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GIPPSLAND BASIN.
HYDROSTATIC REPORT.
FLOPETROL
MANTA-1.
H/C BOX

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P.V.T.STUDY REPORT

W846

Client:SHELL DEVELOPMENT AUSTRALIA
Field :GIPPSLAND Well : MANTA#1 ZONE 2
Zone :2755-2761m Samp. date:07/03/1984

Report #:84ADL009 Date: APRIL,1984

ADELAIDE LABORATORY

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FLOPETROL INTERNATIONAL S.A.
ADELAIDE OFFICE:
3 CHARLES STREET,
ALLENBY GARDENS, S.A. 5009
TEL: (08) 46 7256
TELEX: AA87372

YOUR REF:

OUR REF: 84/AUD/MV/062

15th May, 1984

Shell Development (Australia) Pty. Ltd,
8th Floor,
140 St. George's Terrace,
PERTH. W.A. 6000.

Att: Mr. T. Carlson

Dear Sir,

Re: PVT Study on Manta #1 Zone 2
Report No. 84ADL009

Surface and Bottom Hole samples from well Manta #1 Zone 2 were received in our laboratory for PVT analysis on 21.03.84. The results of this study, as requested by Shell Development (Australia) Pty. Ltd. are presented in this report.

Sample validity checks of the bottom hole and recombined surface samples as measured by the bubble point pressure determination at 227°F temperature produced values at variance with each other. These are shown in Annex 1.

Sample validity checks of the separator liquid samples, as measured by the bubble point pressure determination at separator temperature, gave values in good agreement between themselves. Further bases for comparison are provided from flash of the separator liquid samples to stock tank conditions. These are shown in Annex 1. All separator gases were analysed to heptanes plus by gas chromatography and these are presented in Annex 2.

At this stage, the provisional results obtained so far were telexed to Shell Development (Australia) Pty. Ltd. who advised us to use recombined samples. These samples were physically recombined, after correction for gravity and super compressibility, in the ratio of 895 standard cubic feet of separator gas per barrel of separator oil.

The calculation is shown in Annex 3. This ratio was used, in conjunction with the composition of the separator samples, to obtain the molecular composition of the reservoir fluid. This calculation is shown in Annex 4.

A known volume of the recombined surface sample was then charged to a PVT cell and thermally expanded to the reservoir temperature of 227°F. The thermal expansion factor at 5000 psig between 70°F and 227°F was found to be 0.452×10^{-3} F^{-1}. This fluid was found to have a bubble point pressure 3910 psig which on comparison with the initial reservoir pressure of 3970 psig. Other volumetric data from the pressure volume relation measurements are presented in Annex 5.

During differential vaporization study at 227°F, the reservoir fluid liberated a total of 1035 standard cubic feet of gas/standard barrel of oil. The associated oil volume factor was found to be 1.746/std.bbl. Other data, including the composition of the liberated gases are presented in Annex 6.

Four single stage separation tests were performed at 125°F to determine the effects of separator pressure on GOR, Bo and shrinkage. The results are tabulated in Annex 7. Gases from both separator and tank stages were collected and analysed. These are shown also in Annex 7.

The viscosity of the reservoir fluid was measured over a wide range of pressures at 227°F, using a rolling ball viscosimeter. The values were found to vary from 0.24 centipoise at the bubble point pressure to a maximum of 0.92 centipoise at atmospheric pressure. These results are presented in Annex 8.

We are glad to be of service to Shell Development (Australia) Pty. Ltd. and should you require further information, please do not hesitate to contact us.

Yours faithfully,
FLOPETROL INTERNATIONAL S.A.

M. VOLANT

Laboratory Supervisor

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COMPANY : SHELL DEVELOPMENT AUSTRALIA

WELL : MANTA#1 ZONE 2

NOTICE

Curve Presentation

This report contains graphs of physical properties together with curves which are now drawn by computer program . These curves are empirical as the formulae used are not based on any theory , and are obtained using special Flopetrol computer programs . Except for saturation pressure determinations , equations are given on pages following each graph to enable easy and accurate interpolation using a calculator or a computer ; generally extrapolation is not advisable as the Flopetrol software is based only on the experimental range of measurements.
Although in most cases less significant figures can be used for parameters, we advise a validity check against experimental points when using less than the eleven significant figures given.
Clearly , properties can be calculated in this fashion to high precision , but cannot be more accurate than the original experimental measurements.

Parameters are given in E-format , where , for example :
b = -3.76908251347E-02 means b = -0.037690851347.

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WELL : MANTA#1 ZONE 2

SUMMARY AND MAIN RESULTS

The present report gives the experimental results of the P.V.T. study carried out on bottom hole and surface samples from well MANTA#1 ZONE 2

The initial reservoir conditions are :

- Pi : 3970 psig
- T : 227 F

Bubble point pressure determined on sample which was selected for complete P.V.T. study is :

- Pb : 3910 psig at 227 F
- c : 22.50 x 10^{-6} psi^{-1} (3970- 3910 psig)

Main differential vaporization data at reservoir temperature :

		Pi	Pb
oil volume factor (bbl/Std bbl)	:	1.744	1.746
solution gas-oil ratio (Std cu ft/bbl)	:	1035	1035
reservoir fluid viscosity (centipoises)	:	0.24	0.24
reservoir fluid density (g/cm3)	:	0.585	0.585
Residual oil gravity	:	0.822	60/60 F
		40.6	API

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WELL : MANTA#1 ZONE 2

TABLE 1

SAMPLING CONDITIONS

I. RESERVOIR AND WELL CHARACTERISTICS

Producing zone	:	2755-2761m
Static pressure	:	3970 psig
Bottom hole temperature	:	227 F
Tubing diameter	:	3 1/2" PH6
Casing size	:	7"
Casing shoe	:	3560 M

II. SAMPLING CONDITIONS

A) SURFACE SAMPLE(S)

Date	:	07/03/1984
Choke	:	7/16" since 20hrs30
Flowing bottom hole pressure	:	3813.8 psia at 2770 M
Well head pressure	:	1495 psig
Separator pressure	:	360 psig
Well head temperature	:	93 F
Separator temperature	:	123 F
Gas rate (Separator)	:	2222000 scf/D
Stock tank temperature	:	-
Compressibility factor	:	0.941
Gas gravity	:	0.750(Air=1)
Liquid rate (Separator)	:	2502.72 bbl/D
G.L.R.	:	887.83 scf/bbl
Sample(s) received	:	gas A 12012
		liq.12689/92

B) BOTTOM HOLE SAMPLE(S)

Date	:	-
Choke	:	-
Sample(s) received	:	-
		-

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WELL : MANTA#1 ZONE 2

SAMPLE(S) VALIDITY

SEPARATOR LIQUID SAMPLE(S)

1) Sample bottle No 12689/92

Bubble point pressure determination at 122 F is 335 psig

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WELL : MANTA#1 ZONE 2

TABLE 2

BUBBLE POINT PRESSURE DETERMINATION AT 122 F

Separator liquid sample (cylinder 12689/92)

	Pressure (psig)	Pump reading (cm3)
	5000	152.59
	4000	151.87
	3000	151.10
	2000	150.28
	1000	149.42
	500	148.96
Pb =	335	148.70
	334	148.49
	330	147.99
	325	147.00
	315	145.00
	295	141.00
	260	133.02
	218	117.04

FLASH OF SEPARATOR LIQUID TO STOCK TANK CONDITIONS

GOR	: 152	Std cu ft/Std bbl
Shrinkage factor	: 0.889	Std bbl/bbl
Liberated gas gravity	: 1.315	(Air = 1)
Stock tank oil gravity	: 0.818	60/60 F

This sample has been used for recombination

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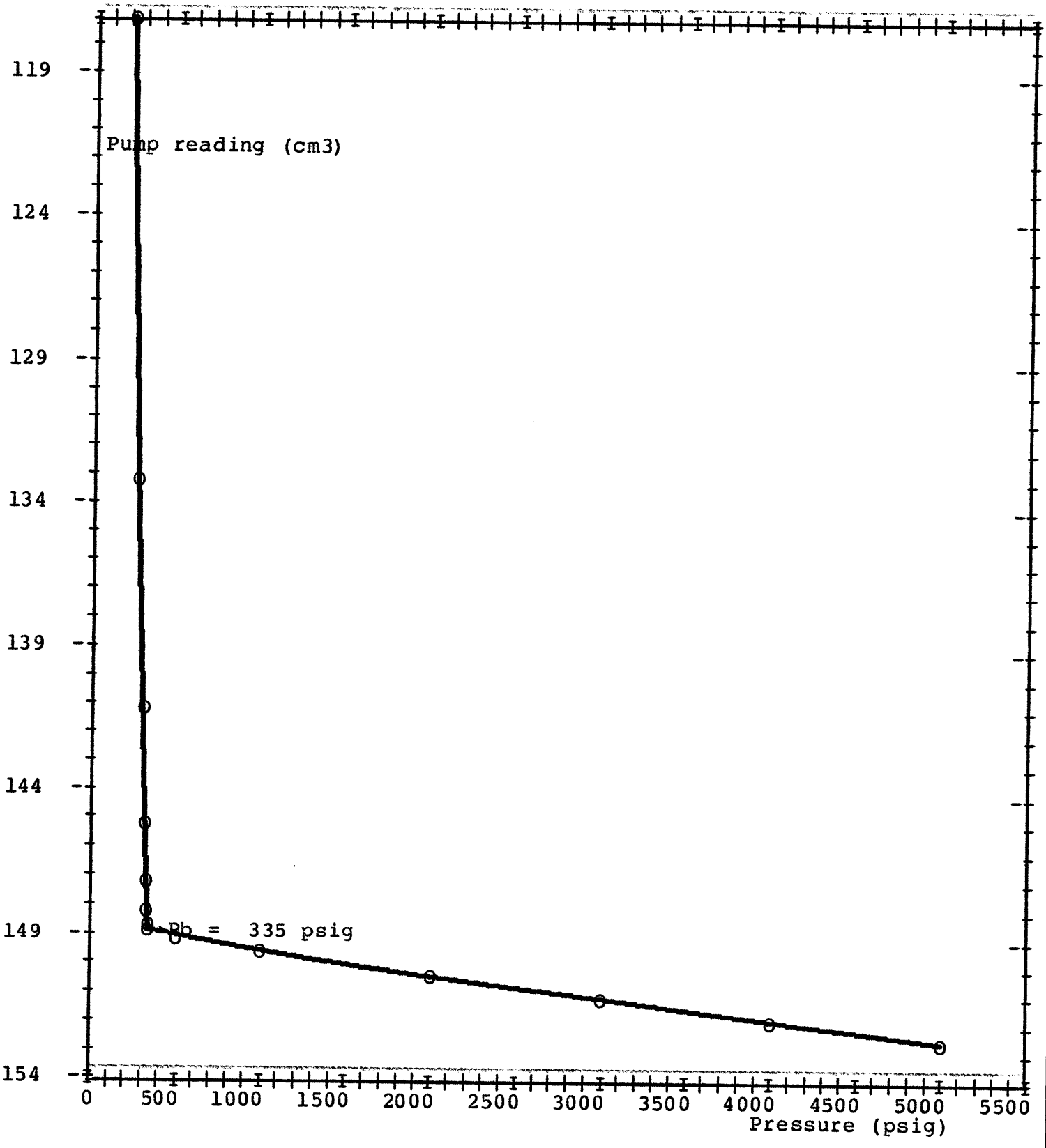
WELL : MANTA#1 ZONE 2

BUBBLE POINT PRESSURE DETERMINATION AT 122 F

Separator liquid sample (cylinder 12689/92)



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WELL : MANTA#1 ZONE 2

TABLE 3

MOLECULAR COMPOSITION OF FIELD SEPARATOR GAS(ES)

(mole percent)

Components	Cylinder 12012
Nitrogen	0.00
Carbon dioxide	3.19
Hydrocarbons:	
Methane	74.57
Ethane	11.80
Propane	6.84
I - Butane	1.00
N - Butane	1.64
I - Pentane	0.38
N - Pentane	0.36
Hexanes	0.13
Heptanes plus	0.09
TOTAL	100.00
Molecular weight	22.205
Gravity (Air=1)	0.766
Molecular weight of heptanes plus	103.3

The cylinder 12012 has been used for recombination

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WELL : MANTA#1 ZONE 2

TABLE 4

RECOMBINATION OF SEPARATOR SAMPLES

I. FLASH OF SEPARATOR LIQUID TO STOCK TANK CONDITIONS

G.O.R.	:	152	Std cu ft/Std bbl
Shrinkage factor	:	0.889	Std bbl/bbl
Liberated gas gravity	:	1.315	(Air=1)
Stock tank oil gravity	:	0.818	60/60 F

II. CORRECTION OF GAS OIL RATIO

Field G.O.R. : 888 Std cu ft/bbl

Separator gas gravity(from chromatographic analysis)

G lab. : 0.766 (Air=1)

Compressibility factor Z at separator conditions

Z lab. : 0.942

$$\text{Corrected G.O.R.} : \text{Field G.O.R.} \times \sqrt{\frac{G_{field} \times Z_{field}}{G_{lab.} \times Z_{lab.}}}$$

$$\text{Corrected G.O.R.} : 888 \sqrt{\frac{0.750 \times 0.941}{0.766 \times 0.942}} = 878 \text{ Std cu ft /bb}$$

III. PHYSICAL RECOMBINATION

Surface samples were physically recombined in the ratio of 878 standard cubic feet of separator gas per barrel of separator liquid

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WELL : MANTA#1 ZONE 2

TABLE 5

BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Recombined surface sample

Pressure (psig)	Pump reading (cm3)
6000	410.72
5500	407.28
5000	403.72
4500	399.85
4000	395.70
Pb= 3935	395.00
3856	392.60
3798	390.53
3744	388.45
3643	384.55
3524	379.38
3305	369.00

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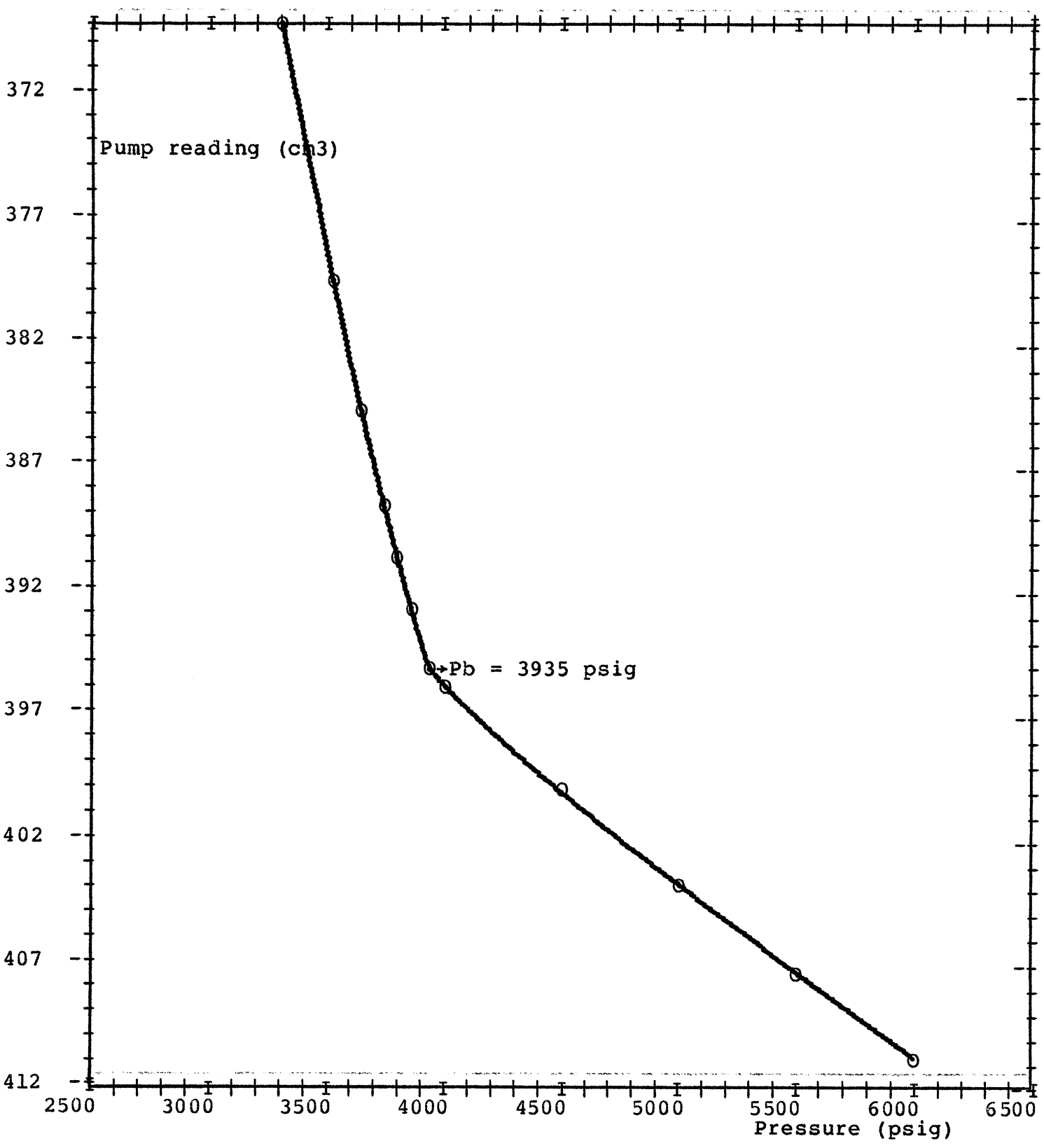
BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Recombined surface sample



