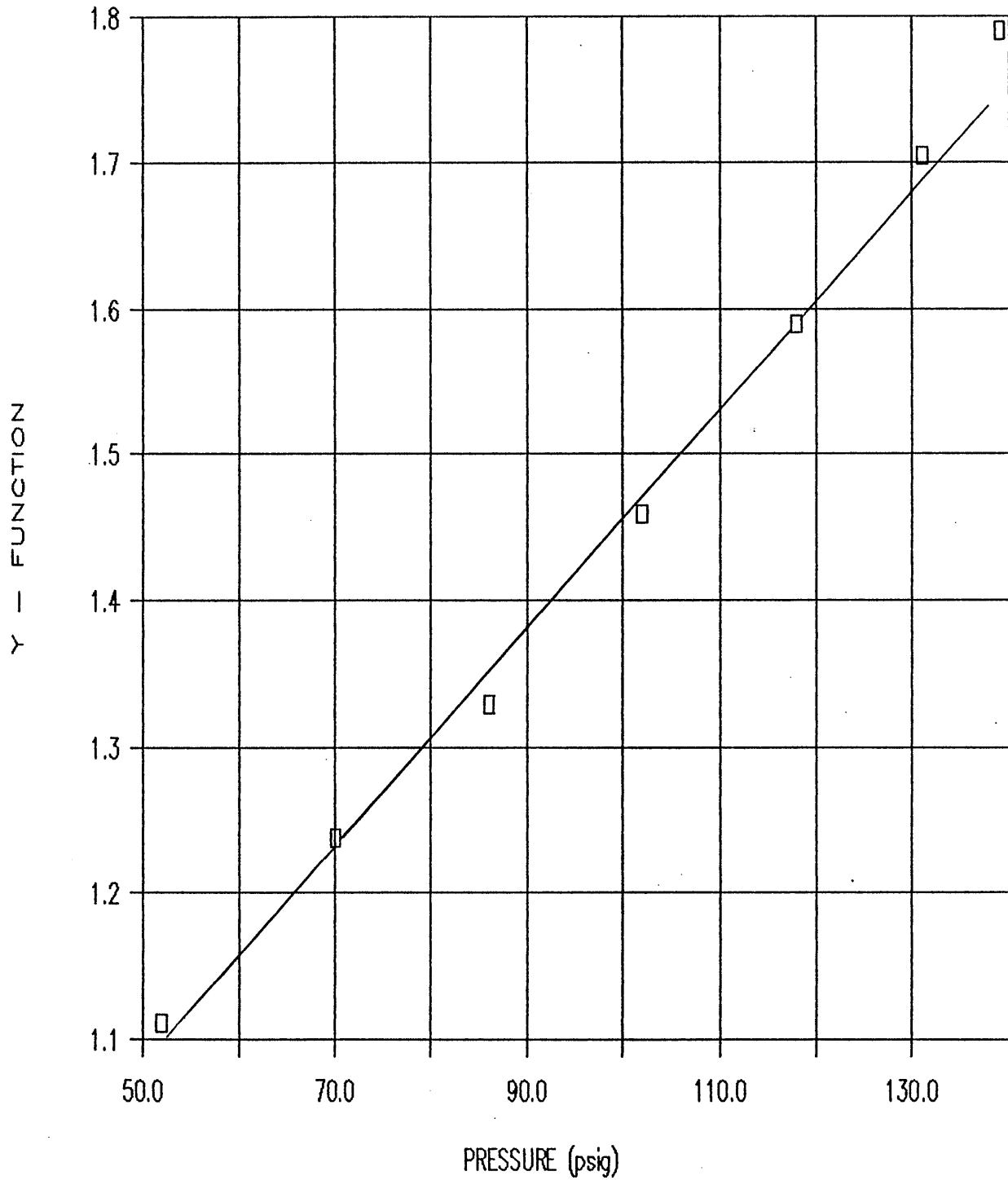


P E T R O L A B

Company: Esso Australia Ltd.
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Y - FUNCTION

