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

W846

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FLOPETROL JOHNSTON
Schlumberger

25 JUL 1984 W846

P.V.T.STUDY REPORT

OIL and GAS DIVISION

Client: SHELL DEVELOPMENT AUSTRALIA
Field : GIPPSLAND Well : MANTA#1 ZONE 3
Zone : 2615-2626 M Samp. date: 13/04/1984

Report #: 84ADL008 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: Telex No. 410 on 27.03.84

OUR REF: 84/AUD/MV/058

3rd May, 1984.

Shell Development Co. 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 3
Report No. 84 ADL 008

Bottom Hole samples from well MANTA #1 were received in our laboratory for PVT analysis on 21.03.84. The results of this study, as requested by Shell Development Co. Pty. Ltd. are presented in this report.

Preliminary investigation of the bottom hole samples indicated a reasonably close agreement between the opening pressures of the sample bottles in the laboratory and their final shipping conditions thus indicating no leakage during transportation. The results of these initial checks are reported in Annex 1.

Sample validity checks of the bottom hole samples as measured by the bubble point pressure determination at bottom hole temperature.

At this stage, the provisional results obtained so far were telexed to Shell Development Co. Pty. Ltd. (telex no. AUD 390 - 3.04.84) who advised us by telex no. 438 - 3.04.84 to use bottom hole sample 1116/23.

A known volume of the bottom hole sample was then charged to a PVT cell and thermally expanded to the reservoir temperature of 222°F. The thermal expansion factor at 5000 psig between 70°F and 222°F was found to be $0.706 \times 10^{-3}\ F^{-1}$. This fluid was found to have a bubble point pressure 3745 psig which on comparison with the initial reservoir pressure of 3748 psig indicates that the fluid presently exists in a saturated condition. Other volumetric data from the pressure volume relation measurements are presented in Annex 5.

During differential vaporization study at 222°F, the reservoir fluid liberated a total of 1276 standard cubic feet of gas/standard barrel of oil. The associated oil volume factor was found to be 1.798/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 222°F, using a rolling ball viscosimeter. The values were found to vary from 0.26 centipoise at the bubble point pressure to a maximum of 0.81 centipoise at atmospheric pressure. These results are presented in Annex 8.

We are glad to be of service to Shell Development Co. 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 3

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WELL : MANTA#1 ZONE 3

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 3

SUMMARY AND MAIN RESULTS

The present report gives the experimental results of the P.V.T. study carried out on bottom hole sample(s) from well MANTA#1 ZONE 3

The initial reservoir conditions are :

- Pi : 3748 psig at 2615 M
- T : 222 F at 2615 M

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

- Pb : 3745 psig at 222 F

Main differential vaporization data at reservoir temperature :

		Pi	Pb
oil volume factor (bbl/Std bbl)	:	-----	1.798
solution gas-oil ratio (Std cu ft/bbl)	:	-----	1276
reservoir fluid density (g/cm3)	:	-----	0.594
Residual oil gravity	:	0.819	60/60 F
		41.2	API

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WELL : MANTA#1 ZONE 3

TABLE 1

SAMPLING CONDITIONS

I. RESERVOIR AND WELL CHARACTERISTICS

Producing zone	:	2615-2626 M
Static pressure	:	3748 psig at 2615 M
Bottom hole temperature	:	222 F at 2615 M
Tubing diameter	:	3 1/2" PH6
Casing size	:	7"
Casing shoe	:	2590 M

II. SAMPLING CONDITIONS

A) SURFACE SAMPLE(S)

Date	:	-
Choke	:	-
Flowing bottom hole pressure	:	-
Well head pressure	:	-
Separator pressure	:	-
Well head temperature	:	-
Separator temperature	:	-
Gas rate (Separator)	:	-
Stock tank temperature	:	-
Compressibility factor	:	-
Gas gravity	:	-
Liquid rate (Separator)	:	-
G.L.R.	:	-
Sample(s) received	:	gas - - liq.- -

B) BOTTOM HOLE SAMPLE(S)

Date	:	13/14/03/84
Choke	:	3/16" ADJ
Sample(s) received	:	SCHL783-1116/23 80291/375

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WELL : MANTA#1 ZONE 3

SAMPLE(S) VALIDITY

BOTTOM HOLE SAMPLE(S)

1) Sample bottle No 1116/23

   Bubble point pressure determination at 222 F is 3745 psig

2) Sample bottle No 80291/375

   Bubble point pressure determination at 222 F is 3717 psig

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WELL : MANTA#1 ZONE 3

TABLE 2

BUBBLE POINT PRESSURE DETERMINATION AT 222 F

Bottom hole sample (Cylinder 1116/23)

Pressure (psig)	Pump reading (cm3)
5000	165.74
4500	160.32
4000	154.48
3900	153.24
3800	151.95
Pb= 3745	151.20
3725	150.19
3719	149.71
3711	149.22
3689	148.25
3652	146.25
3582	142.31
3460	134.36
3236	118.58

..is sample has been used for complete PVT study

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BUBBLE POINT PRESSURE DETERMINATION AT 222 F

Bottom hole sample (cylinder 1116/23)