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WELL : MANTA#1 ZONE 2

TABLE 6

SAMPLING CONDITIONS

I. RESERVOIR AND WELL CHARACTERISTICS

Producing zone	:	2755-2761M
Static pressure	:	3970 psig
Bottom hole temperature	:	227 F
Tubing diameter	:	3 1/2" PH6
Casing size	:	7"
Casing shoe	:	3560 M

II. SAMPLING CONDITIONS

A) SURFACE SAMPLE(S)

Date	:	7/03/1984
Choke	:	7/16" since 20hrs30
Flowing bottom hole pressure	:	3811.4 psia at 2770 M
Well head pressure	:	1495 psig
Separator pressure	:	360 psig
Well head temperature	:	92 F
Separator temperature	:	129 F
Gas rate (Separator)	:	2246000scf/D
Stock tank temperature	:	-
Compressibility factor	:	0.943
Gas gravity	:	0.750(Air=1)
Liquid rate (Separator)	:	2505.12 bbl/D
G.L.R.	:	896.56 scf/bbl
Sample(s) received	:	gas A 13752
		liq.22400/55

B) BOTTOM HOLE SAMPLE(S)

Date	:	-
Choke	:	-
Sample(s) received	:	-
		-

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WELL : MANTA#1 ZONE 2

SAMPLE(S) VALIDITY

RECOMBINED SURFACE SAMPLE(S)

Bubble point pressure determination at 227 F is 3895 psig

SEPARATOR LIQUID SAMPLE(S)

1) Sample bottle No 22400/55

Bubble point pressure determination at 129 F is 340 psig

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WELL : MANTA#1 ZONE 2

TABLE 7

BUBBLE POINT PRESSURE DETERMINATION AT 129 F

Separator liquid sample (cylinder 22400/55)

	Pressure (psig)	Pump reading (cm3)
	5000	153.24
	4000	152.52
	3000	151.75
	2000	150.89
	1000	150.04
	500	149.57
	400	149.48
Pb =	340	149.40
	335	149.31
	334	148.81
	331	148.30
	329	147.32
	326	145.32
	300	141.34
	218	117.39

FLASH OF SEPARATOR LIQUID TO STOCK TANK CONDITIONS

GOR	:	148 Std cu ft/Std bbl
Shrinkage factor	:	0.897 Std bbl/bbl
Liberated gas gravity	:	1.301 (Air = 1)
Stock tank oil gravity	:	0.817 60/60 F

This sample has been used for recombination

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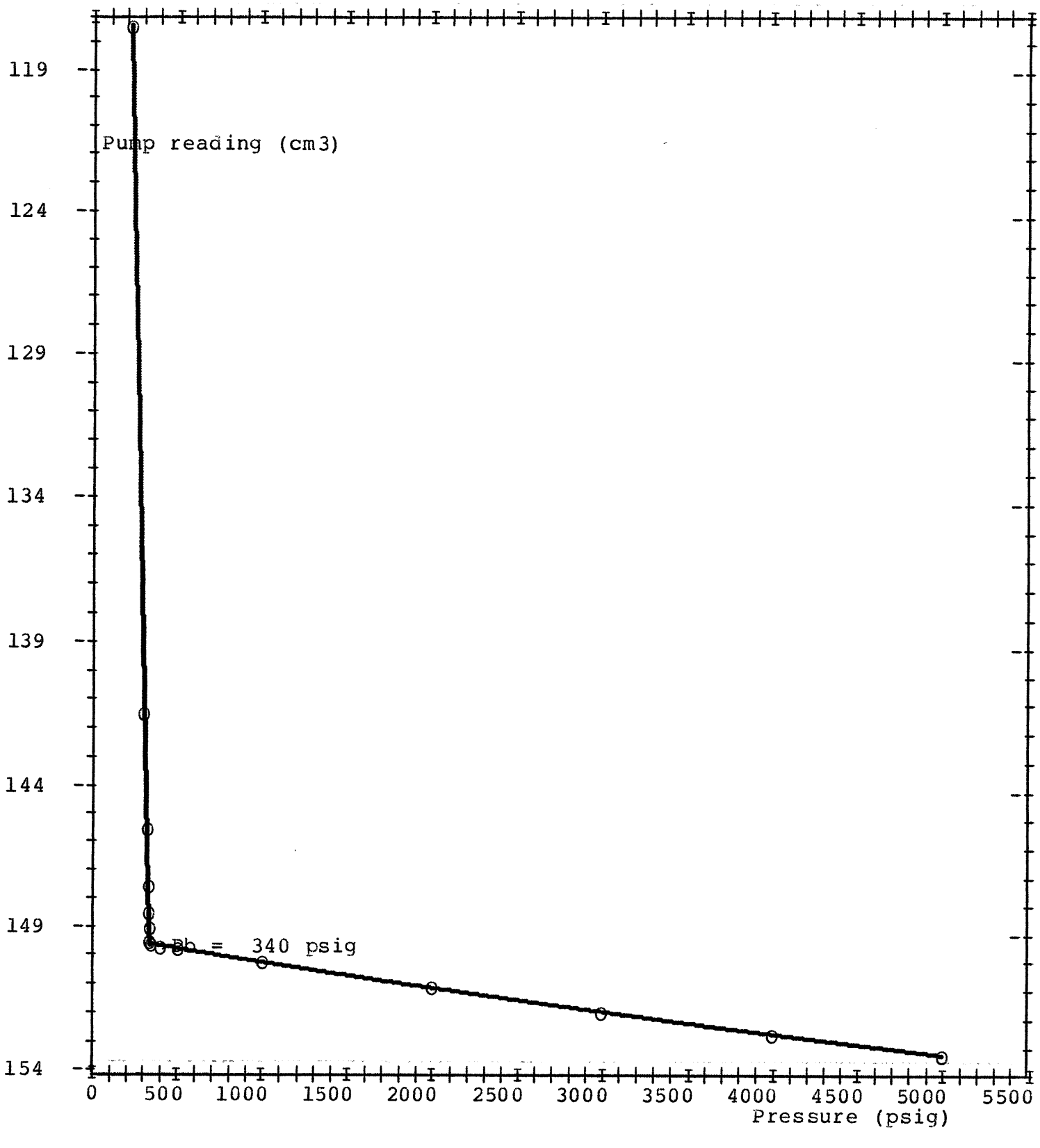
BUBBLE POINT PRESSURE DETERMINATION AT 129 F

Separator liquid sample (cylinder 22400/55)



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WELL : MANTA#1 ZONE 2

TABLE 8

MOLECULAR COMPOSITION OF FIELD SEPARATOR GAS(ES)

(mole percent)

Components	Cylinder 13752
Nitrogen	0.00
Carbon dioxide	3.19
Hydrocarbons:	
Methane	74.19
Ethane	11.82
Propane	6.98
I - Butane	1.03
N - Butane	1.73
I - Pentane	0.40
N - Pentane	0.40
Hexanes	0.17
Heptanes plus	0.09
TOTAL	100.00
Molecular weight	22.359
Gravity (Air=1)	0.772
Molecular weight of heptanes plus	103.3

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WELL : MANTA#1 ZONE 2

TABLE 9

RECOMBINATION OF SEPARATOR SAMPLES

I. FLASH OF SEPARATOR LIQUID TO STOCK TANK CONDITIONS

G.O.R.	: 148	Std cu ft/Std bbl
Shrinkage factor	: 0.897	Std bbl/bbl
Liberated gas gravity	: 1.301	(Air=1)
Stock tank oil gravity	: 0.817	60/60 F

II. CORRECTION OF GAS OIL RATIO

Field G.O.R. : 897 Std cu ft/bbl

Separator gas gravity(from chromatographic analysis)

G lab. : 0.772 (Air=1)

Compressibility factor Z at separator conditions

Z lab. : 0.944

Corrected G.O.R. : Field G.O.R. x $\sqrt{\frac{G\ field \times Z\ field}{G\ lab. \times Z\ lab.}}$

Corrected G.O.R. : $897 \sqrt{\frac{0.750 \times 0.943}{0.772 \times 0.944}} = 883$ Std cu ft /bb

III. PHYSICAL RECOMBINATION

Surface samples were physically recombined in the ratio of 883 standard cubic feet of separator gas per barrel of separator liquid

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TABLE 10

BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Recombined surface sample

Pressure (psig)	Pump reading (cm3)
6000	271.90
5500	268.20
5000	264.60
4500	260.79
4000	256.60
3900	255.63
Pb= 3895	255.55
3875	255.21
3860	254.78
3835	253.80
3815	252.85
3740	250.00
3629	245.00
3442	236.00

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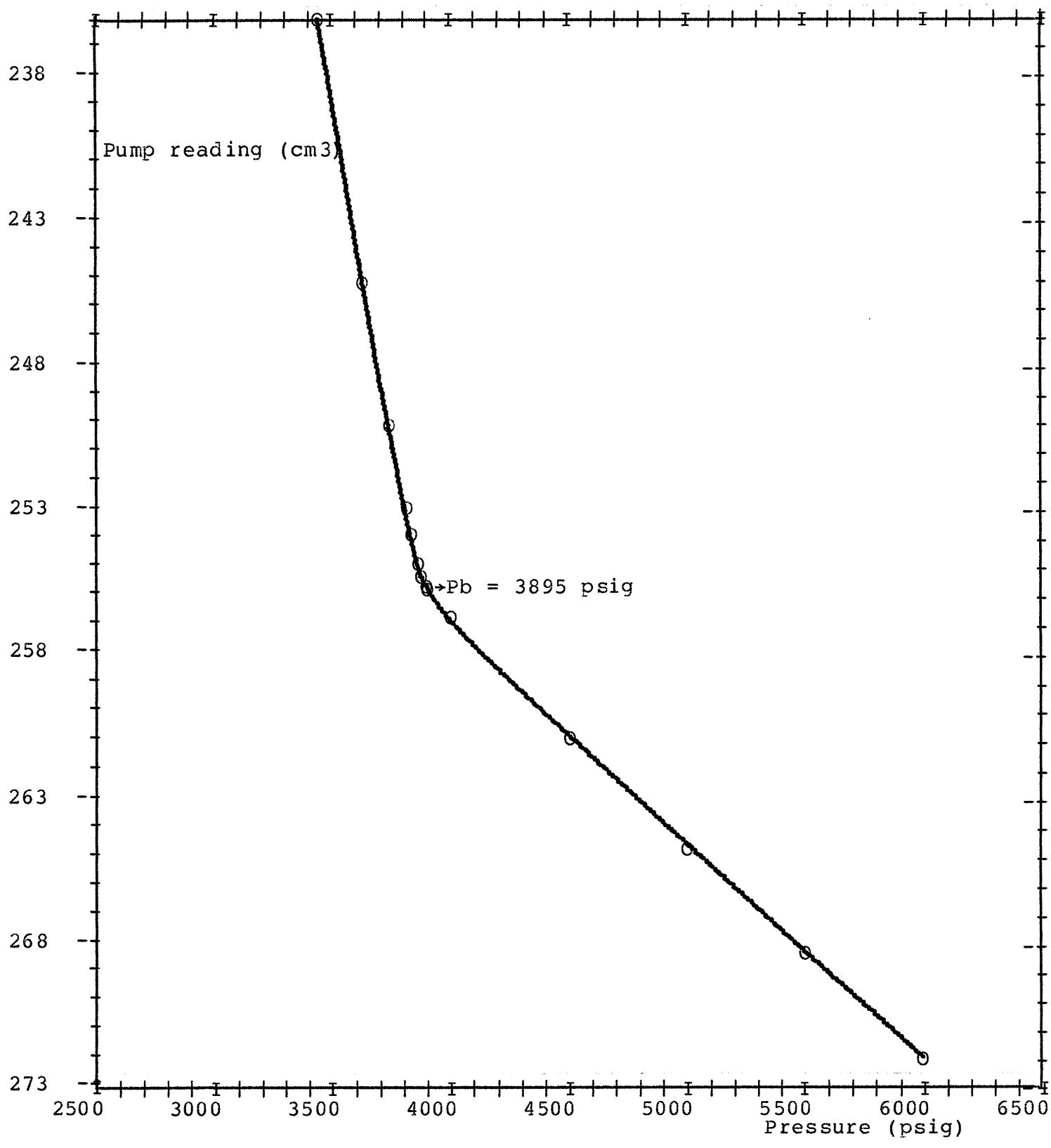
WELL : MANTA#1 ZONE 2

BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Recombined surface sample



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WELL : MANTA#1 ZONE 2

TABLE 11

SAMPLING CONDITIONS

I. RESERVOIR AND WELL CHARACTERISTICS

Producing zone	:	2755-2761 M
Static pressure	:	3970 psig
Bottom hole temperature	:	227 F
Tubing diameter	:	3 1/2" PH6
Casing size	:	7"
Casing shoe	:	3560 M

II. SAMPLING CONDITIONS

A) SURFACE SAMPLE(S)

Date	:	07/03/1984
Choke	:	7/16" since 20hrs30
Flowing bottom hole pressure	:	3813.3 psia at 2770 M
Well head pressure	:	1495 psig
Separator pressure	:	360 psig
Well head temperature	:	93 F
Separator temperature	:	129 F
Gas rate (Separator)	:	2240000scf/D
Stock tank temperature	:	-
Compressibility factor	:	0.941
Gas gravity	:	0.750(Air=1)
Liquid rate (Separator)	:	2503.20 bbl/D
G.L.R.	:	894.85 scf/bbl
Sample(s) received	:	gas A 12683
		liq.80291/315

B) BOTTOM HOLE SAMPLE(S)

Date	:	08/03/1984
Choke	:	3/16"ADJ
Sample(s) received	:	20112/140-SCHL 810
		8008/127

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WELL : MANTA#1 ZONE 2

SAMPLE(S) VALIDITY

BOTTOM HOLE SAMPLE(S)

1) Sample bottle No 20112/140

   Bubble point pressure determination at 227 F is 3607 psig

2) Sample bottle No 80291/137

   Bubble point pressure determination at 227 F is 3002 psig

3) Sample bottle No 1116/410(

   Bubble point pressure determination at 227 F is 3535 psig

4) Sample bottle No 8008/127(

   Bubble point pressure determination at 227 F is 5440 psig

RECOMBINED SURFACE SAMPLE(S)

Bubble point pressure determination at 227 F is 3935 psig

Bubble point pressure determination at 227 F is 3895 psig

Bubble point pressure determination at 227 F is 3910 psig

SEPARATOR LIQUID SAMPLE(S)

1) Sample bottle No 80291/315

   Bubble point pressure determination at 128 F is 335 psig

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WELL : MANTA#1 ZONE 2

TABLE 12

BUBBLE POINT PRESSURE DETERMINATION AT 128 F

Separator liquid sample (cylinder 80291/315)

Pressure (psig)	Pump reading (cm3)
5000	153.22
4000	152.51
3000	151.72
2000	151.04
1000	150.10
500	149.61
400	149.51
Pb = 335	149.50
330	148.93
327	147.93
324	144.92
303	140.93
225	116.96
300	132.88
225	116.96

FLASH OF SEPARATOR LIQUID TO STOCK TANK CONDITIONS

GOR	: 159	Std cu ft/Std bbl
Shrinkage factor	: 0.887	Std bbl/bbl
Liberated gas gravity	: 1.328	(Air = 1)
Stock tank oil gravity	: 0.818	60/60 F