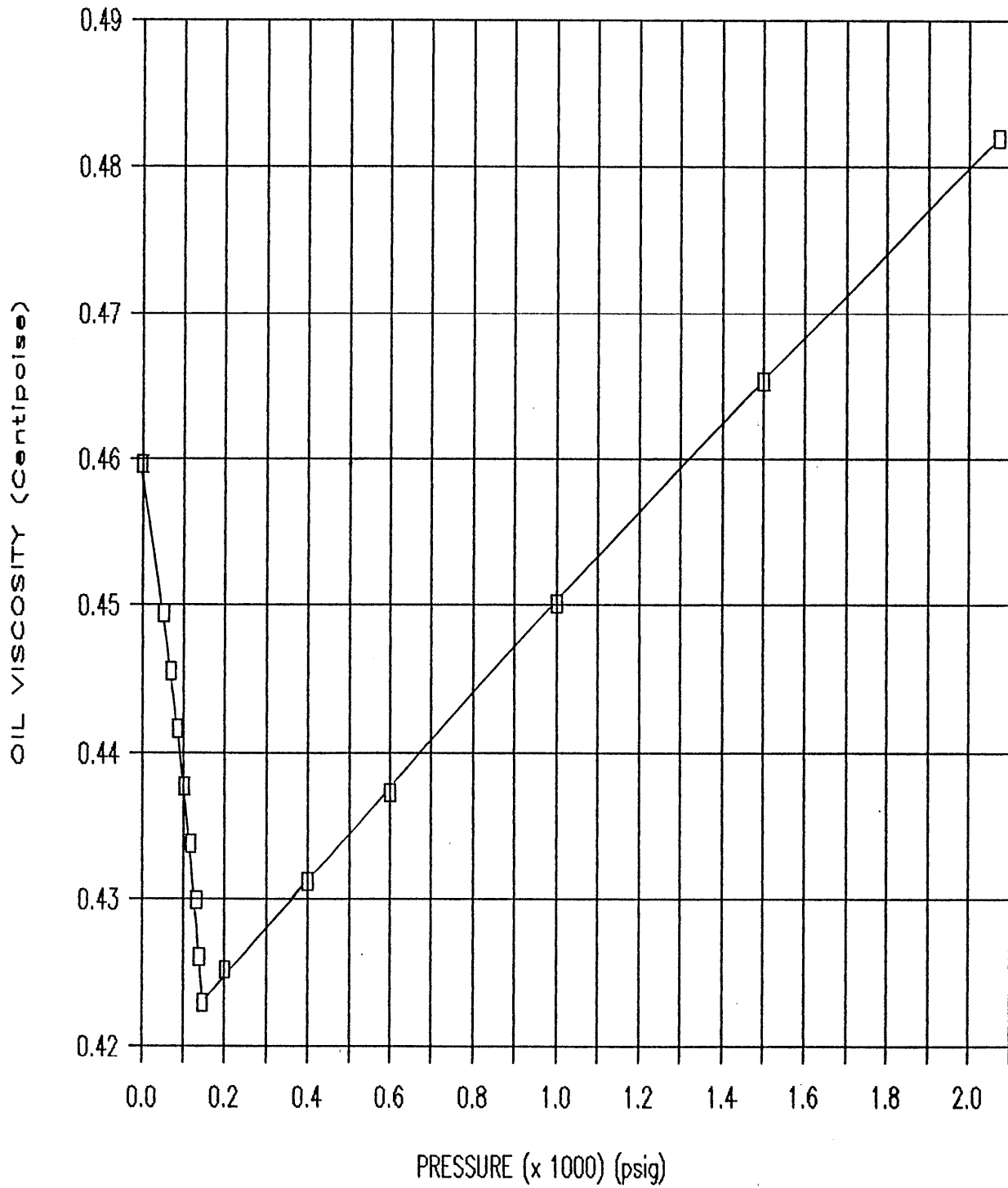


P E T R O L A B

Company: Esso Australia Ltd.
Well : Whiting # A-6

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OIL VISCOSITY



P E T R O L A B

Company: Esso Australia Ltd.
Well : Whiting # A-7

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SUMMARY OF RESULTS

R F T CHAMBER RFS AD 1116

Depth (mRT):	2338.5
RT (m):	45.5
Capacity (Gal):	1
Reservoir Pressure (psia):	2562
Reservoir Temperature (°F):	219

CONSTANT MASS DATA:

Saturation Pressure (psig):	2650 @ 219 °F
Thermal Expansion @ 5000 psig (1/°C):	0.001215
(1/°F):	0.000675
Compressibility of saturated oil @	219 °F
&	2650 psig
(1/psi) * 10 ⁻⁶	19.70

ATMOSPHERIC FLASH DATA OF SATURATED OIL:

From P V T storage cylinder for compositional purposes.