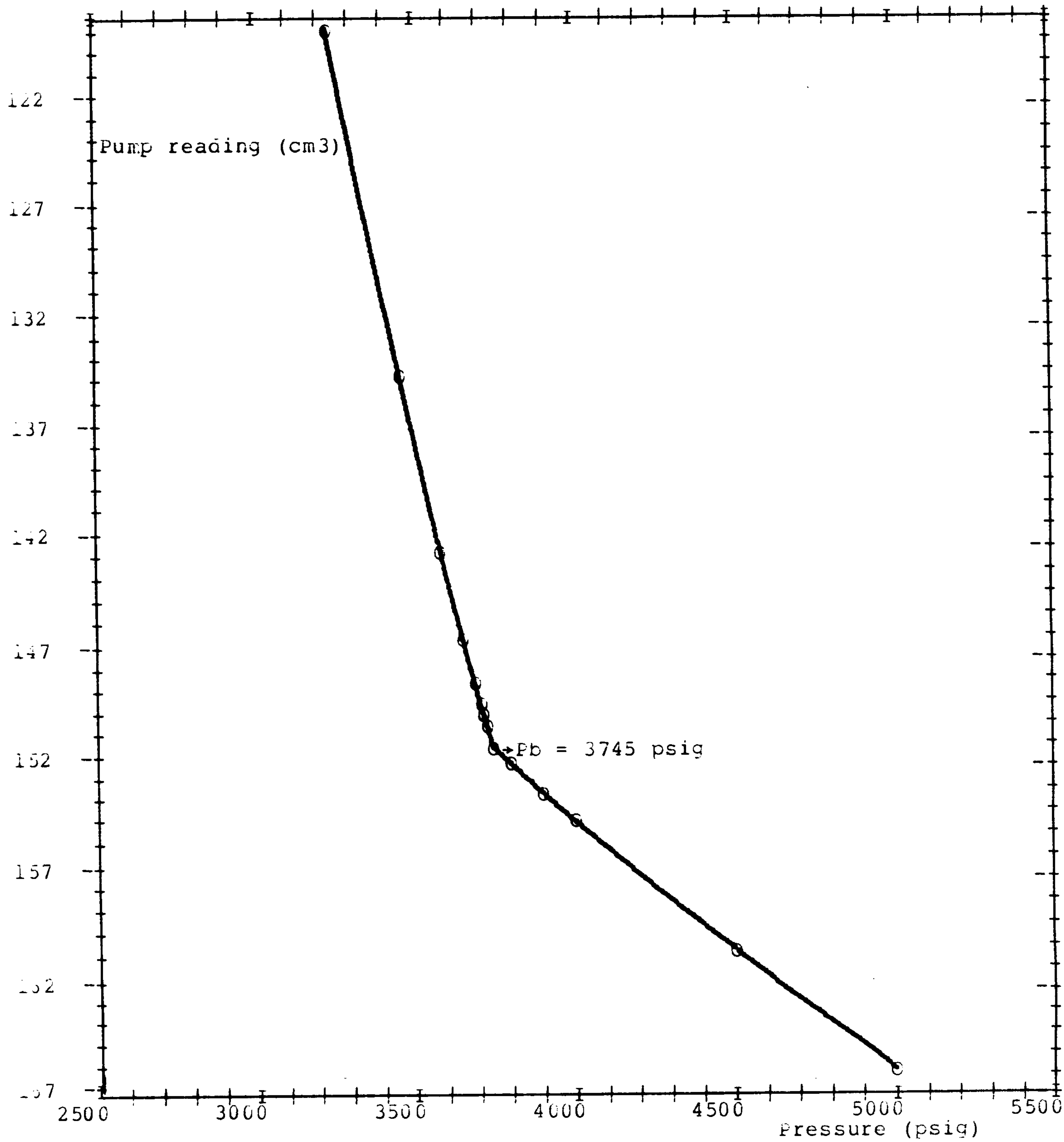

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TABLE 3

BUBBLE POINT PRESSURE DETERMINATION AT 222 F

Bottom hole sample (Cylinder 80291/375)

Pressure (psig)	Pump reading (cm3)
5000	298.15
4500	292.82
4000	287.13
3900	285.75
3800	284.59
3750	283.75
Pb= 3717	283.30
3690	282.72
3682	281.60
3674	281.17
3660	280.28
3623	278.30
3555	274.36
3425	266.44
3208	250.59

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BUBBLE POINT PRESSURE DETERMINATION AT 222 F

Bottom hole sample (cylinder 80291/375)

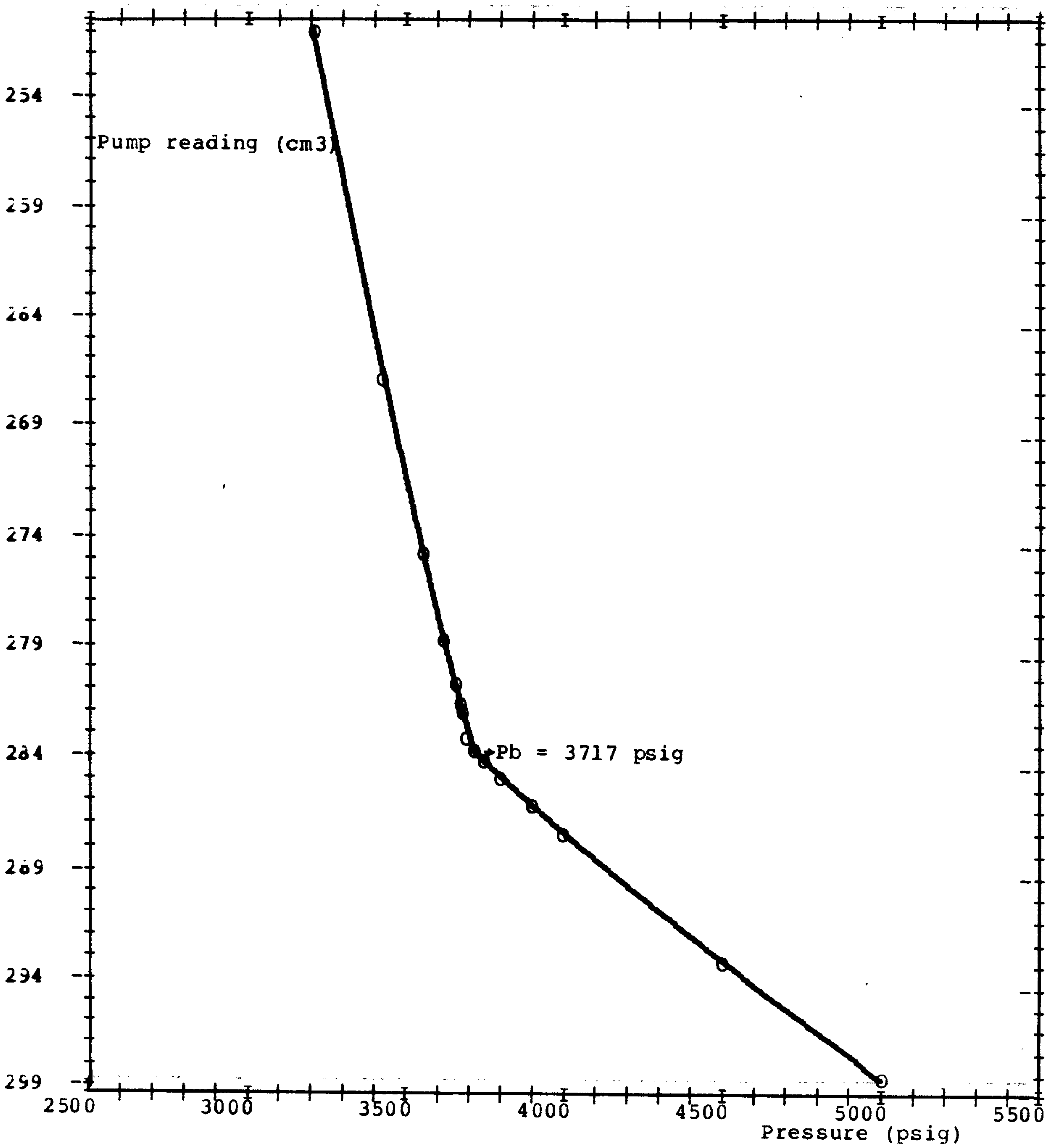

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TABLE 4

BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 222 F

	Pressure (psig)	Relative volume V/VPb	Compressibility factor (psi^{-1})	Y curve Pb/P-1 / V/VPb-1
	5000	0.9760	18.36×10^{-6}	
	4750	0.9805	18.60×10^{-6}	
	4500	0.9850	18.96×10^{-6}	
	4250	0.9897	19.56×10^{-6}	
	4000	0.9945	20.32×10^{-6}	
	3900	0.9966	21.30×10^{-6}	
	3800	0.9987	23.84×10^{-6}	
Pb=	3745	1.0000		
	3710	1.0030		3.18
	3695	1.0043		3.17
	3648	1.0084		3.15
	3596	1.0133		3.13
	3500	1.0227		3.08
	3410	1.0323		3.04
	3245	1.0519		2.97
	2974	1.0911		2.85
	2578	1.1696		2.67
	2082	1.3265		2.45
	1544	1.6466		2.20