This sample has been used for recombination

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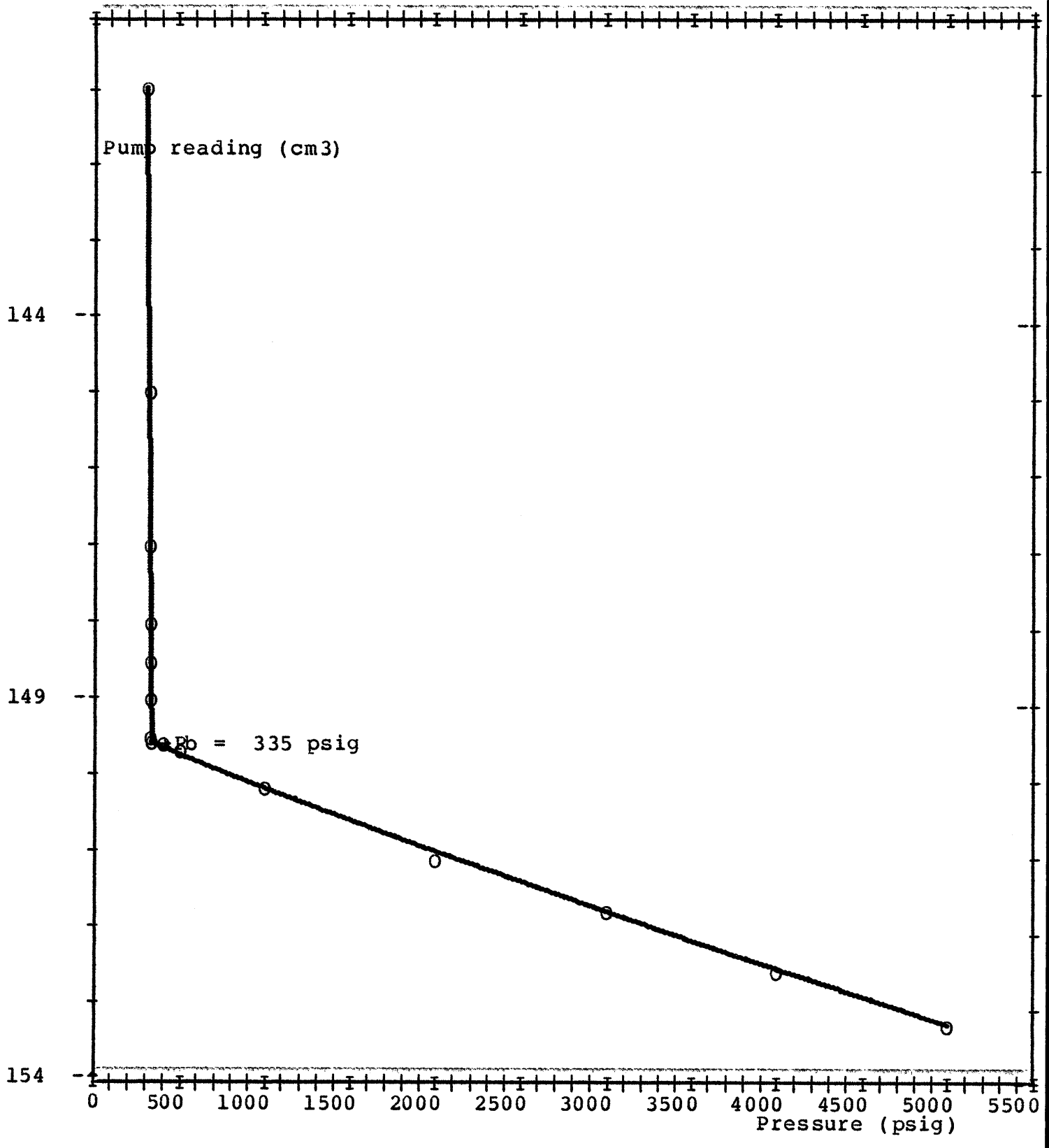
WELL : MANTA#1 ZONE 2

BUBBLE POINT PRESSURE DETERMINATION AT 128 F

Separator liquid sample (cylinder 80291/315)



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WELL : MANTA#1 ZONE 2

TABLE 13

MOLECULAR COMPOSITION OF FIELD SEPARATOR GAS(ES)

(mole percent)

Components	Cylinder 12683
Nitrogen	0.00
Carbon dioxide	3.24
Hydrocarbons:	
Methane	74.46
Ethane	11.83
Propane	6.88
I - Butane	1.01
N - Butane	1.65
I - Pentane	0.38
N - Pentane	0.35
Hexanes	0.12
Heptanes plus	0.08
TOTAL	100.00
Molecular weight	22.223
Gravity (Air=1)	0.767
Molecular weight of heptanes plus	105.5

The cylinder 12683 has been used for recombination

TABLE 14

RECOMBINATION OF SEPARATOR SAMPLES

I. FLASH OF SEPARATOR LIQUID TO STOCK TANK CONDITIONS

G.O.R.	: 159	Std cu ft/Std bbl
Shrinkage factor	: 0.887	Std bbl/bbl
Liberated gas gravity	: 1.328	(Air=1)
Stock tank oil gravity	: 0.818	60/60 F

II. CORRECTION OF GAS OIL RATIO

Field G.O.R. : 895 Std cu ft/bbl

Separator gas gravity(from chromatographic analysis)

G lab. : 0.767 (Air=1)

Compressibility factor Z at separator conditions

Z lab. : 0.944

$$\text{Corrected G.O.R.} : \text{Field G.O.R.} \times \sqrt{\frac{G_{field} \times Z_{field}}{G_{lab.} \times Z_{lab.}}}$$

$$\text{Corrected G.O.R.} : 895 \sqrt{\frac{0.750 \times 0.941}{0.767 \times 0.944}} = 883 \text{ Std cu ft /bb}$$

III. PHYSICAL RECOMBINATION

Surface samples were physically recombined in the ratio of 883 standard cubic feet of separator gas per barrel of separator liquid

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COMPANY : SHELL DEVELOPMENT AUSTRALIA

WELL : MANTA#1 ZONE 2

TABLE 15

BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Recombined surface sample

Pressure (psig)	Pump reading (cm3)
6000	113.12
5500	111.66
5000	110.10
4500	108.38
4200	107.20
4100	106.80
4000	106.35
Pb= 3910	105.90
3870	105.50
3820	104.91
3770	104.35
3725	103.77
3630	102.50
3500	100.67

This sample has been used for complete PVT study

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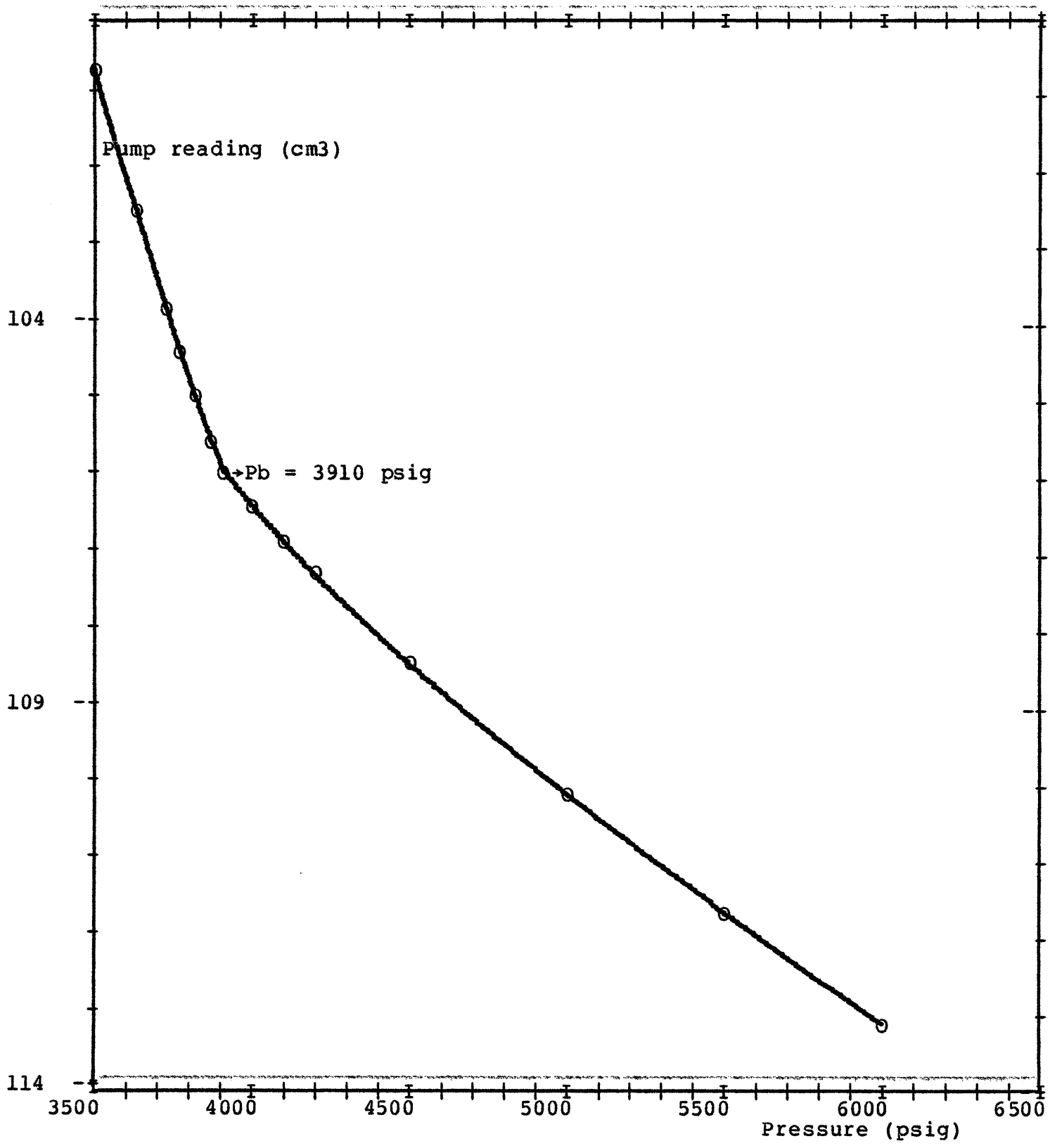
COMPANY : SHELL DEVELOPMENT AUSTRALIA

WELL : MANTA#1 ZONE 2

BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Recombined surface sample



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WELL : MANTA#1 ZONE 2

TABLE 16

BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Bottom hole sample (Cylinder 20112/140)

Pressure (psig)	Pump reading (cm3)
5000	396.17
4500	391.45
4000	386.27
3900	385.19
3800	384.07
3700	383.00
Pb= 3607	381.98
3605	381.84
3592	381.02
3588	380.63
3575	380.16
3556	379.23
3523	377.25
3457	373.28
3323	365.37

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BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Bottom hole sample (cylinder 20112/140)

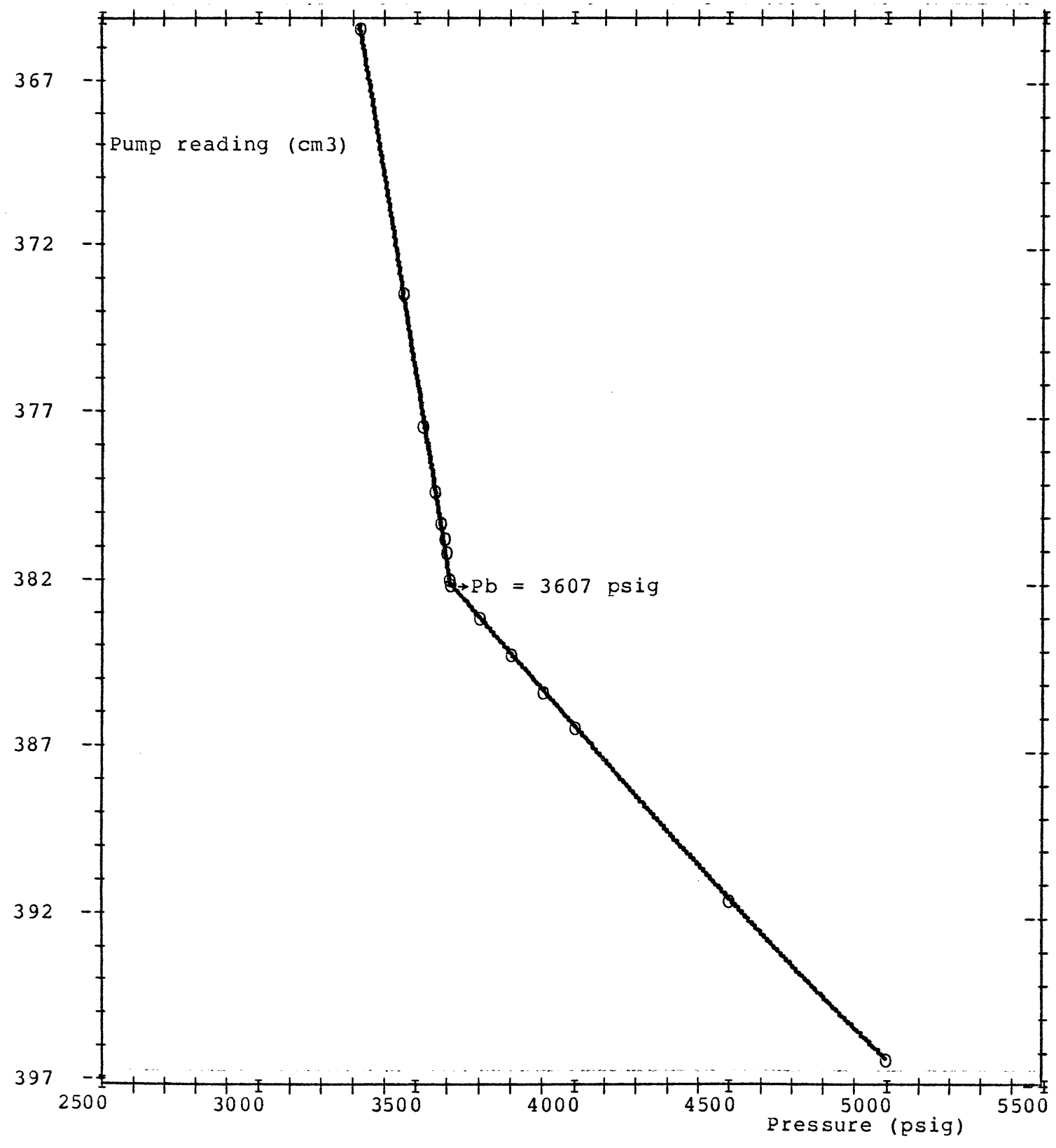

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TABLE 17

BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Bottom hole sample (Cylinder 80291/137)

Pressure (psig)	Pump reading (cm3)
5000	201.33
4000	192.93
3700	190.08
3500	188.19
3300	186.20
3200	185.14
Pb= 3002	182.90
2992	182.01
2983	181.52
2978	181.09
2965	180.20
2932	177.88
2887	174.21
2785	166.35
2610	150.52

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BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Bottom hole sample (cylinder 80291/137)

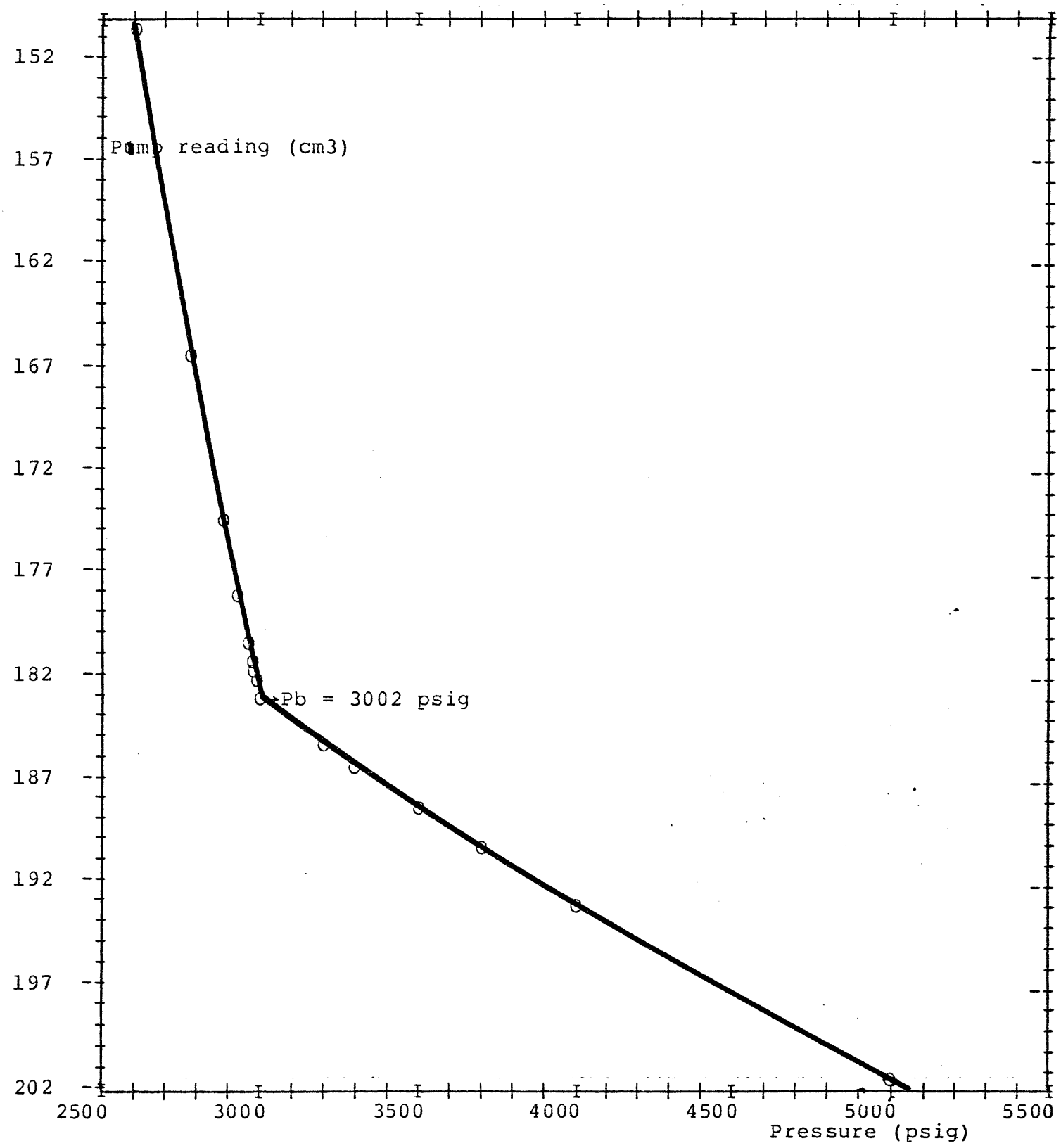

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TABLE 18

BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Bottom hole sample (Cylinder 1116/410( )