Solution GOR (scf/bbl):	783
Formation Volume Factor (rbbl/stbbl):	1.4619
Molecular Weight:	90.3

RESIDUAL OIL:

API Gravity @ 60 °F:	43.9
Density @ 60 °F (gm/cc):	0.8060
Molecular Weight:	170.5
Oil Density (gm/cc @ PT):	0.7421 *
Specific Volume (ft ³ /lb @ PT):	0.02159 *

* P(ressure) 2650 psig, T(emperature) 219 deg F

Stock Tank Oil Wax content U O P Method 46-64 (wt %):	0.16
Stock Tank Oil Pour Point A S T M Method D 97-66 (°C):	-5
Stock Tank Oil Cloud Point A S T M Method D 2500 (°C):	6

P E T R O L A B

Company : Esso Australia Ltd.
 Well : Whiting # A-7
 File : E-89030

Sample # 1

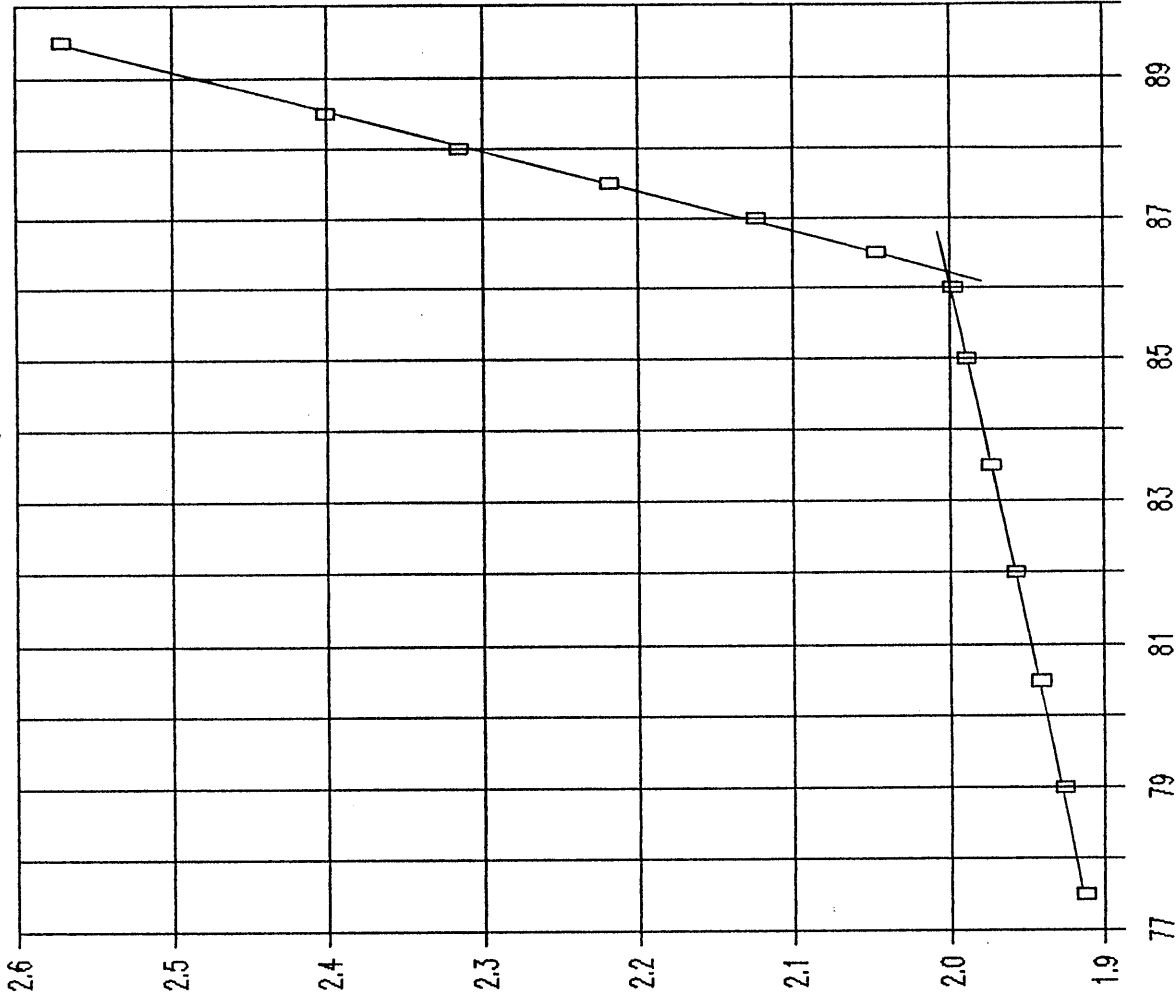
Sampling Conditions

Depth : 2338.5 mRT
 RT : 45.5 m
 R F T Chamber No : RFS AD 1116
 Capacity : 1 Gallon
 Res. Pressure : 2562.4 psia
 Res. Temperature : 220 deg F

Opening Pressure : 1450 psig
 Temperature : 15 deg C.
 Transferred to : Cyl. No. 66