Thermal expansion factor of reservoir fluid at 5000 psig

between 70 F and 222 F : = 0.706×10^{-3} F^{-1}

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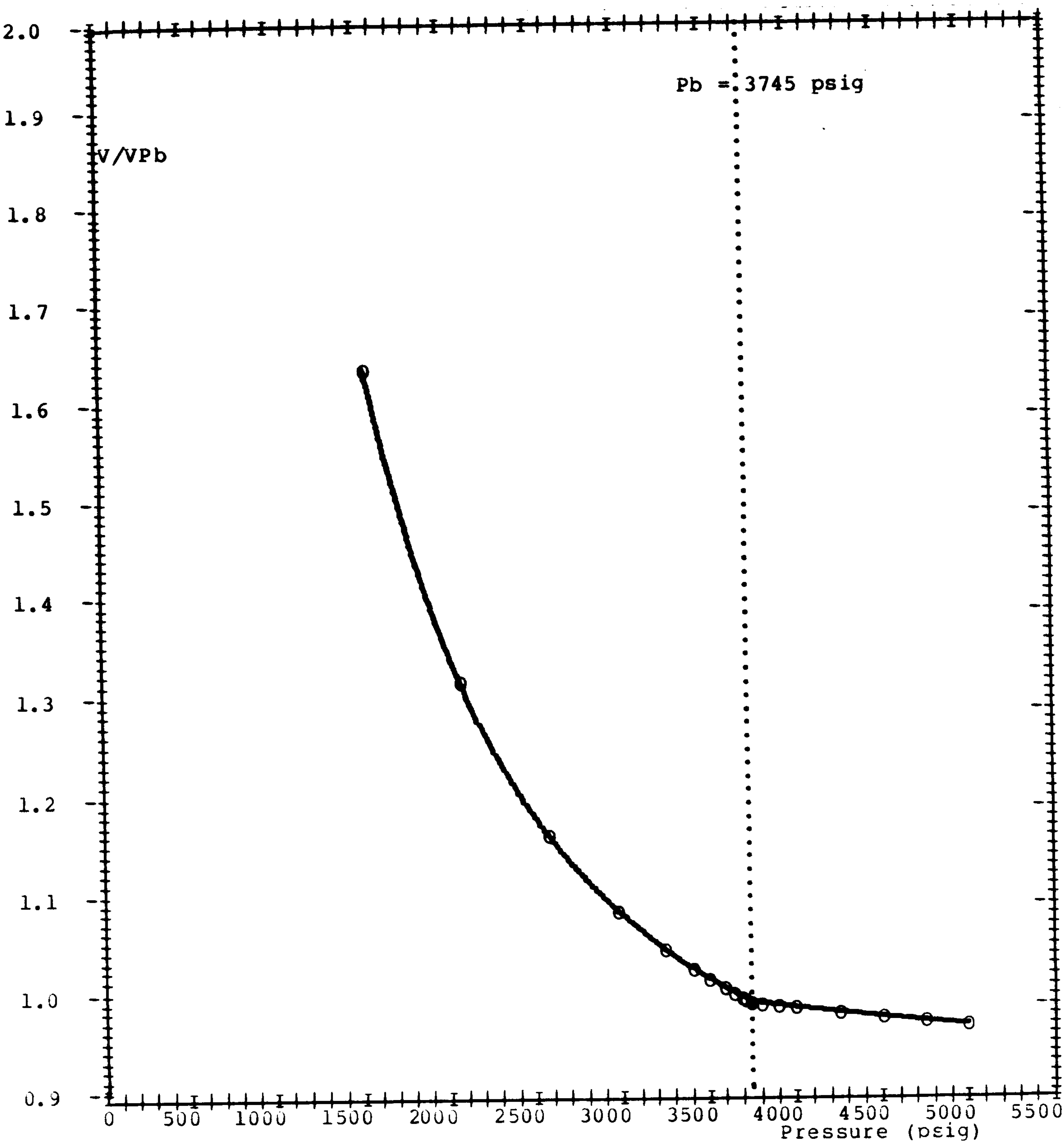
BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 222 F

Relative volume



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BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 222 F

Relative Volume

1. For Pb < P <= 5000

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

where:

Pb = 3745 psig
a = 9.29982250524E-01
b = -4.50147242400E 00

2. For 1544 <= P < Pb

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

where:

Pb = 3745 psig
a = 1.68078463562E 00
b = 1.51165574670E 00

x = P/Pb

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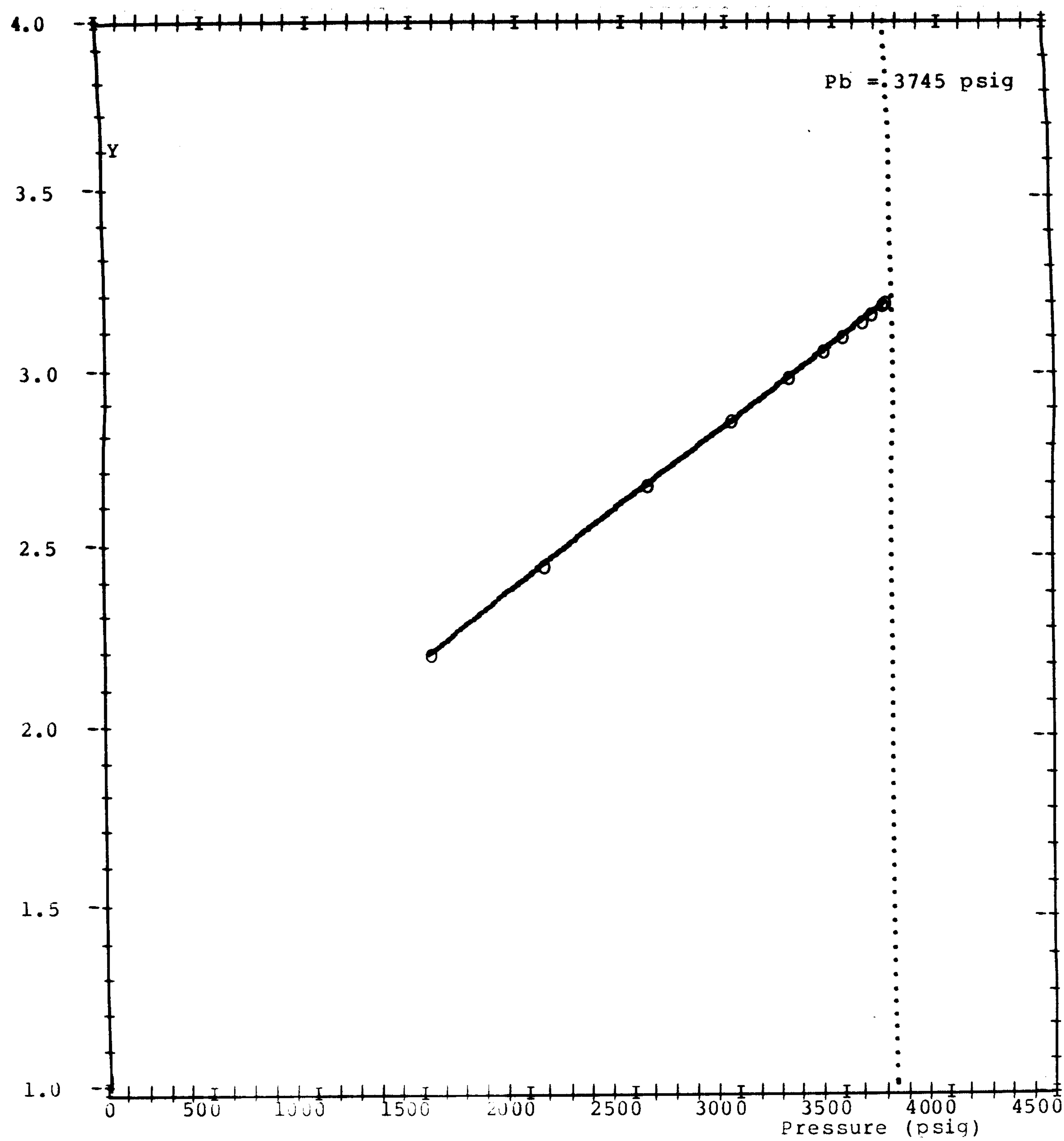
BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 222 F