Pressure (psig)	Pump reading (cm3)
5000	326.76
4500	322.22
4000	317.31
3900	316.29
3800	315.22
3700	314.16
3600	313.04
Pb= 3535	312.30
3512	311.33
3485	310.07
3480	309.64
3470	309.26
3447	308.27
3408	306.29
3336	302.32

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BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Bottom hole sample (cylinder 1116/410()

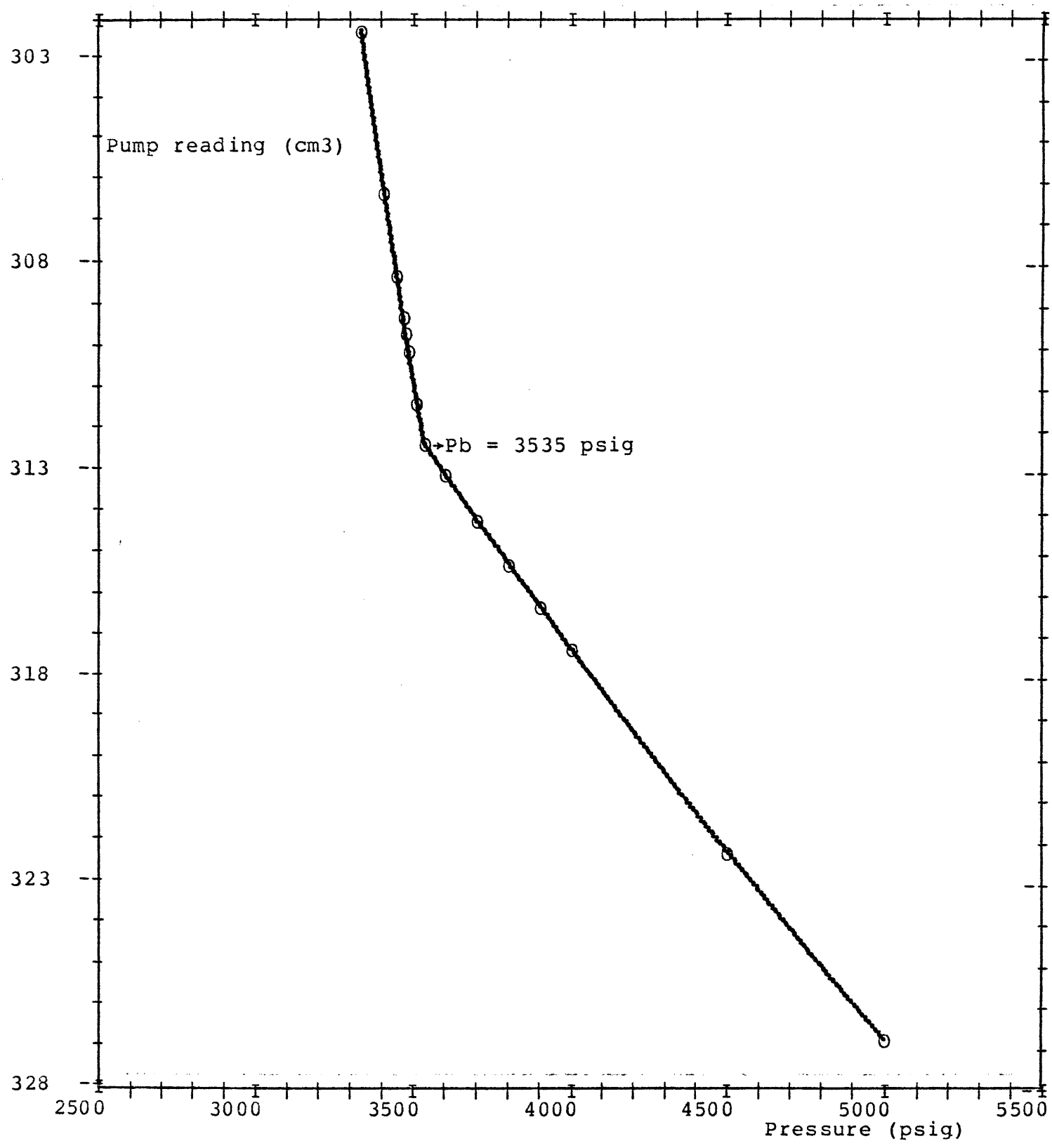

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TABLE 19

BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Bottom hole sample (Cylinder 8008/127( )

Pressure (psig)	Pump reading (cm3)
7000	271.34
6750	268.86
6500	266.22
6250	263.32
6010	260.46
5754	257.20
5500	253.86
Pb= 5440	252.90
5410	251.80
5333	249.31
5322	248.78
5312	248.45
5286	247.48
5225	245.64
5108	241.75

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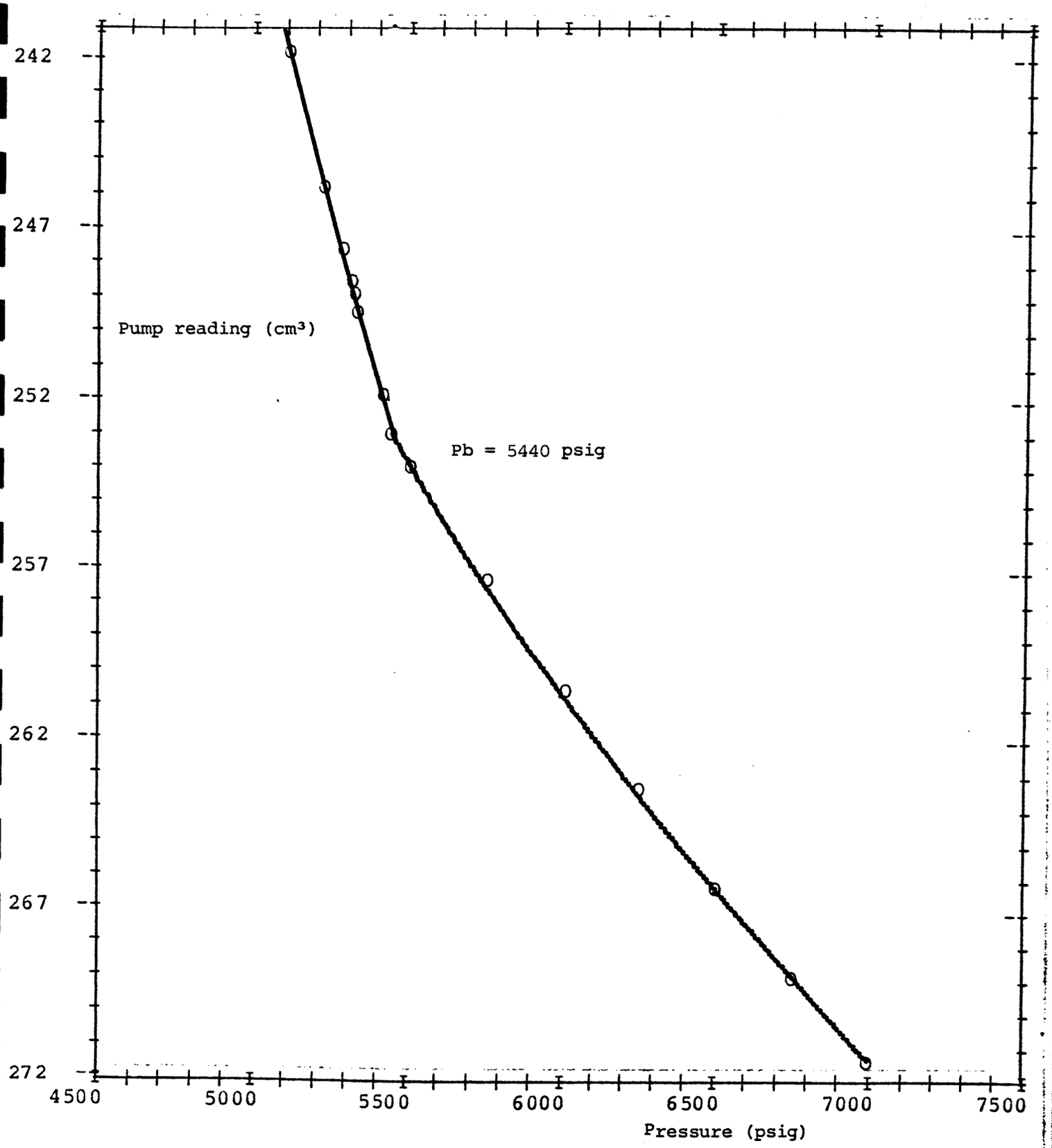
BUBBLE POINT PRESSURE DETERMINATION AT 227 F

Bottom hole sample (cylinder 8008/127()



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WELL : MANTA#1 ZONE 2

TABLE 20

MOLECULAR COMPOSITION OF FIELD SEPARATOR GAS(ES)

(mole percent)

Components	Cylinder 12683
Nitrogen	0.00
Carbon dioxide	3.24
Hydrocarbons:	
Methane	74.46
Ethane	11.83
Propane	6.83
I - Butane	1.01
N - Butane	1.65
I - Pentane	0.38
N - Pentane	0.35
Hexanes	0.12
Heptanes plus	0.08
TOTAL	100.00
Molecular weight	22.223
Gravity (Air=1)	0.767
Molecular weight of heptanes plus	105.5

The cylinder 12683 has been used for recombination

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WELL : MANTA#1 ZONE 2

TABLE 21

RECOMBINATION OF SEPARATOR SAMPLES

I. FLASH OF SEPARATOR LIQUID TO STOCK TANK CONDITIONS

G.O.R.	: 159	Std cu ft/Std bbl
Snrinkage factor	: 0.887	Std bbl/bbl
Liberated gas gravity	: 1.328	(Air=1)
Stock tank oil gravity	: 0.818	60/60 F

II. CORRECTION OF GAS OIL RATIO

Field G.O.R. : 895 Std cu ft/bbl

Separator gas gravity(from chromatographic analysis)

G lab. : 0.767 (Air=1)

Compressibility factor Z at separator conditions

Z lab. : 0.944

Corrected G.O.R. : Field G.O.R. x $\sqrt{\frac{G\ field \times Z\ field}{G\ lab. \times Z\ lab.}}$

Corrected G.O.R. : $895 \sqrt{\frac{0.750 \times 0.941}{0.767 \times 0.944}} = 883$ Std cu ft /bbl

III. PHYSICAL RECOMBINATION

Surface samples were physically recombined in the ratio of 883 standard cubic feet of separator gas per barrel of separator liquid

TABLE 22

FLASH OF SEPARATOR LIQUID TO STOCK TANK CONDITIONS

(Molecular composition)

Components	Stock tank liquid (mole percent)	Evolved gas (mole percent)	Recombined separator liquid (mole percent)
Nitrogen	0.00	0.00	0.00
Carbon dioxide	0.04	2.43	0.63
Hydrocarbons:			
Methane	0.00	29.34	7.19
Ethane	0.29	17.91	4.61
Propane	0.39	24.31	6.25
I - Butane	0.92	5.84	2.13
N - Butane	0.47	11.54	3.18
I - Pentane	0.21	3.56	1.03
N - Pentane	0.33	3.42	1.08
Hexanes	1.96	1.32	1.80
Heptanes plus	95.39	0.33	72.10
TOTAL	100.00	100.00	100.00
Molecular weight	221.5	38.494	176.7
Gravity	0.818 60/60 F	1.328 (Air=1)	-----
Molar ratio	75.51	24.49	100.00
Mass ratio	94.66	5.34	100.00

Molecular weight of Heptanes plus in STO: 229
Gravity of Heptanes plus in STO : 0.821 (60/60 F)

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TABLE 23

MOLECULAR COMPOSITION OF RESERVOIR FLUID

Components	Recombined Separator liquid (mole percent)	Separator gas (mole percent)	Recombined Reservoir fluid (mole percent)
Nitrogen	0.00	0.00	0.00
Carbon dioxide	0.63	3.24	2.21
Hydrocarbons:			
Methane	7.19	74.46	47.88
Ethane	4.61	11.83	8.98
Propane	6.25	6.88	6.63
I - Butane	2.13	1.01	1.45
N - Butane	3.18	1.65	2.26
I - Pentane	1.03	0.38	0.64
N - Pentane	1.08	0.35	0.64
Hexanes	1.80	0.12	0.78
Heptanes plus	72.10	0.08	28.53
TOTAL	100.00	100.00	100.00
Molecular weight	176.7	22.223	83.2
Gravity	-----	0.767 (Air=1)	-----
Molar ratio	39.50	60.50	100.00
Mass ratio	83.85	16.15	100.00

Molecular weight of Heptanes plus in reservoir fluid : 229

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TABLE 24

BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 227 F

	Pressure (psig)	Relative volume V/VPb	Compressibility factor (psi^{-1})	Y curve Pb/P-1 V/VPb-1
	6000	0.9683		
			14.11×10^{-6}	
	5500	0.9752		
			14.52×10^{-6}	
	5000	0.9822		
			15.20×10^{-6}	
	4500	0.9897		
			16.49×10^{-6}	
	4100	0.9962		
			18.30×10^{-6}	
	4000	0.9981		
			19.54×10^{-6}	
Pi=	3970	0.9987		
			22.50×10^{-6}	
Pb=	3910	1.0000		
	3880	1.0022		3.58
	3840	1.0051		3.56
	3780	1.0097		3.53
	3715	1.0150		3.50
	3530	1.0317		3.40
	3374	1.0478		3.32
	3110	1.0808		3.18
	2700	1.1508		2.97
	2175	1.2953		2.70
	1610	1.5927		2.41
	1090	2.2079		2.14

Thermal expansion factor of reservoir fluid at 6000 psig

between 70 F and 227 F : $= 0.452 \times 10^{-3}$ F^{-1}

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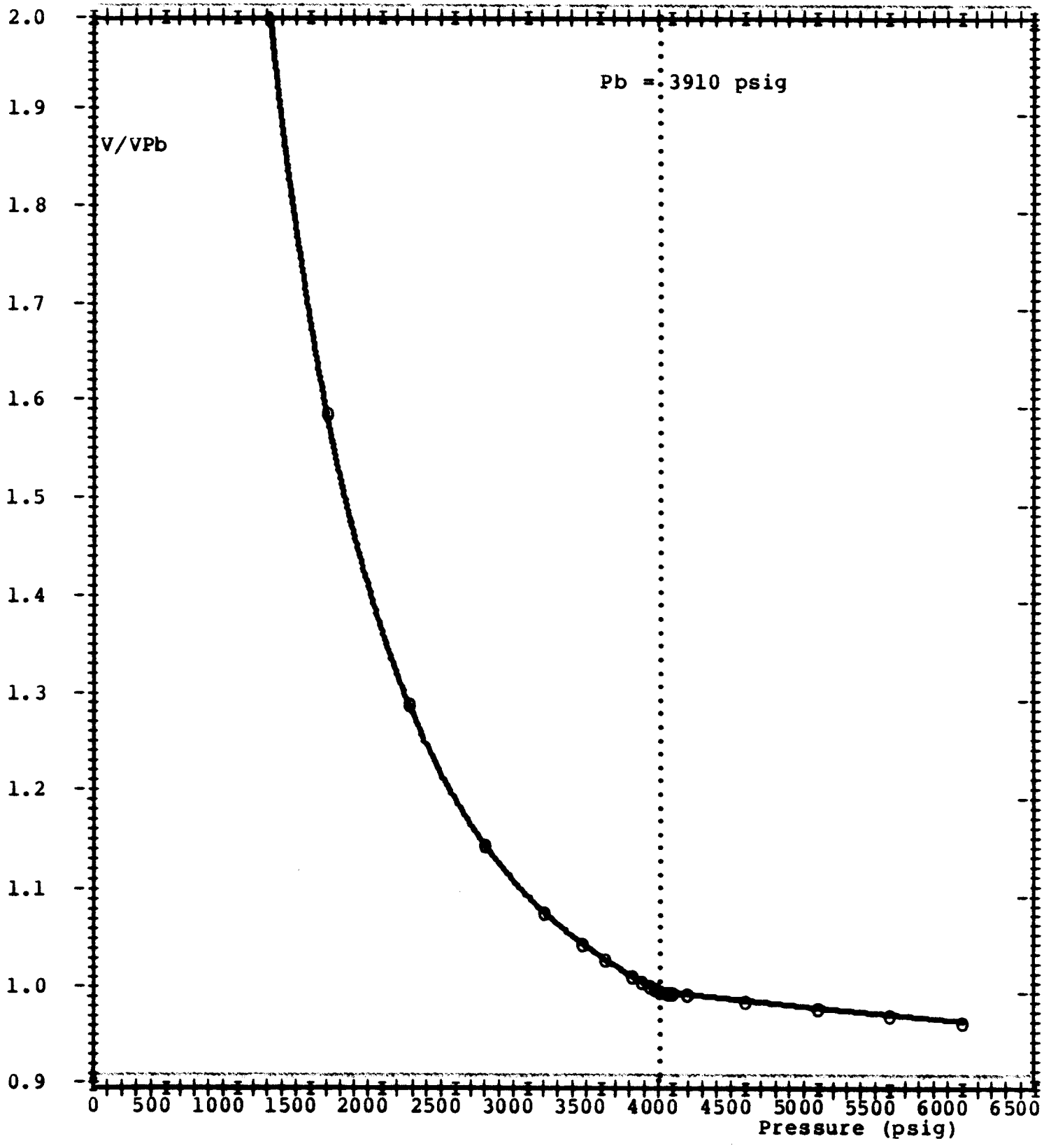
BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 227 F