Volume (cc's)	Pressure (psig)
77.50	1912
79.00	1926
80.50	1941
82.00	1957
83.50	1973
85.00	1989
86.00	1998
86.50	2047
87.00	2124
87.50	2218
88.00	2315
88.50	2401
89.50	2570

Saturation Pressure : 2002 psig @ 21 deg C



VOLUME (cc's of Hg injected)

P E T R O L A B

Company : Esso Australia Ltd.
 Well : Whiting # A-7
 File : E-89030

Sample # 2

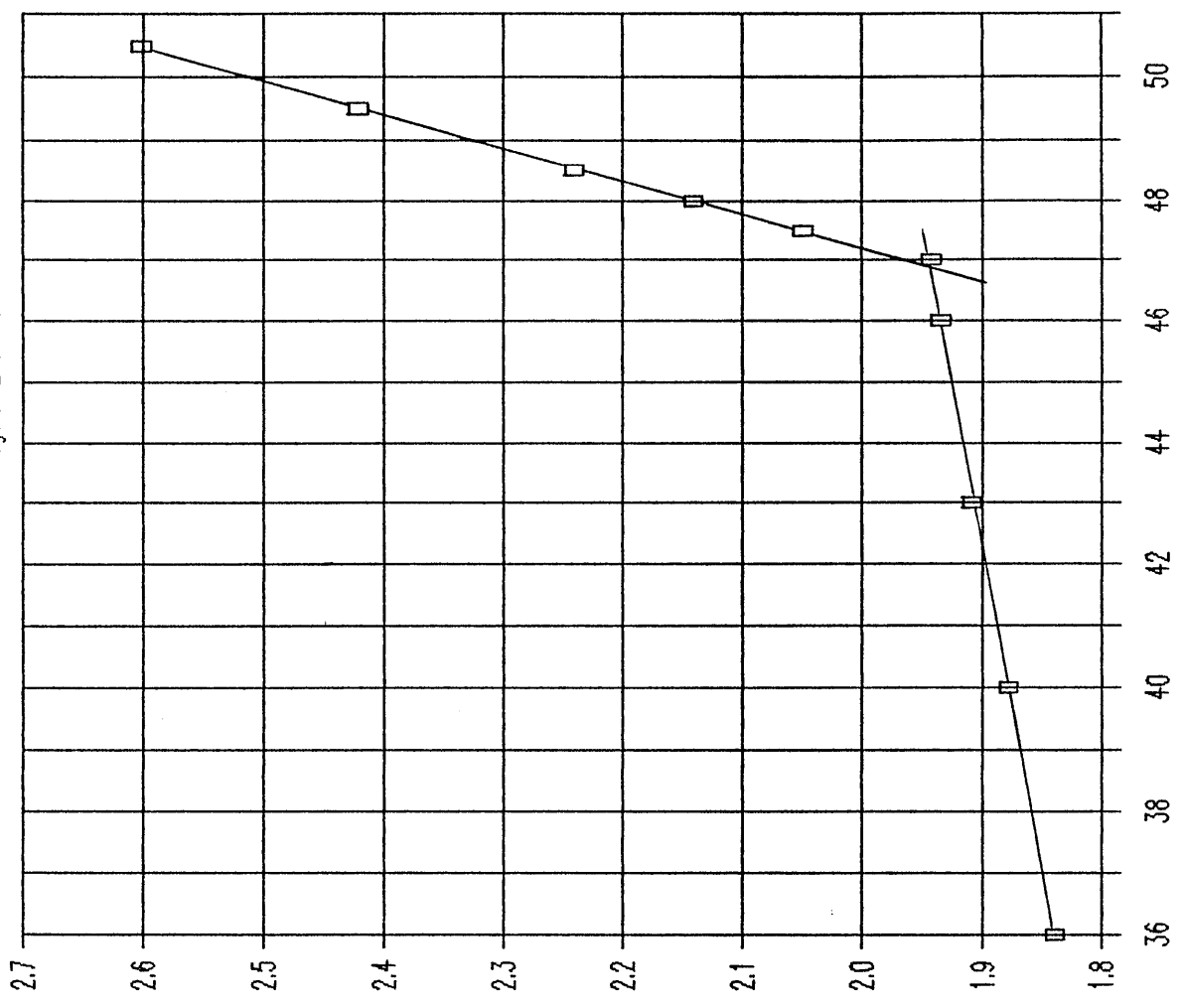
Sampling Conditions

Depth : 2338.5 mRT
 RT : 45.5 m
 R F T Chamber No : RF5 AD 1116
 Capacity : 1 Gallon
 Res. Pressure : 2562.4 psia
 Res. Temperature : 220 deg F