Y curve pressure-volume function



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BUBBLE POINT PRESSURE DETERMINATION AND CONSTANT MASS STUDY AT 222 F

Y curve pressure-volume function

For 1544 <= P < Pb

Y = a*P+b

where:

Pb	=	3745 psig
a	=	4.48807646360E-04
b	=	1.51165574670E 00

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TABLE 5

DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 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)
5000	1.755			0.609
4750	1.763			0.606
4500	1.771			0.603
4250	1.780			0.601
4000	1.788			0.598
3900	1.792			0.596
3800	1.796			0.595
Pb= 3745	1.798	1276		0.594
3000	1.646	969	0.56×10^{-2}	0.619
2500	1.563	793	0.67×10^{-2}	0.633
2000	1.486	636	0.84×10^{-2}	0.649
1500	1.415	487	1.12×10^{-2}	0.664
1000	1.356	357	1.71×10^{-2}	0.676
500	1.286	216	3.51×10^{-2}	0.692
200	1.236	124	8.70×10^{-2}	0.703
0	1.099	0	------------	0.746

Residual oil gravity : 0.819 60/60 F
41.2 API

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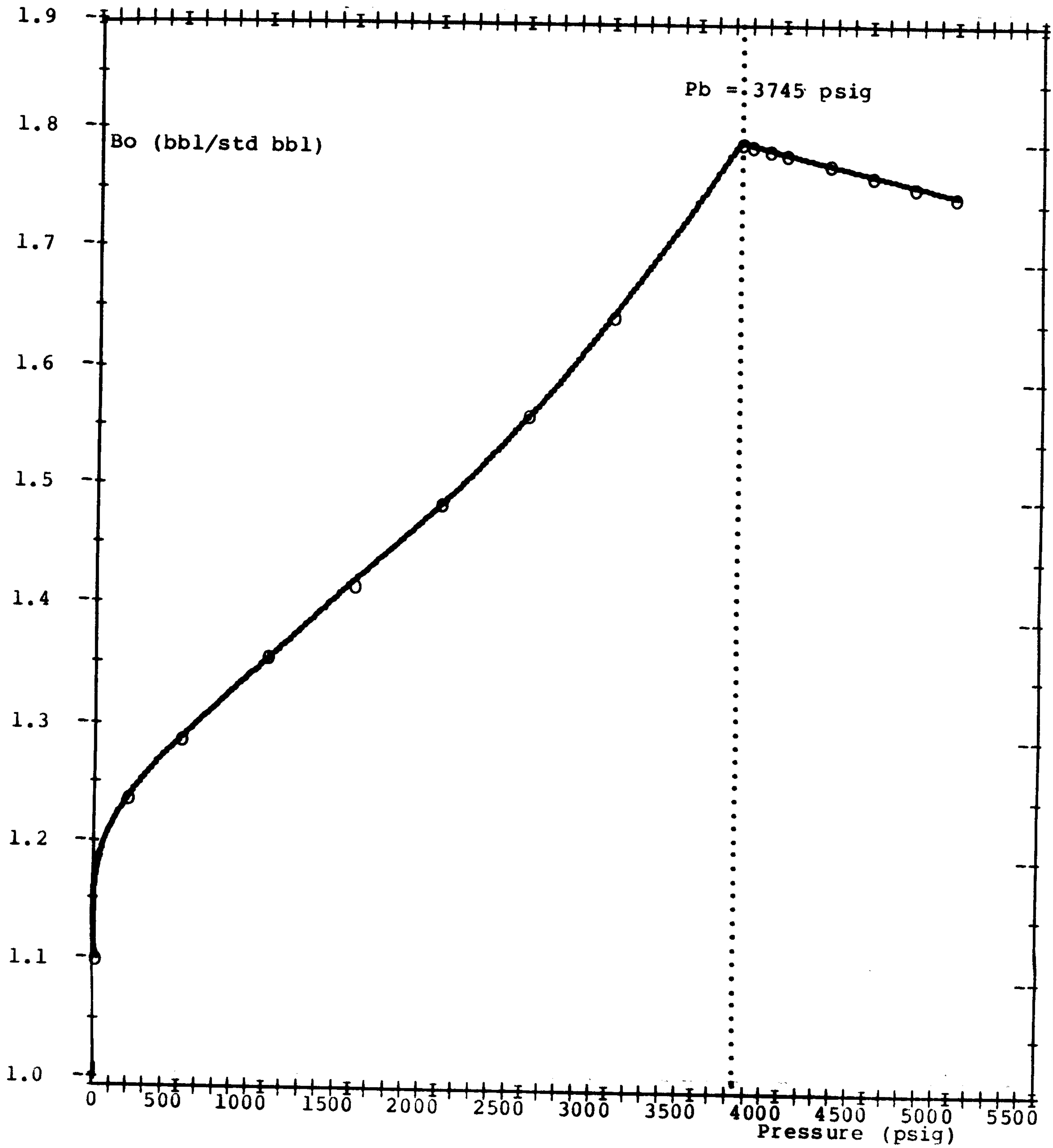
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Oil volume factor



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Oil volume factor

1. For Pb < P <= 5000

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

where:

Pb =	3745 psig	x	=	P/Pb
a =	1.79813698317E 00			
b =	9.29982250524E-01			
c =	-4.24664965052E 00			

2. For 0 <= P <= Pb

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

where:

Pb =	3745 psig	x	=	P/Pb
a =	1.09878035382E 00	i	=	0.2
b =	2.23029916644E-01	j	=	1.0
c =	3.10334783076E-01	k	=	3
d =	1.65991929633E-01			