Relative volume



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BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 227 F

Relative Volume

1. For Pb < P <= 6000

$$Vr = 1-10^{(a*\log(P-Pb)+b)}$$

where:

Pb = 3910 psig
a = 8.88981070816E-01
b = -4.45099661045E 00

2. For 1090 <= P < Pb

$$Vr = 1+(1-x)/(x*(a*x+b))$$

where:

Pb = 3910 psig
a = 2.01778549357E 00
b = 1.57930200365E 00

x = P/Pb

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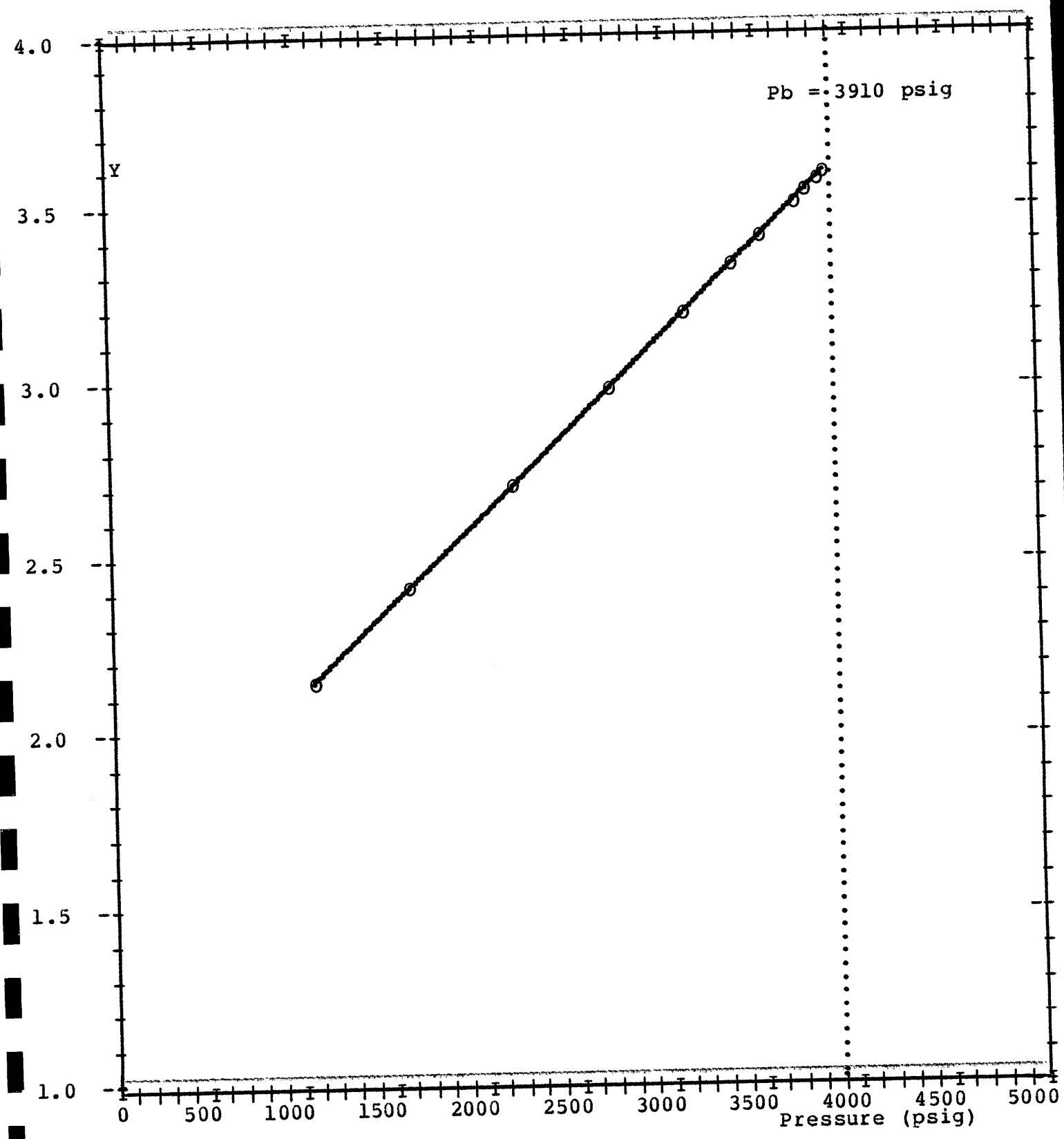
BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 227 F

Y curve pressure-volume function



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BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 227 F

Y curve pressure-volume function

For 1090 <= P < Pb

$$Y = a*P+b$$

where:

Pb	=	3910 psig
a	=	5.160576709 91E-04
b	=	1.57930200365E 00

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TABLE 25

DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Pressure (psig)	Oil volume factor Bo (bbl/Std bbl)	Solution gas-oil ratio Rs (Std cu ft/Std bbl)	Gas volume factor Bg (cu ft/Std cu ft)	Reservoir oil density (g/cm3)
6000	1.693			0.604
5500	1.703			0.600
5000	1.715			0.595
4500	1.728			0.591
4100	1.740			0.587
4000	1.743			0.586
Pi= 3970	1.744			0.585
Pb= 3910	1.746	1035		0.585
3500	1.664	924	0.49×10^{-2}	0.603
3000	1.581	773	0.56×10^{-2}	0.619
2500	1.508	641	0.67×10^{-2}	0.635
2000	1.440	520	0.84×10^{-2}	0.652
1500	1.376	408	1.14×10^{-2}	0.669
1000	1.315	302	1.75×10^{-2}	0.687
500	1.253	194	3.56×10^{-2}	0.704
0	1.086	0	----------	0.757

Residual oil gravity : 0.822 60/60 F
40.6 API

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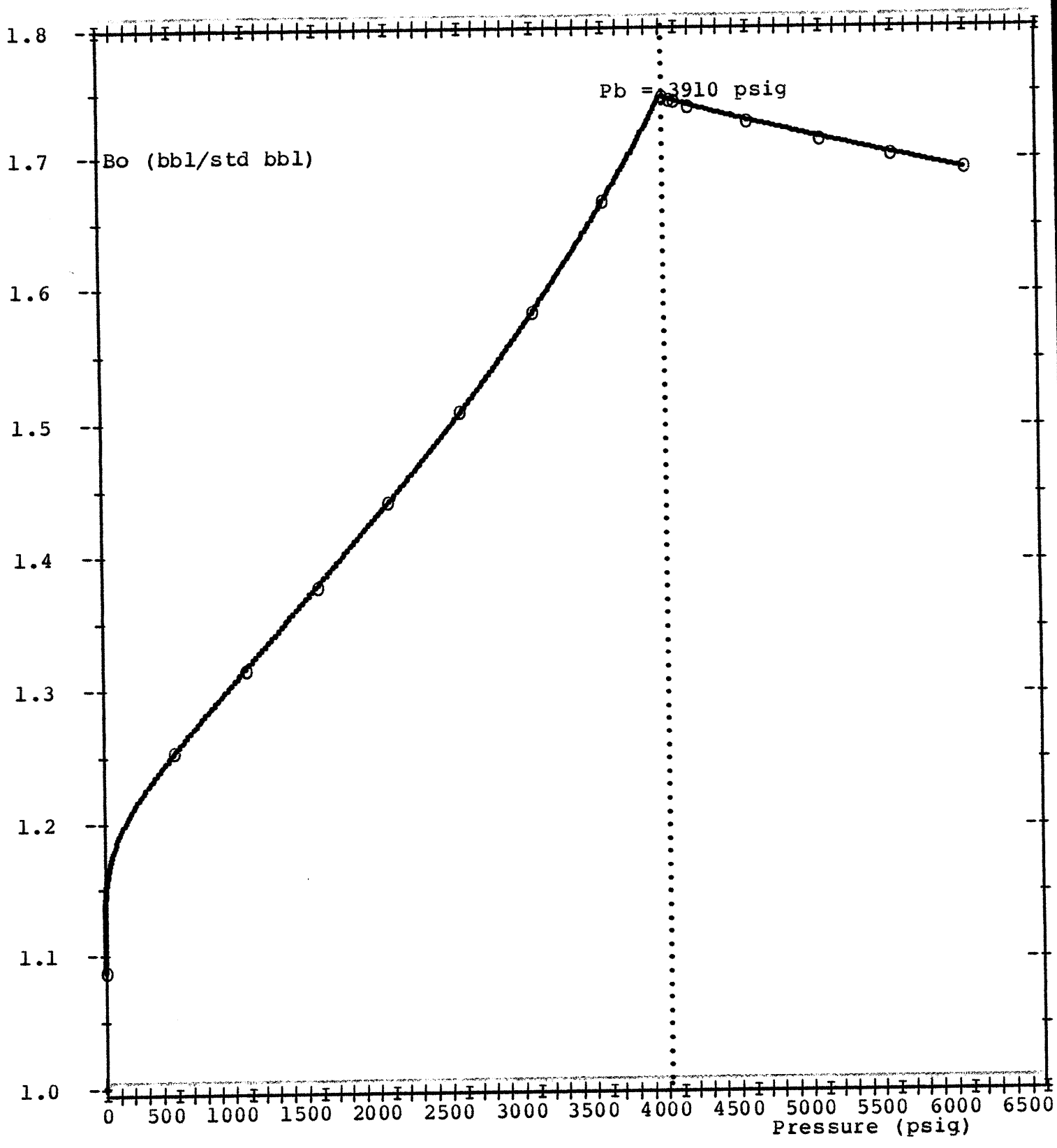
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Oil volume factor



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Oil volume factor

1. For Pb < P <= 6000

$$Bo\ (bbl/Std\ bbl) = a-10^{(b*\log(P-Pb)+c)}$$

where:

Pb	= 3910 psig	x	= P/Pb
a	= 1.74643885722E 00		
b	= 8.88981070816E-01		
c	= -4.20884322485E 00		

2. For 0 <= P <= Pb

$$Bo\ (bbl/Std\ bbl) = a+b*x^{i}+c*x^{j}+d*x^{k}$$

where:

Pb	= 3910 psig	x	= P/Pb
a	= 1.08636610539E 00	i	= 0.2
b	= 2.21472831795E-01	j	= 1.3
c	= 3.86420967684E-01	k	= 6
d	= 5.21789523534E-02		

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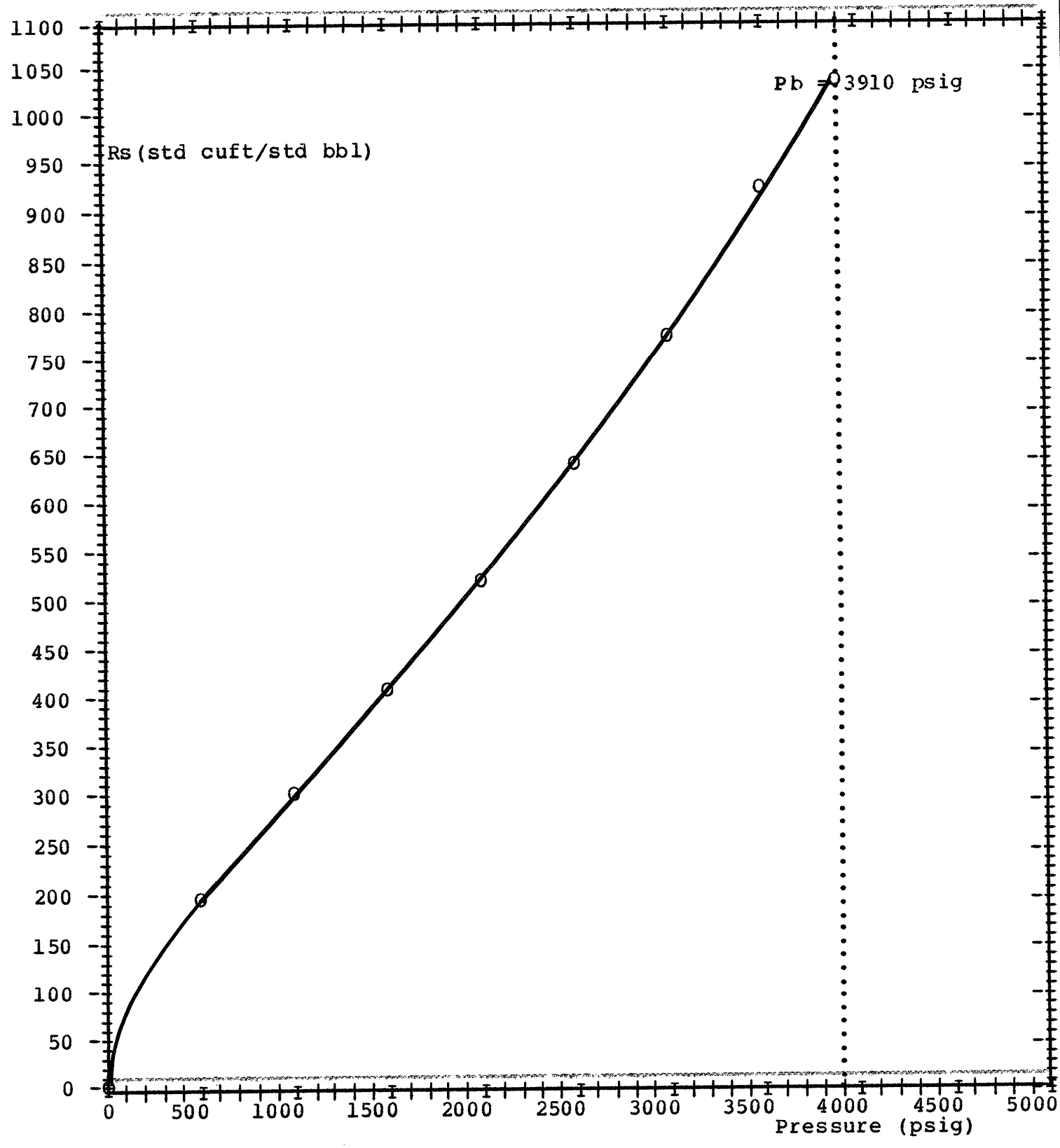
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Solution gas oil ratio



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Solution gas oil ratio

For $0 <= P <= Pb$

$$Rs \text{ (std cuft/std bbl)} = a*x^i + b*x^j + c*x^k$$

where:

Pb	=	3910 psig	x	=	P/Pb
a	=	6.60365437947E 02	i	=	0.6
b	=	6.36371796314E 02	j	=	3.0
c	=	-2.61969869885E 02	k	=	5