Opening Pressure : 1450 psig
 Temperature : 15 deg C.
 Transferred to : Cyl. No. 72

Volume (cc's)	Pressure (psig)
36.00	1840
40.00	1879
43.00	1909
46.00	1935
47.00	1943
47.50	2050
48.00	2142
48.50	2240
49.50	2421
50.50	2601

Saturation Pressure : 1955 psig @ 21 deg C



(P l a) W R C S S W R L D

VOLUME (cc's of Hg injected)

P E T R O L A B

Company : Esso Australia Ltd.
 Well : Whiting # A-7
 File : E-89030

Sample # 3

Sampling Conditions

Depth : 2338.5 mRT
 RT : 45.5 m
 R F T Chamber No : RFS AD 1116
 Capacity : 1 Gallon
 Res. Pressure : 2562.4 psia
 Res. Temperature : 220 deg F

Opening Pressure : 1450 psig
 Temperature : 15 deg C.
 Transferred to : Cyl. No. 25

Volume (cc's)	Pressure (psig)
25.00	1866
26.00	1878
27.00	1890
28.00	1904
29.00	1916
30.00	1928
31.00	1951
32.00	2057
33.00	2236
34.00	2417
35.00	2638

Saturation Pressure : 1955 psig @ 21 deg C



(0 1 0 0) W A C 0 0 0 W A 0

VOLUME (cc's of Hg injected)

P E T R O L A B

Company: Esso Australia Ltd.
Well : Whiting # A-7

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COMPOSITIONAL ANALYSIS OF
RESERVOIR FLUID SAMPLE

Ex R F T Chamber RFS AD 1116

Component	Stock Tank Liquid Mol %	Stock Tank Gas Mol %	Reservoir Fluid Mol %
Hydrogen Sulphide H2S	0.00	0.00	0.00
Carbon Dioxide CO2	0.19	12.17	6.83
Nitrogen N2	0.00	0.08	0.04
Methane C1	0.39	65.63	36.56
Ethane C2	0.35	9.58	5.47
Propane C3	0.84	6.25	3.84
Iso-Butane iC4	0.40	1.17	0.83
N-Butane nC4	1.16	2.32	1.80
Iso-Pentane iC5	0.96	0.71	0.82
N-Pentane nC5	1.26	0.72	0.96
Hexanes C6	3.90	0.67	2.11
Heptanes C7	9.13	0.64	4.42
Octanes C8	8.09	0.05	3.63
Nonanes C9	9.41	0.01	4.20
Decanes C10	6.68	0.00	2.98
Undecanes C11	4.95	0.00	2.21
Dodecanes Plus C12+	52.29	0.00	23.30
TOTAL	100.00	100.00	100.00
<u>Ratios</u>			
Molar Ratio :	0.4456	0.5544	1.0000
Mass Ratio :	0.8413	0.1587	1.0000
Liquid Ratio (bbl/bbl) :	1.0000 @ SC	--	1.4619 @ PT*
Gas Liquid Ratio :	1.0000 bbl @ SC	783 SCF	--
<u>Stream Properties</u>			
Molecular Weight :	170.5	25.85	90.3
Density obs. (gm/cc) :	0.8060 @ 60 F	--	0.6559 @ PT*
Gravity (AIR = 1.000) :	--	0.896	--
GHV (BTU/scf) :	--	1238.0	--
<u>Hexanes Plus Properties</u>			
Mol % :	94.45	1.37	42.85
Molecular Weight :	177.2	90.7	175.6
Density (gm/cc @ 60 F) :	0.8122	0.6762	0.8107
Gravity (API @ 60 F) :	42.6	77.6	42.9
<u>Heptanes Plus Properties</u>			
Mol % :	90.55	0.70	40.74
Molecular Weight :	181.2	97.1	180.4
Density (gm/cc @ 60 F) :	0.8158	0.6853	0.8150
Gravity (API @ 60 F) :	41.8	74.8	42.0
<u>Decanes Plus Properties</u>			
Mol % :	63.92	0.00	28.49
Molecular Weight :	211.6	--	211.5
Density (gm/cc @ 60 F) :	0.8326	--	0.8326
Gravity (API @ 60 F) :	38.3	--	38.3
<u>Undecanes Plus Properties</u>			
Mol % :	57.24	0.00	25.51
Molecular Weight :	220.6	--	220.6
Density (gm/cc @ 60 F) :	0.8368	--	0.8368
Gravity (API @ 60 F) :	37.4	--	37.4
<u>Dodecanes Plus Properties</u>			
Mol % :	52.29	0.00	23.30
Molecular Weight :	227.6	--	227.6
Density (gm/cc @ 60 F) :	0.8399	--	0.8399
Gravity (API @ 60 F) :	36.8	--	36.8