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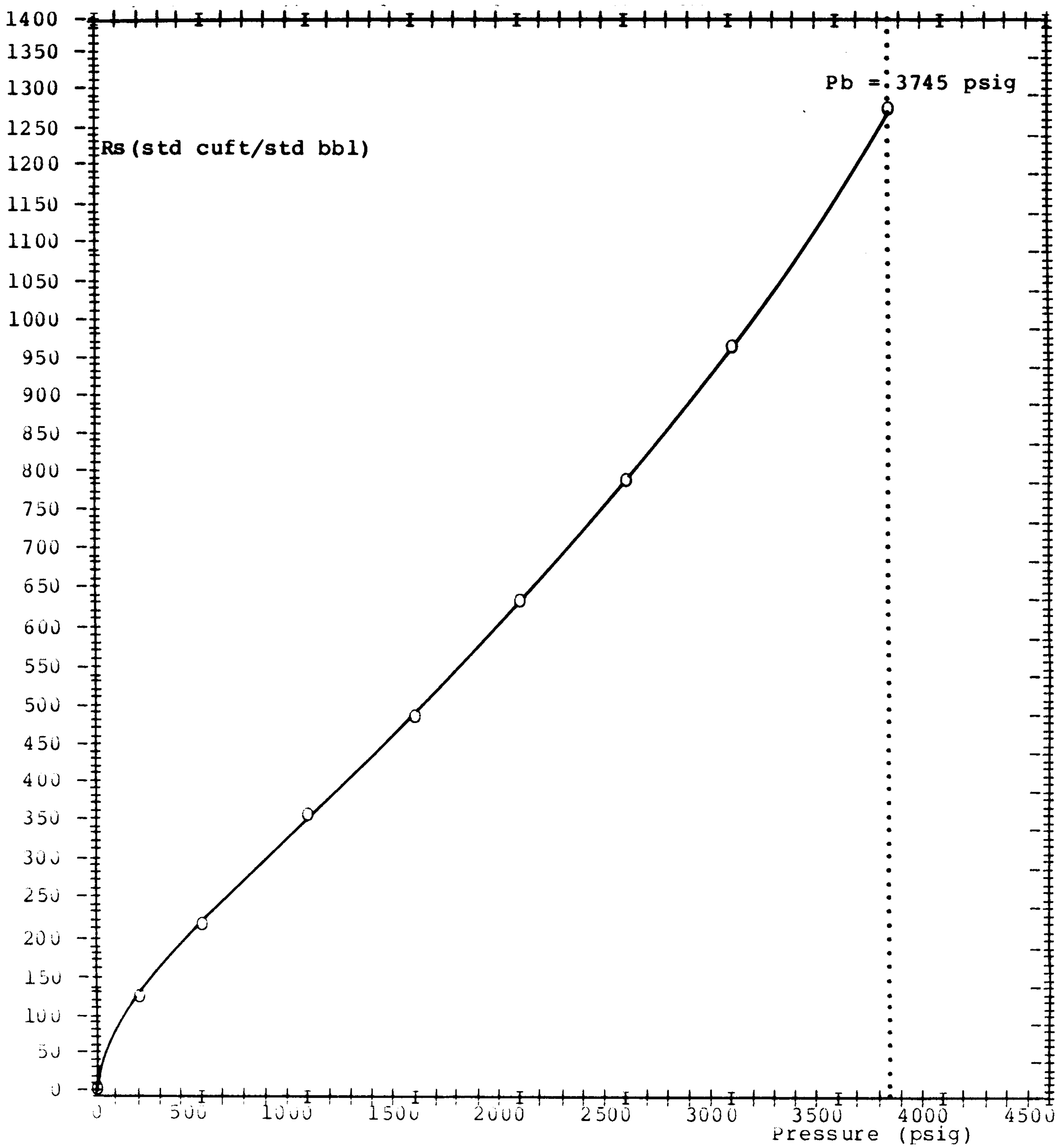
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Solution gas oil ratio



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Solution gas oil ratio

For 0 <= P <= Pb

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

where:

Pb	=	3745 psig	x	=	P/Pb
a	=	7.11343658462E 02	i	=	0.6
b	=	4.35133451698E 02	j	=	2.0
c	=	1.29860539194E 02	k	=	3

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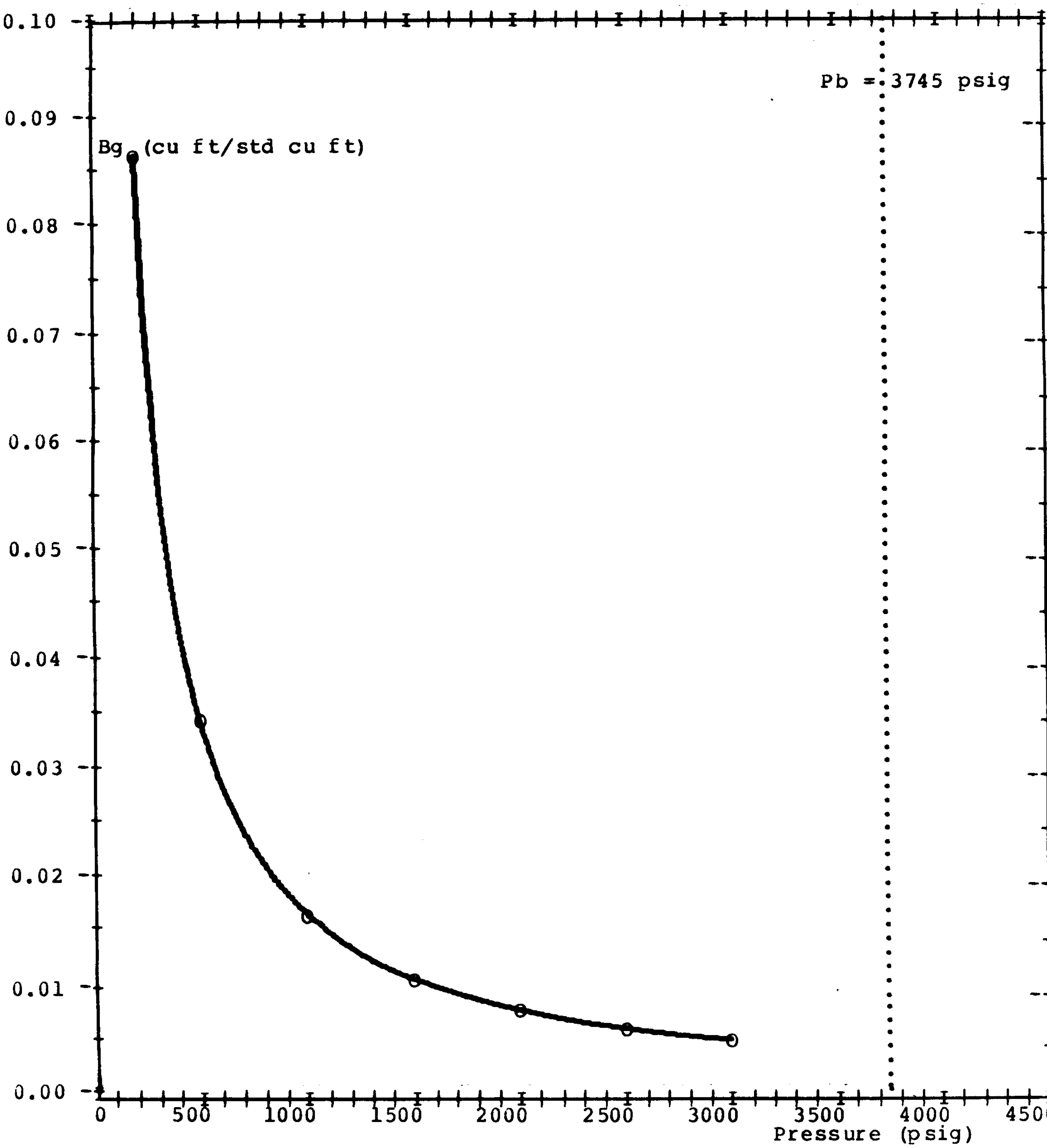
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Gas volume factor