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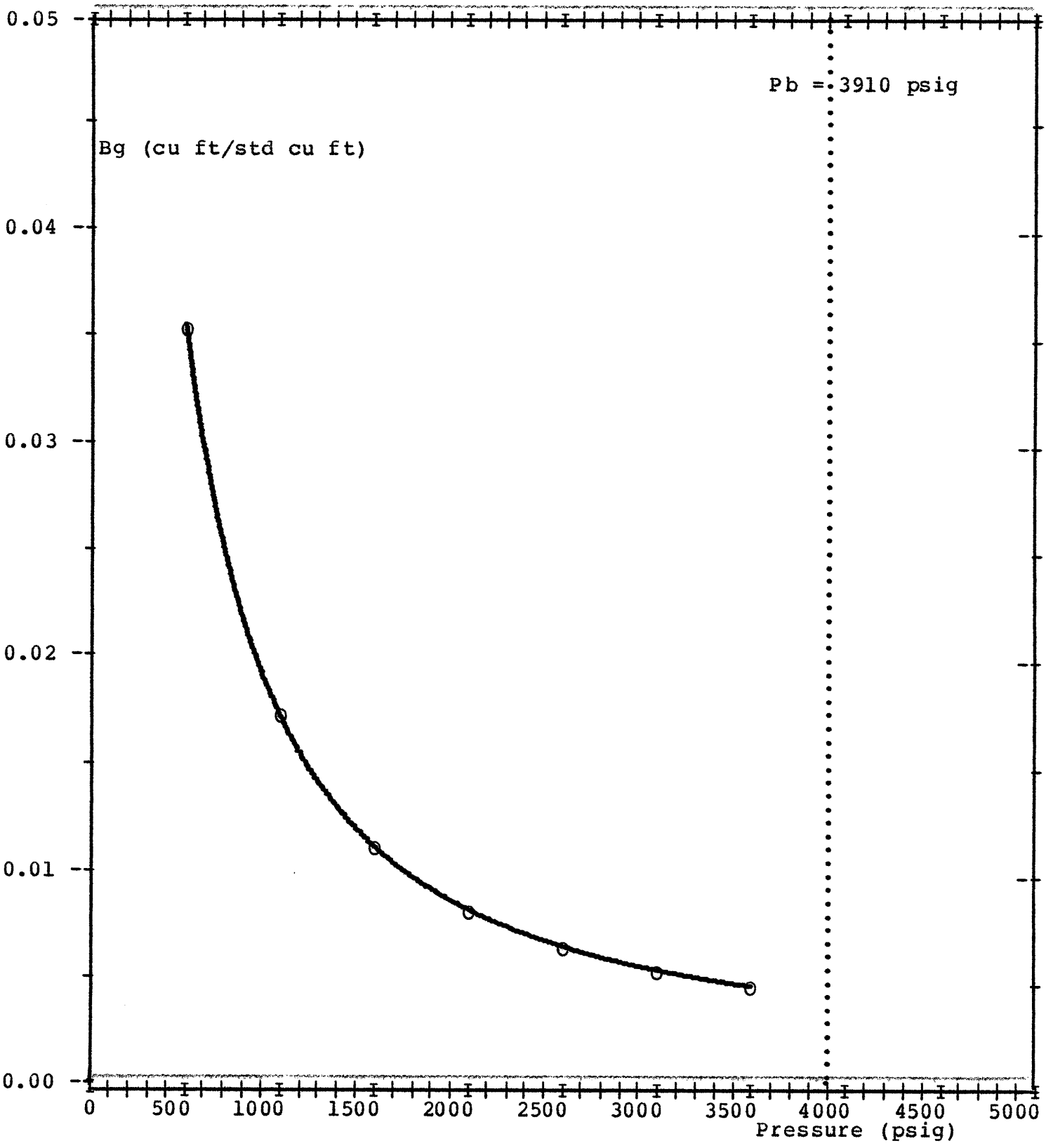
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Gas volume factor



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Gas volume factor

For 500 <= P <= 3500

$$Bg \text{ (cuft/std cuft)} = (a*x^2+b*x+c)/(d*x+1)$$

where:

Pb	=	3910 psig	x = P/Pb
a	=	2.90922074107E-01	
b	=	-3.82152739355E-01	
c	=	1.00720806738E 00	
d	=	2.03557912764E 02	

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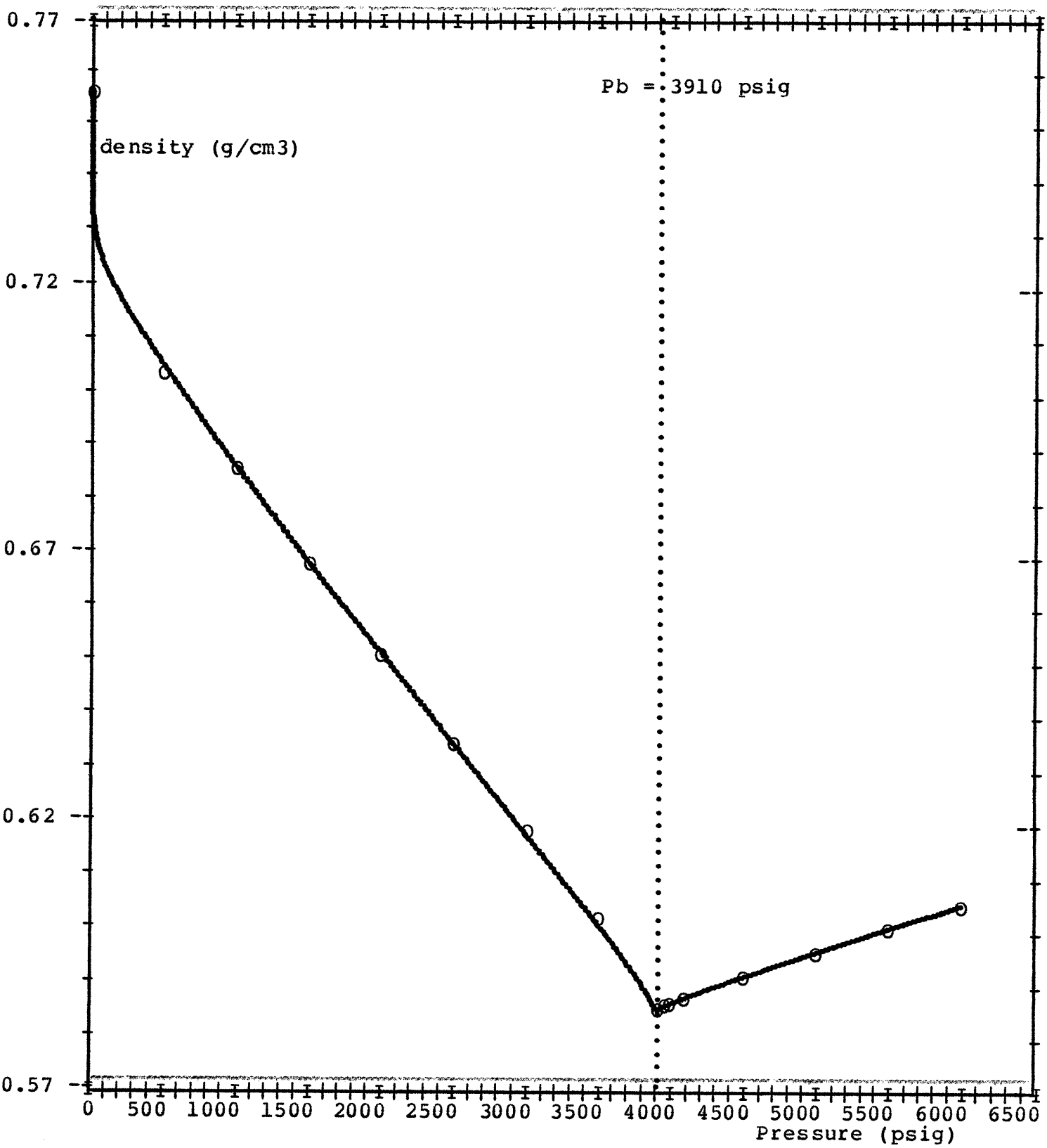
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Reservoir oil density



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Reservoir oil density

1. For Pb < P <= 6000

$$do\ (g/cm3) = 1/(a-10^{(b*\log(P-Pb)+c)})$$

where:

Pb	=	3910 psig
a	=	1.71043901552E 00
b	=	8.88981070816E-01
c	=	-4.21788901611E 00

2. For 0 <= P <= Pb

$$do\ (g/cm3) = a+b*x^{i}+c*x^{j}+d*x^{k}$$

where:

Pb	=	3910 psig	x	=	P/Pb
a	=	7.56743050000E-01	i	=	0.1
b	=	-4.35266463944E-02	j	=	1.0
c	=	-1.25433615692E-01	k	=	30
d	=	-3.13756471123E-03			

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TABLE 26

DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Molecular composition of liberated gases (mole percent)

Pressure (psig)	3500	3000	2500	2000
Nitrogen	0.00	0.00	0.00	0.00
Carbon dioxide	2.76	2.75	2.76	2.85
Hydrocarbons:				
Methane	79.25	79.64	79.40	78.68
Ethane	9.09	9.10	9.42	9.92
Propane	5.18	5.08	5.15	5.33
I - Butane	0.86	0.82	0.82	0.83
N - Butane	1.50	1.44	1.40	1.39
I - Pentane	0.47	0.43	0.39	0.37
N - Pentane	0.53	0.45	0.40	0.39
Hexanes	0.23	0.20	0.18	0.17
Heptanes plus	0.13	0.09	0.08	0.07
TOTAL	100.00	100.00	100.00	100.00
Molecular weight	21.372	21.177	21.155	21.268
Gravity (Air=1)	0.737	0.731	0.730	0.734
Molecular weight of heptanes plus	103.4	103.3	103.7	104.2

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TABLE 27

DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Molecular composition of liberated gases (mole percent)

Pressure (psig)	1500	1000	500	0
Nitrogen	0.00	0.00	0.00	0.00
Carbon dioxide	3.02	3.21	3.61	2.49
Hydrocarbons:				
Methane	77.09	73.97	64.78	30.62
Ethane	10.80	12.31	16.37	19.03
Propane	5.78	6.75	9.88	22.47
I - Butane	0.87	0.99	1.47	4.99
N - Butane	1.45	1.66	2.42	8.95
I - Pentane	0.38	0.42	0.58	2.48
N - Pentane	0.38	0.43	0.55	2.19
Hexanes	0.16	0.17	0.19	0.91
Heptanes plus	0.07	0.09	0.15	5.87
TOTAL	100.00	100.00	100.00	100.00
Molecular weight	21.601	22.352	24.659	41.708
Gravity (Air=1)	0.745	0.771	0.851	1.439
Molecular weight of heptanes plus	104.2	104.9	105.8	133.1

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TABLE 28

DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Pressure (psig)	Gas viscosity (centipoises)	Gas gravity (Air=1)	compressibility factor Z
3500	0.0208	0.737	0.887
3000	0.0193	0.731	0.874
2500	0.0179	0.730	0.870
2000	0.0166	0.734	0.875
1500	0.0153	0.745	0.890
1000	0.0140	0.771	0.914
500	0.0125	0.851	0.944
0	0.0081	1.439	1.000

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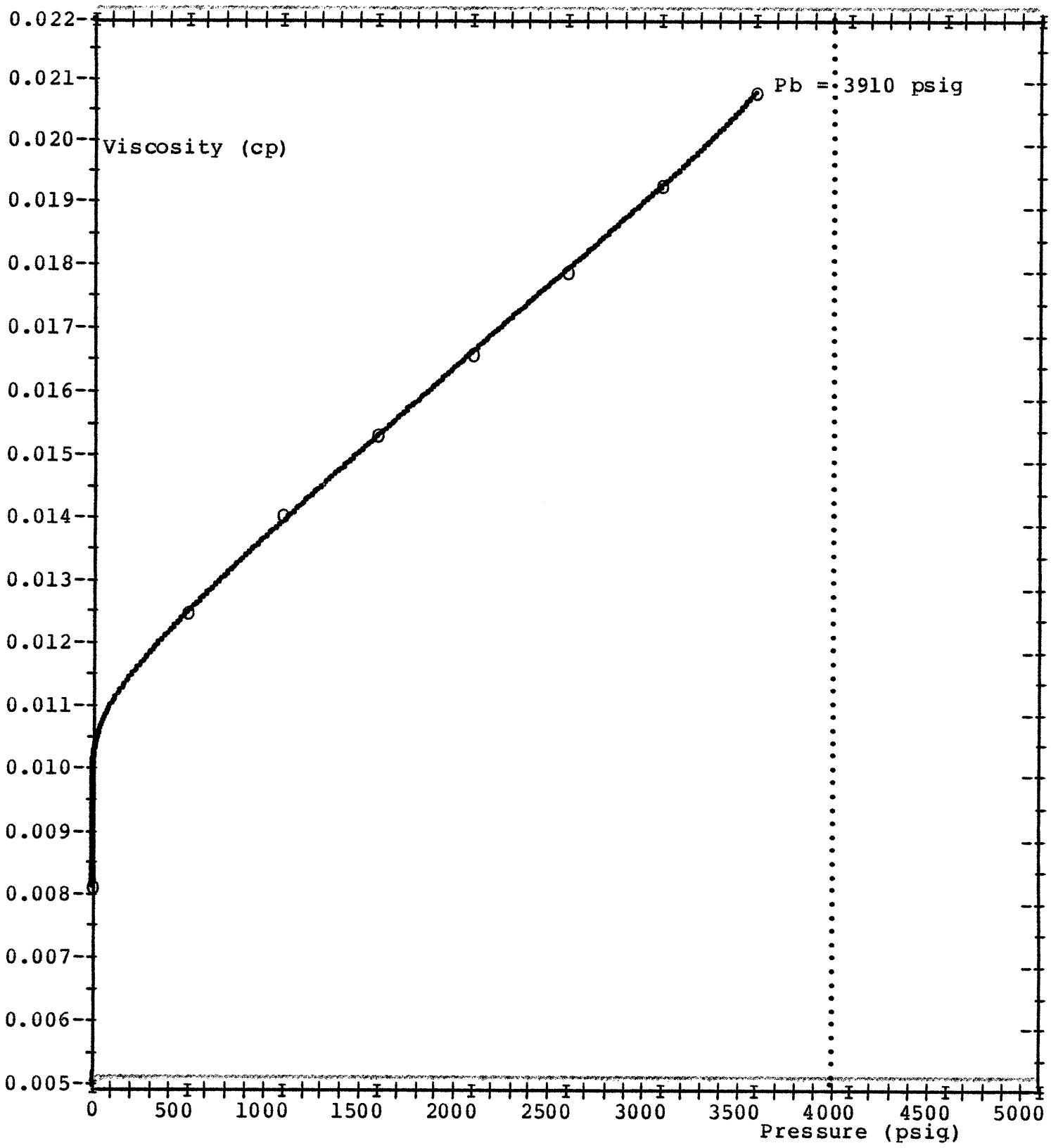
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

liberated gas viscosity



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Liberated gas viscosity

For 0 <= P <= 3500

$$ng \text{ (centipoises)} = a+b*x^{i}+c*x^{j}+d*x^{k}$$

where:

Pb	= 3910 psig	x	= P/Pb
a	= 8.11115391485E-03	i	= 0.1
b	= 3.84283573122E-03	j	= 1.0
c	= 9.59550674812E-03	k	= 12
d	= 1.03814284231E-03		

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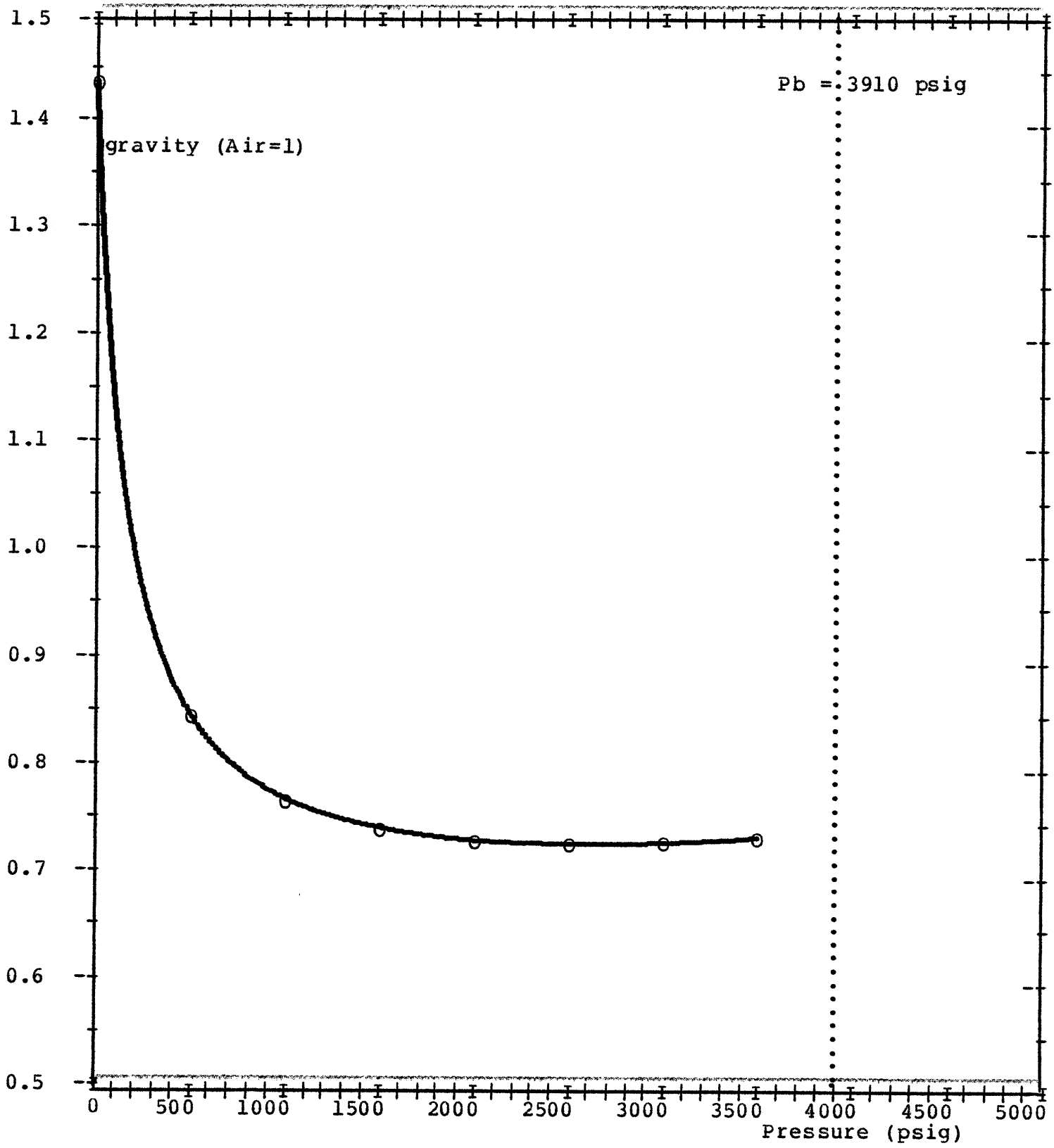
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Liberated gas gravity