* (P)ressure 2650 psig, (T)emperature 219 deg.F

P E T R O L A B

Company: Esso Australia Ltd.
Well : Whiting # A-7

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CONSTANT MASS STUDY
@ 219 deg F

ON BOTTOM HOLE SAMPLE EX RFS AD 1120

Thermal Expansion of reservoir fluid at 5000 psig
= Volume at 219 deg.F/Volume at 65 deg.F = 1.104466

Pressure (psig)	Relative Volume (V/Vsat) (1)	Oil Compressibility (x 10 ⁻⁶)(psig ⁻¹) (2)	Y Function (3)	Oil Viscosity
5000	0.9628	13.08		0.372
4500	0.9695	13.91		0.363
4000	0.9768	14.88		0.353
3500	0.9847	16.04		0.344
3000	0.9934	17.54		0.335
2800	0.9970	18.31		0.331
2650 **	1.0000	19.70		0.328
2610	1.0076		2.028	0.330
2548 *	1.0176		2.272	0.333
2463	1.0334		2.275	0.335
2360	1.0549		2.240	0.338
2268	1.0758		2.221	0.342
2110	1.1183		2.164	0.350
1975	1.1611		2.122	0.357
1795	1.2306		2.066	0.369
1584	1.3377		1.993	0.383
1425	1.4456		1.929	0.397
1294	1.5536		1.893	0.409
1190	1.6621		1.853	0.418
1098	1.7758		1.822	0.428
975	1.9679		1.775	0.440
765	2.4460		1.704	0.463
525	3.5063		1.615	0.490
0				0.618

* Reservoir pressure
** Saturation pressure

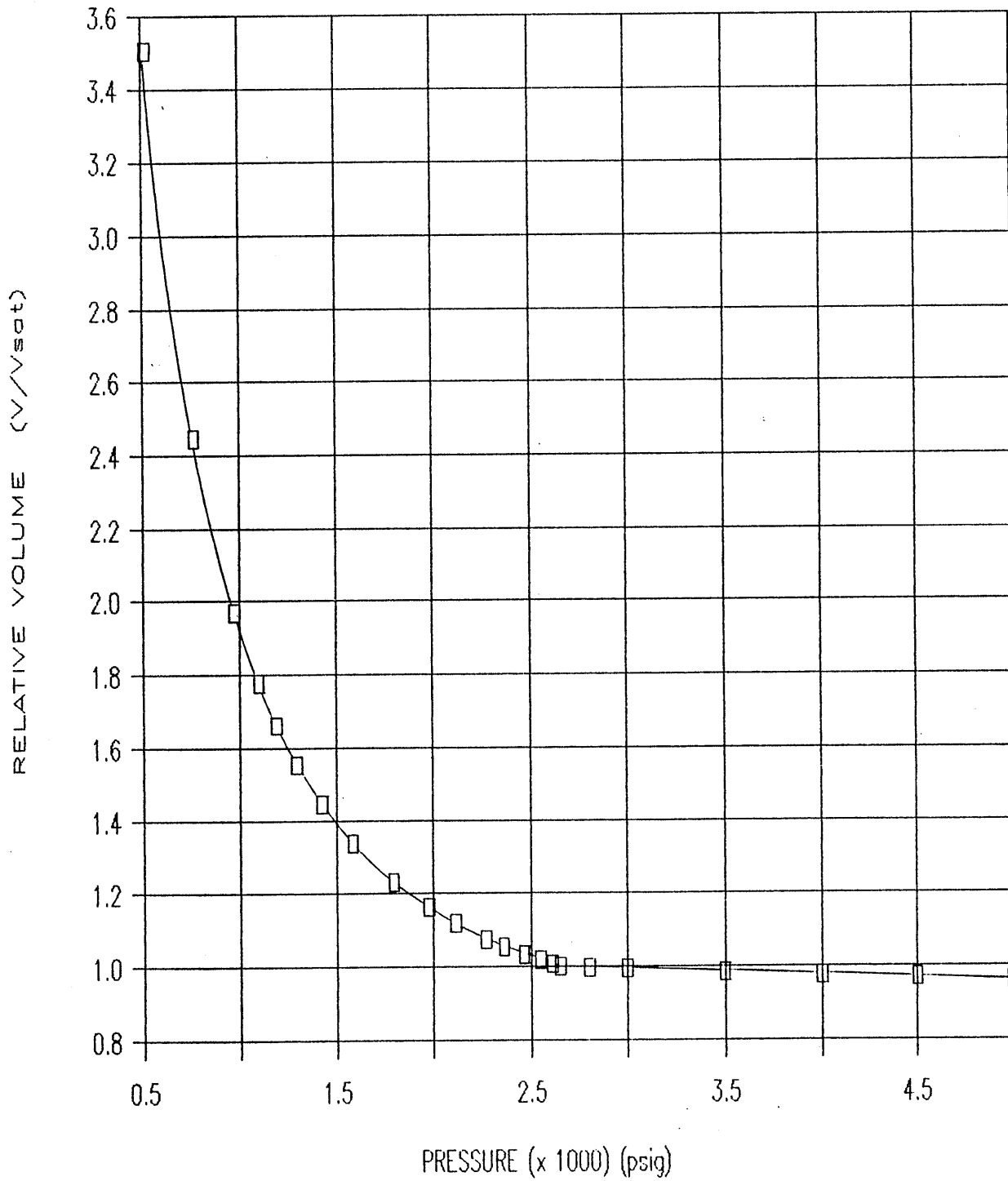
- (1) Barrels at indicated pressure per barrel at saturation pressure.
 (2) Oil Compressibility = - (1/V) * (dV/dP)
 (3) Y Function = (Psat - P) / (P)*(V/Vsat-1)