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Gas volume factor

For 200 <= P <= 3000

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

where:

Pb =	3745 psig	x	= P/Pb
a =	4.37349082164E-01		
b =	-5.63747844877E-01		
c =	1.93936545633E 00		
d =	3.92276932626E 02		

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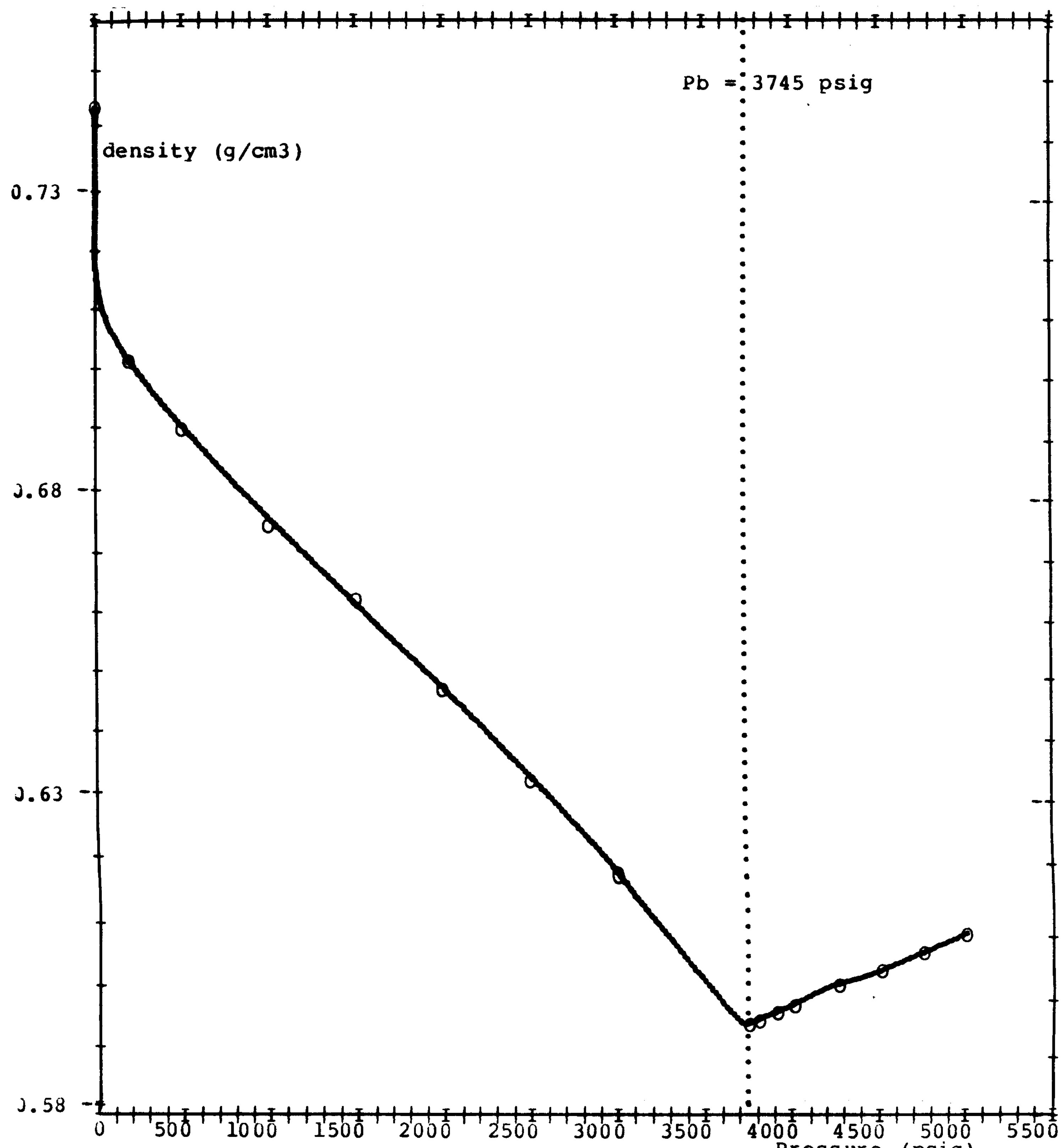
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Reservoir oil density



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Reservoir oil density

1. For Pb < P <= 5000

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

where:

Pb	=	3745 psig
a	=	1.68243123557E 00
b	=	9.29982250524E-01
c	=	-4.27553510125E 00

2. For 0 <= P <= Pb

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

where:

Pb	=	3745 psig	x	=	P/Pb
a	=	7.45553920000E-01	i	=	0.1
b	=	-5.03605534103E-02	j	=	1.0
c	=	-8.93237980832E-02	k	=	3
d	=	-1.14916356303E-02			

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TABLE 6

DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Molecular composition of liberated gases (mole percent)

Pressure (psig)	3000	2500	2000	1500
Nitrogen	0.00	0.00	0.00	0.00
Carbon dioxide	2.66	2.78	2.98	3.12
Hydrocarbons:				
Methane	77.86	77.96	77.26	75.83
Ethane	9.47	9.74	10.21	11.00
Propane	5.66	5.60	5.79	6.19
I - Butane	1.04	0.93	0.93	0.96
N - Butane	1.80	1.65	1.57	1.63
I - Pentane	0.55	0.48	0.45	0.44
N - Pentane	0.59	0.51	0.46	0.46
Hexanes	0.26	0.23	0.22	0.23
Heptanes plus	0.11	0.12	0.13	0.14
TOTAL	100.00	100.00	100.00	100.00
Molecular weight	21.817	21.665	21.763	22.073
Gravity (Air=1)	0.753	0.748	0.751	0.762
Molecular weight of heptanes plus	104.0	103.7	103.4	103.2

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TABLE 7

DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Molecular composition of liberated gases (mole percent)

Pressure (psig)	1000	500	200	0
Nitrogen	0.00	0.00	0.00	0.00
Carbon dioxide	3.40	3.69	3.62	1.78
Hydrocarbons:				
Methane	72.08	63.01	45.31	13.89
Ethane	12.68	16.61	22.32	18.46
Propane	7.33	10.48	17.67	26.84
I - Butane	1.14	1.62	2.94	6.40
N - Butane	1.92	2.68	4.92	11.88
I - Pentane	0.51	0.68	1.20	3.72
N - Pentane	0.52	0.67	1.15	3.45
Hexanes	0.25	0.32	0.47	2.91
Heptanes plus	0.17	0.24	0.40	10.67
TOTAL	100.00	100.00	100.00	100.00
Molecular weight	23.018	25.348	30.459	53.312
Gravity (Air=1)	0.794	0.875	1.051	1.840
Molecular weight of heptanes plus	103.5	104.2	106.1	136.9

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TABLE 8

DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Pressure (psig)	Gas viscosity (centipoises)	Gas gravity (Air=1)	compressibility factor Z
3000	0.0197	0.753	0.877
2500	0.0181	0.748	0.872
2000	0.0167	0.751	0.875
1500	0.0154	0.762	0.883
1000	0.0140	0.794	0.901
500	0.0123	0.875	0.936
200	0.0105	1.051	0.969
0	0.0069	1.840	1.000