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Liberated gas gravity

For 0 <= P <= 3500

$$dg\ (air=1) = (a*x^2+b*x+c)/(d*x^2+e*x+1)$$

where:

Pb	=	3910 psig	x = P/Pb
a	=	-1.05254219057E 01	
b	=	1.56000711074E 01	
c	=	1.43920840580E 00	
d	=	-1.65751430593E 01	
e	=	2.42776613799E 01	

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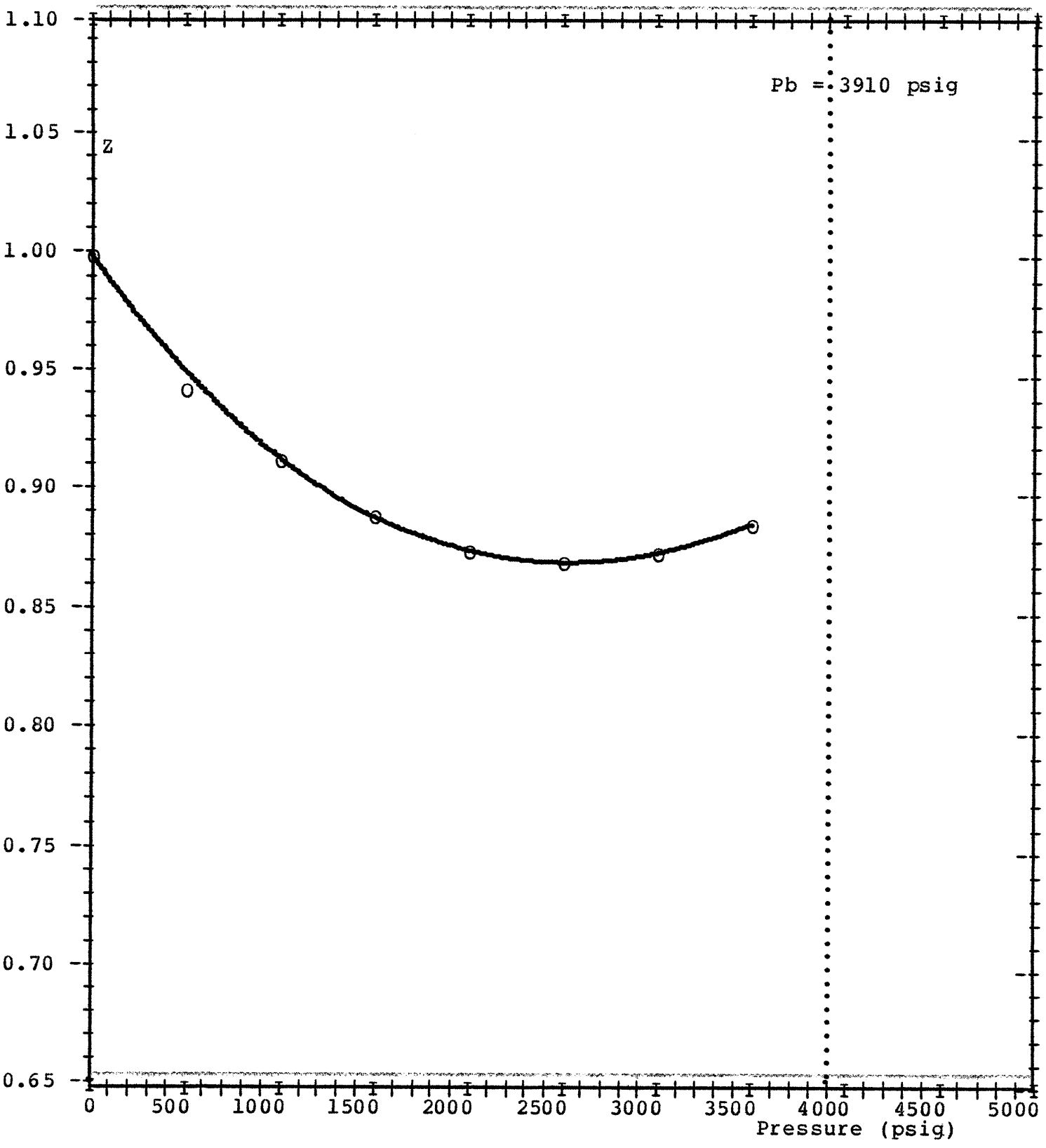
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Compressibility factor Z



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 227 F

Compressibility factor Z

For 0 <= P <= 3500

$$Z = (a*x^2+b*x+c)/(d*x+1)$$

where:

Pb	=	3910 psig	x = P/Pb
a	=	3.12766586350E-01	
b	=	-2.54446898390E-01	
c	=	1.00000000000E 00	
d	=	1.71093951015E-01	

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TABLE 29

SEPARATION TESTS OF RESERVOIR FLUID

Separator		Gas oil ratio (1) (Std cu ft/bbl)			Oil volume factor(2) (bbl/Std bbl)	Sep. liq. density (g/cm3)	Shrinkage factor(3) (Std bbl/bbl)	sto gravity (60/60 F
Press. (psig)	Temp. (F)	Sep.	Tank	Total				
500	125	783	204	987	1.711	0.728	0.831	0.819
400	125	797	163	960	1.698	0.746	0.864	0.817
300	125	819	121	940	1.690	0.763	0.895	0.816
200	125	873	84	957	1.693	0.782	0.930	0.816
0	125	1108	0	1108	1.770	0.821	1.000	0.821

(1) Gas volume at standard conditions per volume of stock tank oil at 60 F

(2) Volume of reservoir fluid at saturation pressure per volume of stock tank oil at 60 F

(3) Volume of stock tank oil at 60 F per volume of separator liquid at separator conditions

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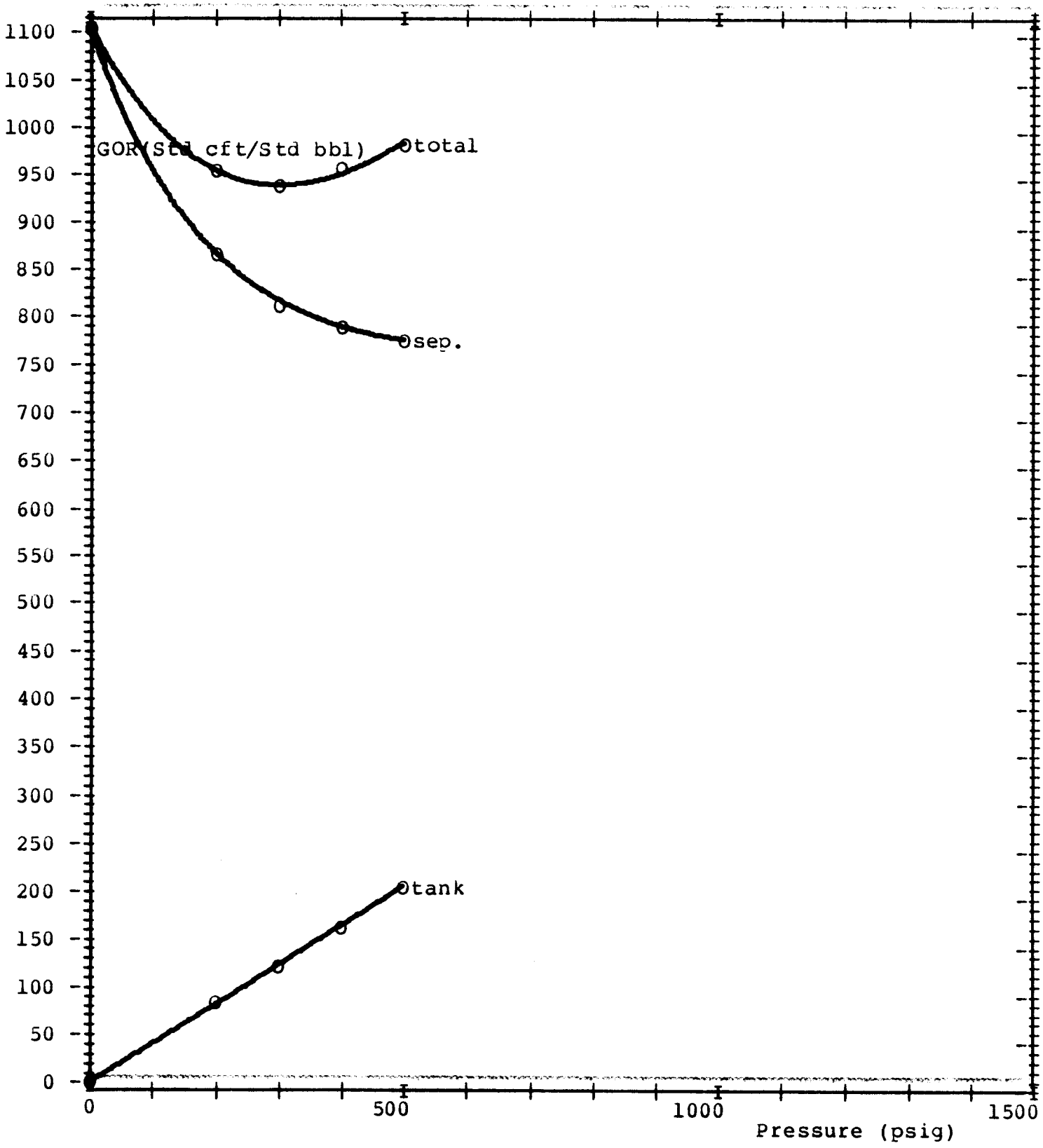
SEPARATION TESTS OF RESERVOIR FLUID

gas oil ratios

Separator temperature :125 F



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SEPARATION TESTS OF RESERVOIR FLUID

Separator temperature: 125 F

Separator gas oil ratio

For 0 <= P < = 500

GOR (std cuft/bbl) = $(a*P^2+b*P+c)/(d*P+1)$

where:

a	=	8.21877842801E-04
b	=	1.36717697350E 00
c	=	1.10804350190E 03
d	=	3.10361089094E-03

Tank gas oil ratio

For 0 <= P < = 500

GOR (std cuft/bbl) = $(a*P^2+b*P+c)/(d*P+1)$

where:

a	=	-5.67347260159E-04
b	=	4.05330497294E-01
c	=	-1.32222597997E-01
d	=	-1.40493910775E-03

Total gas oil ratio

For 0 <= P < = 500

GOR (std cuft/bbl) = $(a*P^2+b*P+c)/(d*P+1)$

where:

a	=	1.80569569253E-03
b	=	-2.12064729927E-01
c	=	1.10804350190E 03
d	=	9.45227518582E-04

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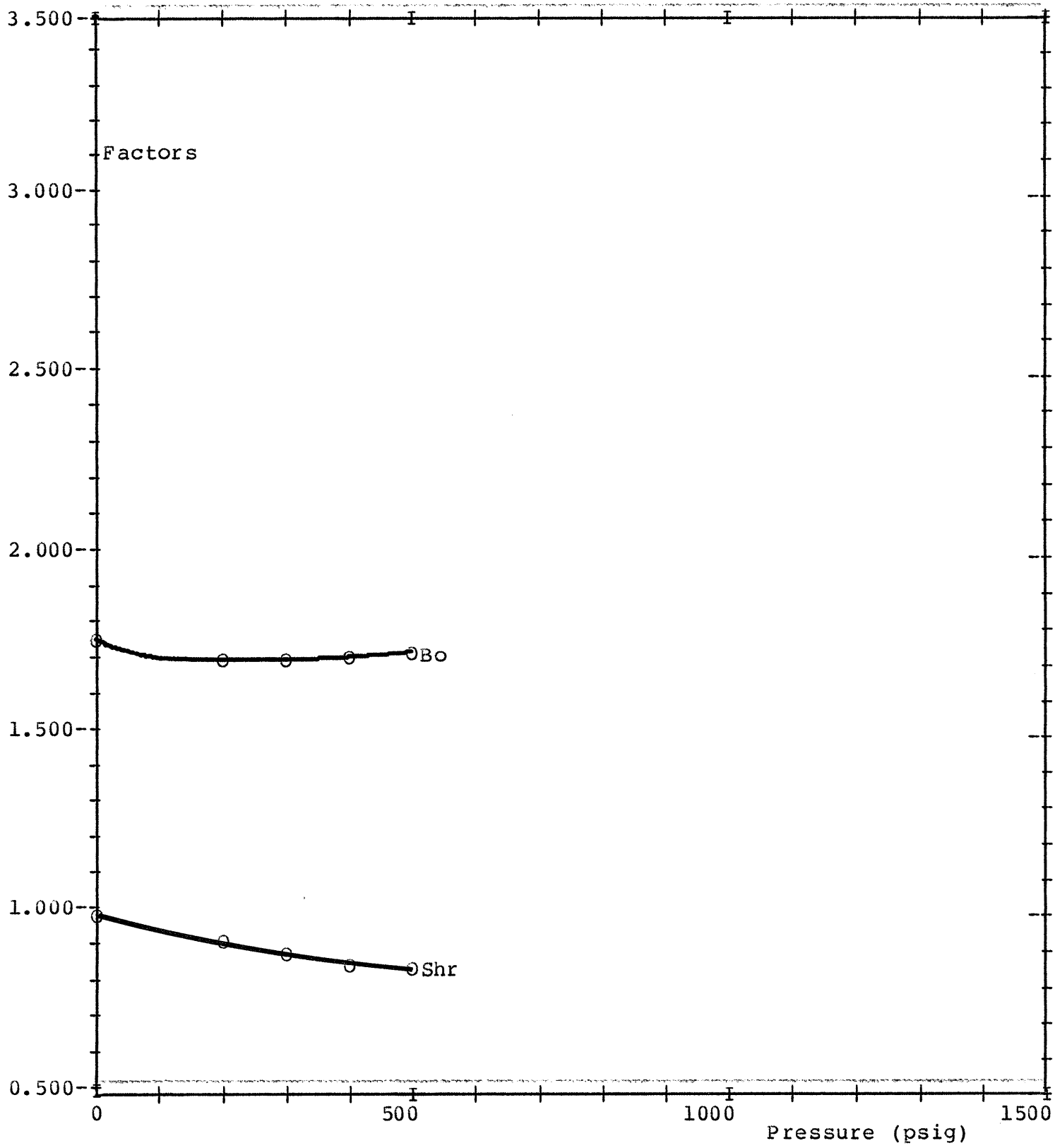
SEPARATION TESTS OF RESERVOIR FLUID

oil volume and shrinkage factors

Separator temperature :125 F



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SEPARATION TESTS OF RESERVOIR FLUID

Separator temperature: 125 F

Oil volume factor

For 0 <= P < = 500

$$Bo\ (bbl/std\ bbl) = (a*P^2+b*P+c)/(d*P+1)$$

where:

a	=	1.09331955858E-06
b	=	5.69696647995E-03
c	=	1.76950111161E 00
d	=	3.71783785656E-03