P E T R O L A B

Company: Esso Australia Ltd.
Well : Whiting # A-7

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RELATIVE VOLUME

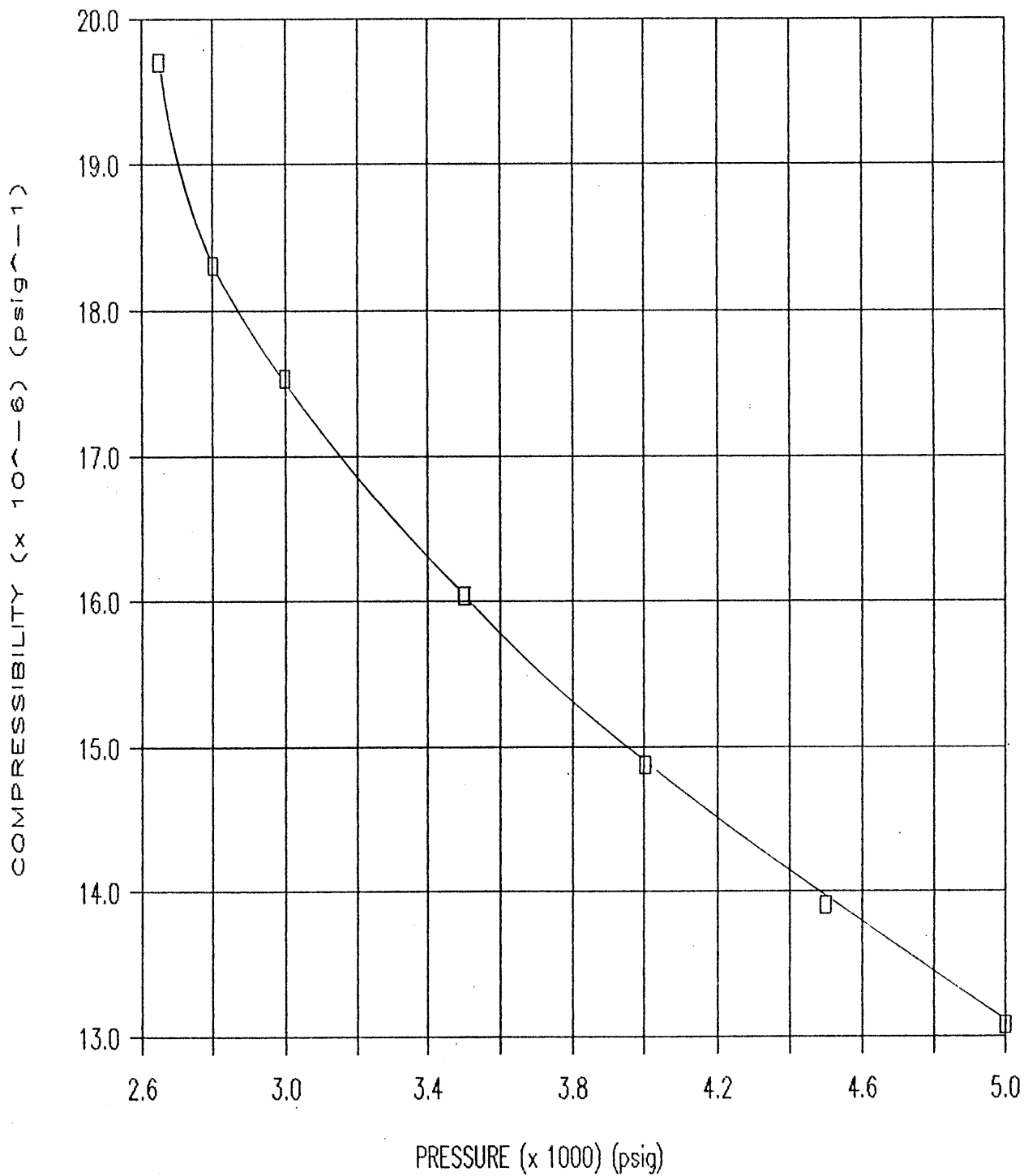


P E T R O L A B

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OIL COMPRESSIBILITY