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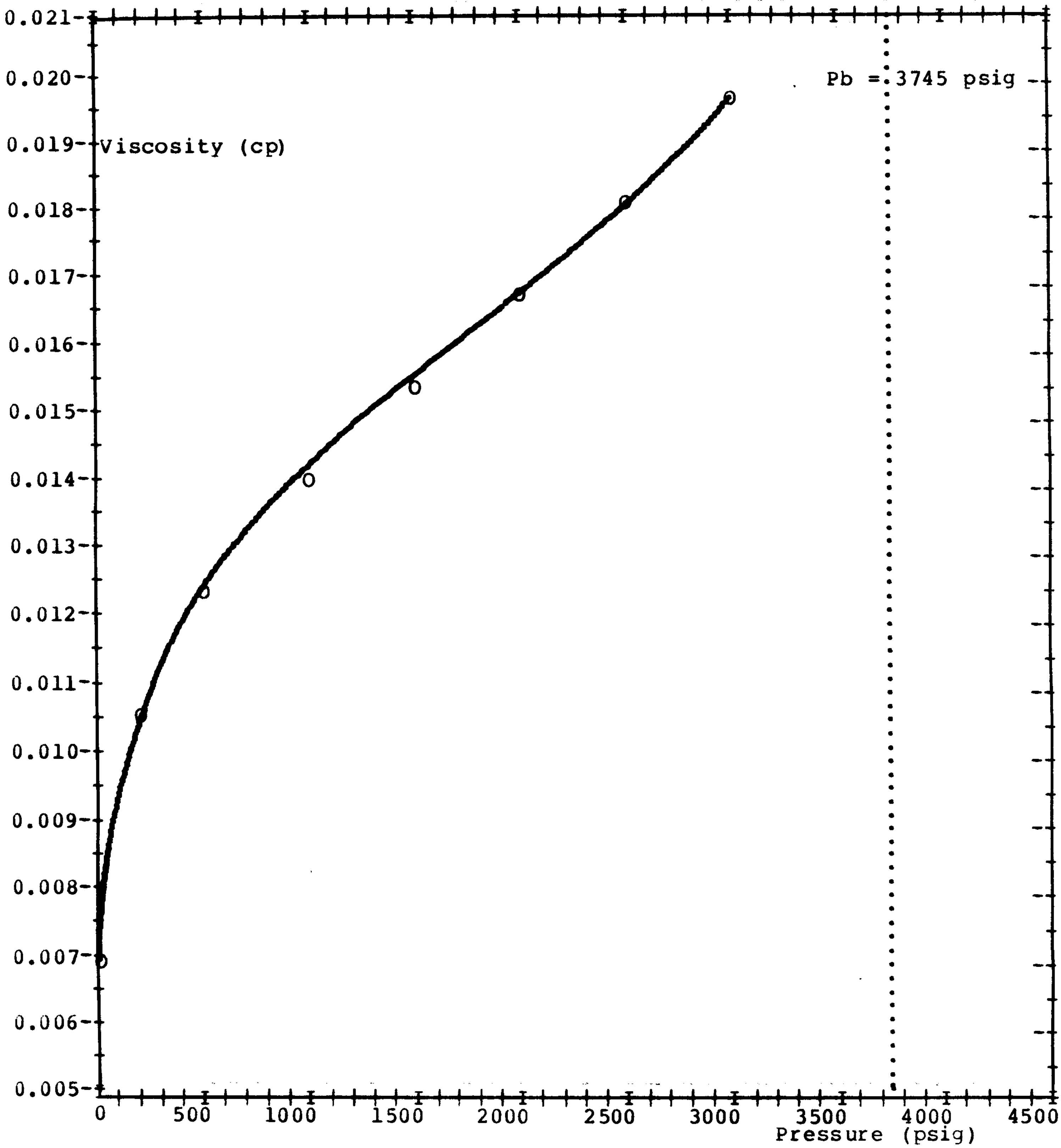
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

liberated gas viscosity



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Liberated gas viscosity

For 0 <= P <= 3000

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

where:

Pb	=	3745 psig	x	=	P/Pb
a	=	6.87702968055E-03	i	=	0.6
b	=	2.55636288830E-02	j	=	1.0
c	=	-1.642063330712E-02	k	=	3
d	=	6.96821378876E-03			

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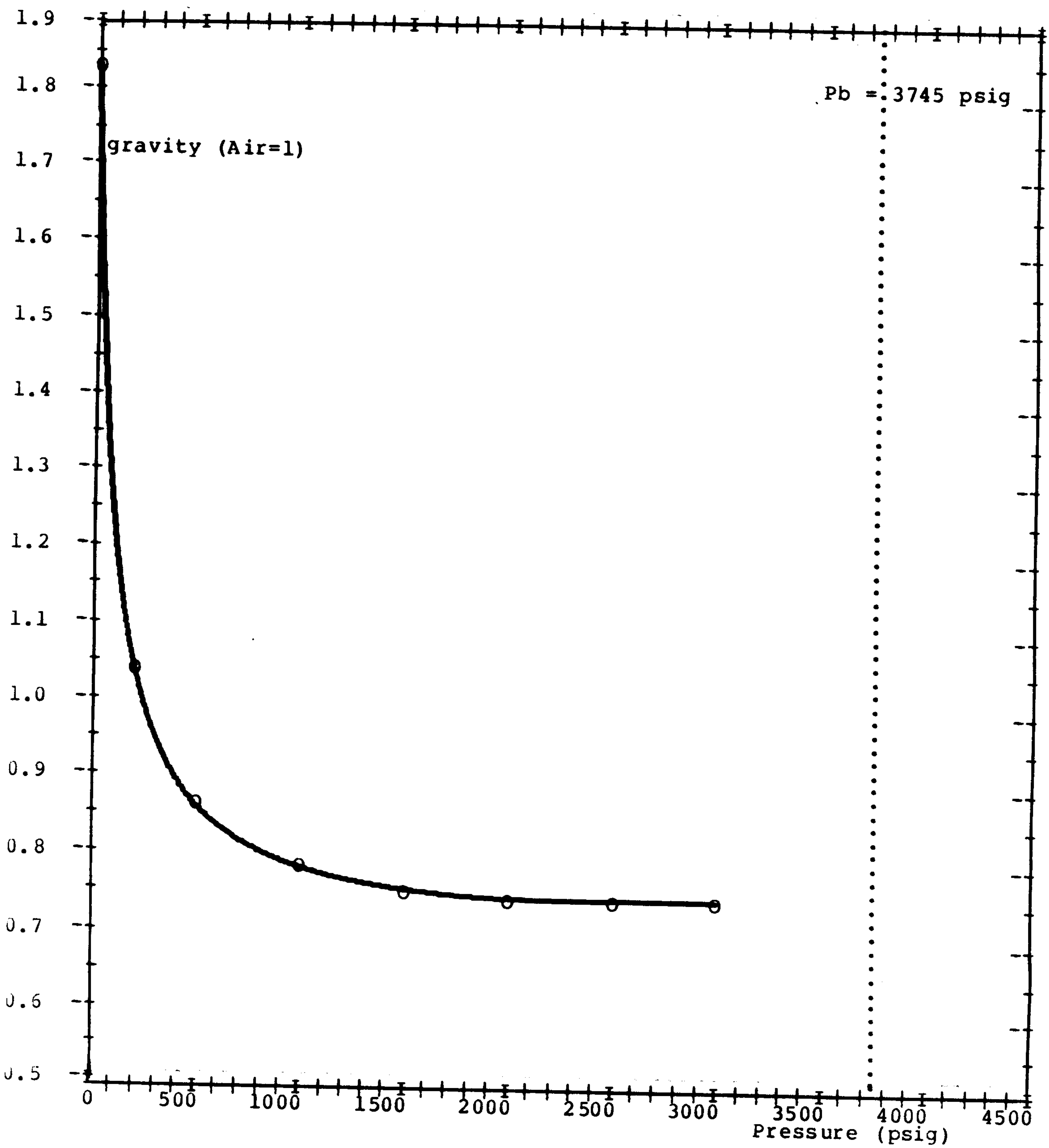
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Liberated gas gravity