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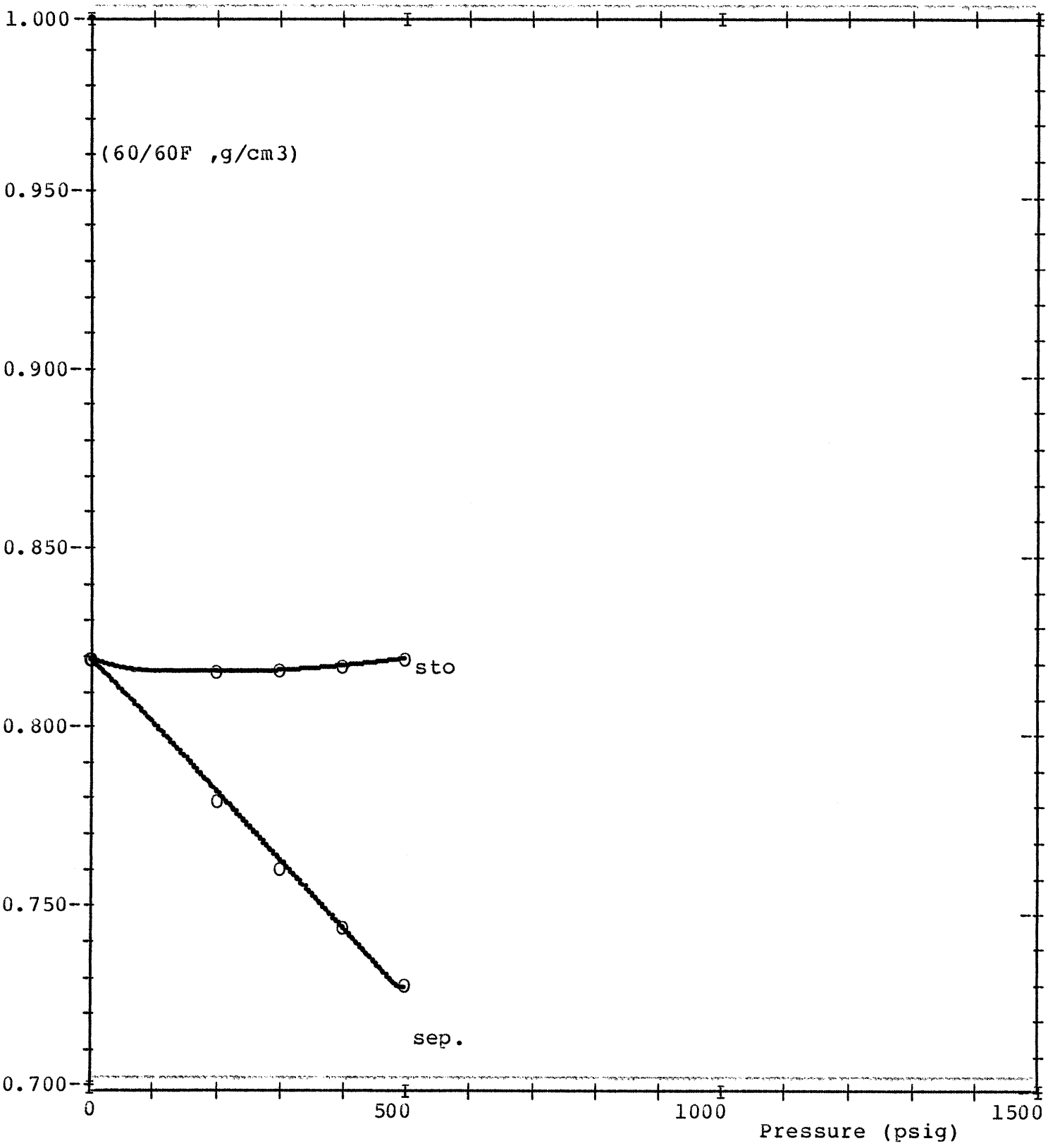
SEPARATION TESTS OF RESERVOIR FLUID

separator liquid density and stock tank oil gravity

Separator temperature :125 F



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SEPARATION TESTS OF RESERVOIR FLUID

Separator temperature: 125 F

Stock tank oil gravity

For 0 <= P < = 500

$$SGo\ (60/60\ F) = (a*P^2+b*P+c)/(d*P+1)$$

where:

a	=	1.06499999921E-07
b	=	1.88874999673E-03
c	=	8.21000000000E-01
d	=	2.37499999596E-03

Separator oil density

For 0 <= P < = 500

$$dl\ (g/cm3) = (a*P^2+b*P+c)/(d*P+1)$$

where:

a	=	-2.23790738866E-06
b	=	9.41770239466E-03
c	=	8.21000000000E-01
d	=	1.16731967826E-02

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WELL : MANTA#1 ZONE 2

TABLE 30

SEPARATION TESTS OF RESERVOIR FLUID

Molecular composition of separator gases (mole percent)

Pressure (psig)	500	400	300	200	0
Temperature (F)	125	125	125	125	125
Nitrogen	0.00	0.00	0.00	0.00	0.00
Carbon dioxide	3.03	3.11	3.17	3.06	2.95
Hydrocarbons:					
Methane	77.82	76.38	74.72	72.66	66.32
Ethane	11.01	11.55	11.98	12.40	12.47
Propane	5.64	6.14	6.80	7.68	9.51
I - Butane	0.73	0.83	0.97	1.17	1.85
N - Butane	1.20	1.32	1.54	1.92	3.50
I - Pentane	0.25	0.28	0.34	0.45	1.18
N - Pentane	0.23	0.27	0.32	0.42	1.23
Hexanes	0.06	0.08	0.11	0.15	0.67
Heptanes plus	0.03	0.04	0.05	0.09	0.32
TOTAL	100.00	100.00	100.00	100.00	100.00
Molecular weight	21.167	21.560	22.065	22.765	25.636
Gravity (Air=1)	0.730	0.744	0.761	0.786	0.885
Molecular weight of heptanes plus	104.9	103.7	103.0	103.3	102.8

TABLE 31

SEPARATION TESTS OF RESERVOIR FLUID

Molecular composition of tank gases (mole percent)

Pressure (psig)	0	0	0	0
Temperature (F)	70	70	70	70
1st stage P(psig)	500	400	300	200
Nitrogen	0.00	0.00	0.00	0.00
Carbon dioxide	2.59	2.48	2.22	2.19
Hydrocarbons:				
Methane	32.73	29.97	25.35	26.67
Ethane	18.79	18.68	18.75	17.58
Propane	23.01	24.04	26.66	25.62
I - Butane	5.22	5.80	6.30	6.27
N - Butane	10.08	11.00	12.07	12.49
I - Pentane	3.09	3.30	3.57	3.78
N - Pentane	2.99	3.18	3.41	3.61
Hexanes	1.20	1.24	1.34	1.45
Heptanes plus	0.30	0.31	0.33	0.34
TOTAL	100.00	100.00	100.00	100.00
Molecular weight	36.806	37.941	39.643	39.659
Gravity (Air=1)	1.270	1.309	1.368	1.368
Molecular weight of heptanes plus	101.6	101.6	101.9	101.9

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WELL : MANTA#1 ZONE 2

TABLE 32

VISCOSITY OF RESERVOIR FLUID AT 227 F

	Pressure (psig)	Viscosity (centipoises)
	6000	0.27
	5500	0.26
	5000	0.25
	4500	0.25
	4100	0.24
	4000	0.24
Pi=	3970	0.24
Pb=	3910	0.24
	3500	0.26
	3000	0.29
	2500	0.32
	2000	0.35
	1500	0.39
	1000	0.45
	500	0.51
	0	0.92

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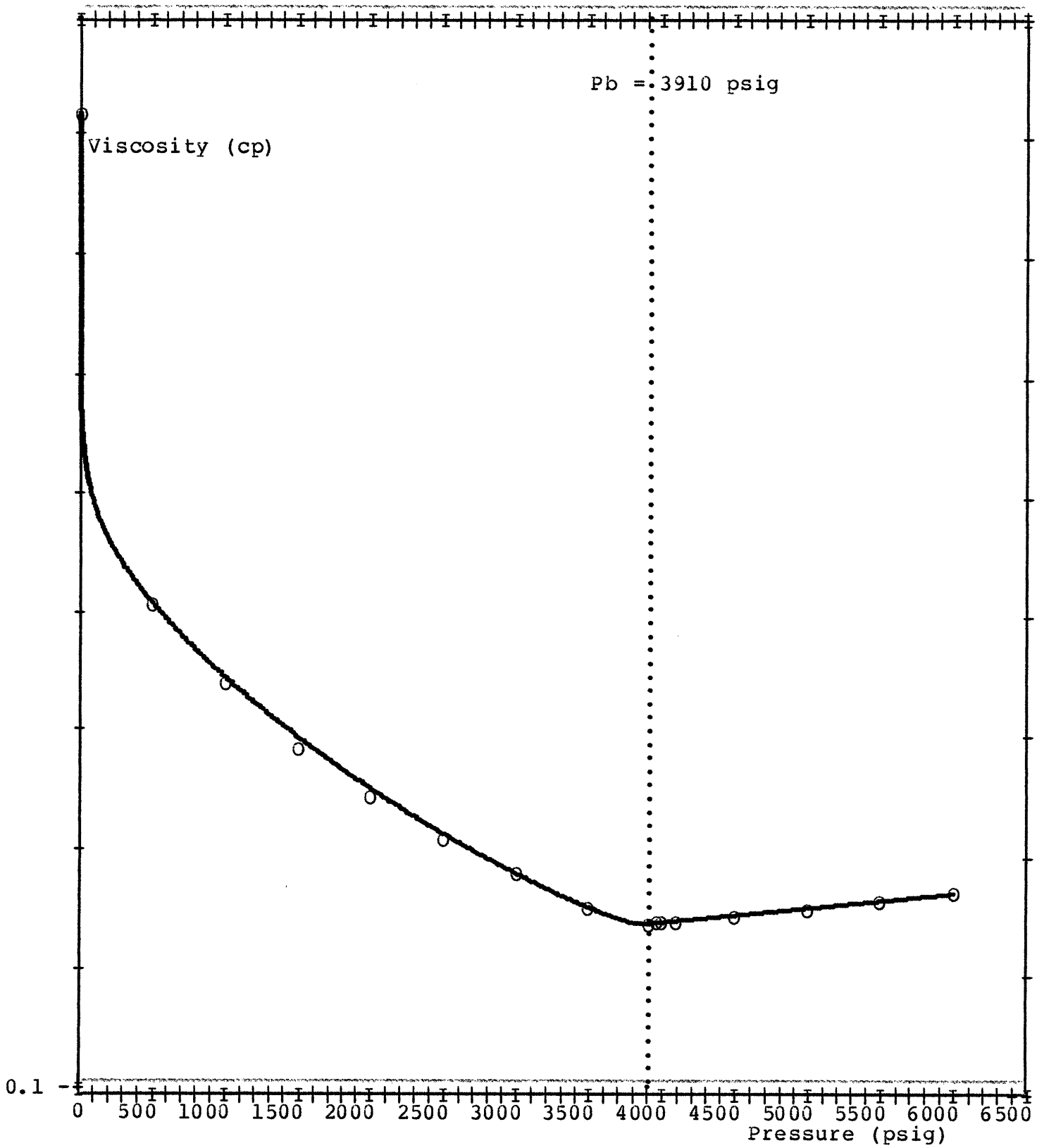
VISCOSITY OF RESERVOIR FLUID AT 227 F



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VISCOSITY OF RESERVOIR FLUID AT 227 F

1. For Pb <= P <= 6000

no (centipoises) = a*P+b

where:

Pb	=	3910 psig
a	=	1.19496855346E-05
b	=	1.91276729560E-01

2. For 0 <= P <= Pb

no (centipoises) = $a+b*x^i+c*x^j+d*x^k$

where:

Pb	=	3910 psig	x	=	P/Pb
a	=	9.20000000000E-01	i	=	0.1
b	=	-4.60830766092E-01	j	=	1.0
c	=	-2.73272015316E-01	k	=	3
d	=	5.21027814043E-02			

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RECEPTION OF SEPARATOR LIQIUID SAMPLES

	12689/92	80291/315	22400/55
Opening pressure (psig)	243	241	220
Water content (cn3)	NIL	NIL	NIL

RECEPTION OF BOTTOM HOLE SAMPLES

	20112/140 SCHLUM	80291/137 SCHL	8008/127 SCHL	1116/410 SCHL
	57	810	1119	1119
Opening pressure (psig)	1860	1630	1995	1590
Water content (cm3)	NIL	NIL	NIL	NIL
GOR(scf/bbl)	1139	948	2344	1080
Oil gravity (60/60 F)	0.8231	0.8231	0.823	0.8226

RECOMBINED SURFACE SAMPLES

	12012 12689/92	12683 80291/315	13752 22400/55
GOR(scf/bbl)	1168	1102	1216
Oil gravity	0.8155	0.821	0.8182

FLASH OF SEPARATOR LIQUID TO STOCK TANK CONDITIONS

	Molecular composition of liberated gases (mole percent)		
Nitrogen	0.00	0.00	0.00
Carbon dioxide	2.34	2.68	2.43
HYDROCARBONS			
Methane	29.94	30.49	29.34
Ethane	18.29	17.94	17.84
Propane	24.23	23.75	24.31
I-Butane	5.75	5.66	5.84
N-Butane	11.25	11.17	11.54
I-Pentane	3.36	3.39	3.56
N-Pentane	3.24	3.28	3.42
Hexanes	1.25	1.30	1.32
Heptanes plus	0.35	0.34	0.33
TOTAL	100.00	100.00	100.00
Molecular weight	38.096	38.000	38.494
Gravity(Air=1)	1.315	1.311	1.328
Molecular weight C7 plus	102.2	101.9	101.9

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WELL : MANTA#1 ZONE 2

	FLASH OF BOTTOM HOLE SAMPLE TO STOCK TANK CONDITIONS			
	1116/410	8008/127	20112/140	80291/137
Nitrogen	0.00	0.00	0.00	0.00
Carbon dioxide	2.46	2.25	2.94	2.80
HYDROCARBONS				
Methane	64.02	71.69	64.56	60.66
Ethane	13.10	11.00	12.79	13.74
Propane	10.43	7.80	10.03	11.40
I-Butane	2.07	1.48	1.99	2.32
N-Butane	3.99	2.78	3.89	4.55
I-Pentane	1.31	0.94	1.31	1.56
N-Pentane	1.39	1.02	1.38	1.63
Hexanes	0.78	0.64	0.77	0.92
Heptanes plus	0.45	0.40	0.34	0.42
TOTAL	100.00	100.00	100.00	100.00
Molecular weight	26.499	24.093	26.291	27.641
Gravity(Air=1)	0.914	0.831	0.907	0.954
Molecular of C7 plus	103.3	103.0	102.7	102.5

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FLASH OF RECOMBINED SURFACE SAMPLES TO STOCK TANK

CONDITIONS (Composition in mole percent)

	12012-12689/92	12683-80291/315	13752-22400/55
Nitrogen	0.00	0.00	0.00
Carbon dioxide	2.98	2.95	2.98
HYDROCARBONS			
Methane	61.63	66.26	65.85
Ethane	13.18	12.47	12.41
Propane	10.90	9.51	9.52
I-Butane	2.24	1.85	1.87
N-Butane	4.34	3.56	3.63
I-Pentane	1.54	1.18	1.24
N-Pentane	1.64	1.23	1.32
Hexanes	1.04	0.67	0.76
Heptanes plus	0.51	0.32	0.42
TOTAL	100.00	100.00	100.00
Mol.weight	27.509	25.664	25.522
Gravity(Air=1)	0.949	0.886	0.881
Mol. weight C7 plus	103.o	102.8	103.2

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NOMENCLATURE

P	:	Pressure
V	:	Volume
T	:	Temperature
Pi	:	Initial static pressure
Pb	:	Bubble point pressure
Pd	:	Dew point pressure
Vr=V/V Pb	:	Relative volume (oil reservoir fluid)
Vr=V/V Pd	:	Relative volume (gas reservoir fluid)
$c = -\frac{1}{V}\frac{dV}{dP}$	:	Compressibility factor of reservoir fluid
$\alpha = \frac{1}{V}\frac{dV}{dT}$	:	Thermal expansion of reservoir fluid
$Y = \frac{Pb/P-1}{Vr-1}$	:	Dimensionless compressibility function
Bo	:	Oil formation volume factor
Rs	:	Solution gas oil ratio
Z	:	Gas compressibility factor or gas deviation factor
Bg	:	Gas formation volume factor
do	:	Reservoir oil density
Go	:	Residual oil gravity
G	:	Gas gravity (Air=1)
sto	:	Stock tank oil
GOR	:	Gas oil ratio
GLR	:	Gas liquid ratio
WOR	:	Water liquid ratio
Shrinkage factor	:	Oil volume at standard conditions / Oil volume at separator conditions
$Z = \frac{PV}{nRT}$	:	n=Total moles of a mixture in the gas state R=Universal gas constant (per mole)
GPM	:	Gallons per thousand standard cubic feet
Standard conditions	:	For gas volumes =60 F and 14.7 psia
	:	For oil measurements=60 F and atmospheric pressure

Gross heat content is calculated from API research project 44
Molecular weights,densities,critical values are from CRC Handbook of chemistry and physics
Gas viscosity is calculated with equations from Standing (Behavior of oil field hydrocarbon systems)

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