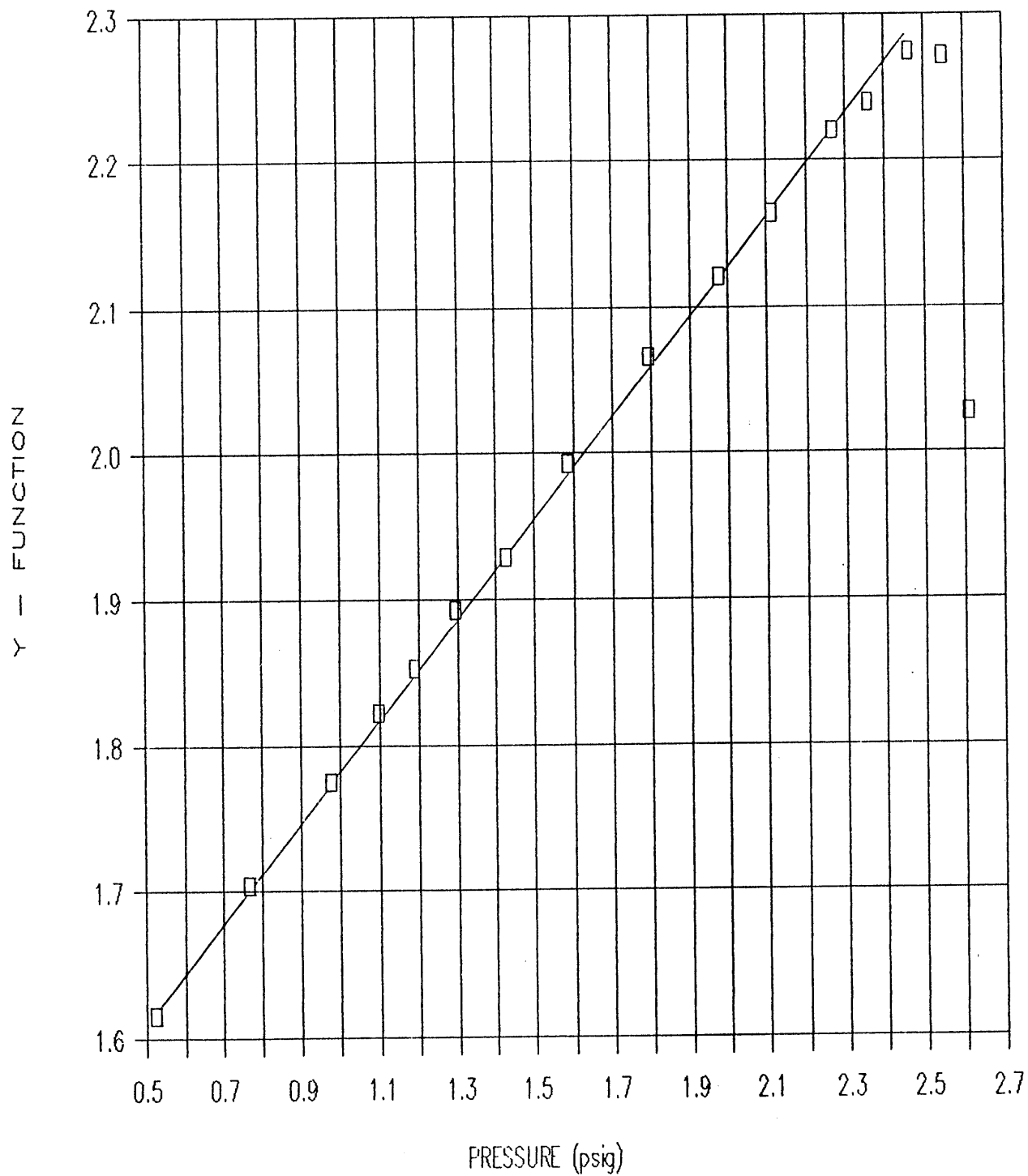


P E T R O L A B

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Well : Whiting # A-7

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Y - FUNCTION



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OIL VISCOSITY