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Liberated gas gravity

For 0 <= P <= 3000

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

where:

Pb =	3745 psig	x	= P/Pb
a =	-2.31154788141E 01		
b =	2.64680292944E 01		
c =	1.83960011042E 00		
d =	-3.43644219776E 01		
e =	3.98917611276E 01		

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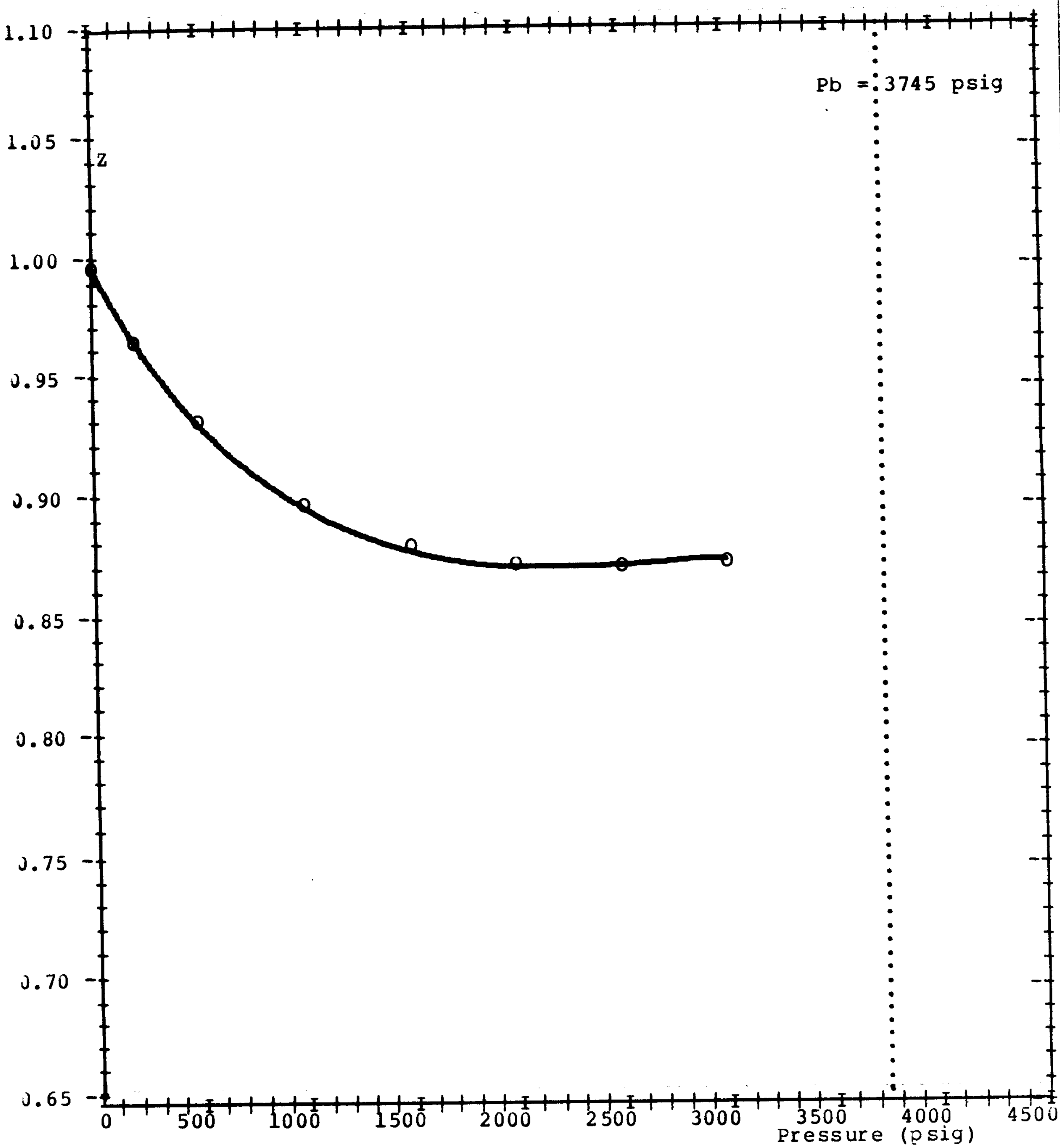
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Compressibility factor Z



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID AT 222 F

Compressibility factor Z

For 0 <= P <= 3000

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

where:

Pb =	3745 psig	x	= P/Pb
a =	3.50820197780E-01		
b =	1.13174330694E 00		
c =	1.00000000000E 00		
d =	1.78632992582E 00		

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WELL : MANTA#1 ZONE 3

TABLE 9

SEPARATION TEST OF RESERVOIR FLUID

Separator		Gas-oil ratio (1) (Std cu ft/std bbl)			Oil volume factor(2) (bbl/Std bbl)	Sep. liq. density (g/cm3)	Shrinkage factor(3) (Std bbl/bbl)	sto gravity (60/60 F)
Pres. (psig)	Temp. (F)	Sep.	Tank	Total				
0	70	-	1342	1342	1.840	-	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

TABLE 10

SEPARATION TEST OF RESERVOIR FLUID

Molecular composition of liberated gases (mole percent)

Pressure (psig)	0
Temperature (F)	125
Nitrogen	0.00
Carbon dioxide	2.80
Hydrocarbons:	
Methane	63.55
Ethane	12.56
Propane	10.20
I - Butane	2.11
N - Butane	4.07
I - Pentane	1.45
N - Pentane	1.60
Hexanes	1.02
Heptanes plus	0.64
TOTAL	100.00
Molecular weight	27.032
Gravity (Air=1)	0.933
Molecular weight of heptanes plus	102.8

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WELL : MANTA#1 ZONE 3

TABLE 11

SEPARATION TESTS OF RESERVOIR FLUID

Separator		Gas oil ratio (1) (Std cu ft/bbl)						
Press. (psig)	Temp. (F)	Sep.	Tank	Total	Oil volume factor(2) (bbl/Std bbl)	Sep. liq. density (g/cm3)	Shrinkage factor(3) (Std bbl/bbl)	sto gravity (60/60 F)
500	125	950	239	1189	1.735	0.781	0.890	0.815
400	125	978	198	1176	1.724	0.782	0.906	0.814
300	125	1007	148	1155	1.714	0.784	0.924	0.813
200	125	1054	96	1150	1.716	0.789	0.944	0.813

(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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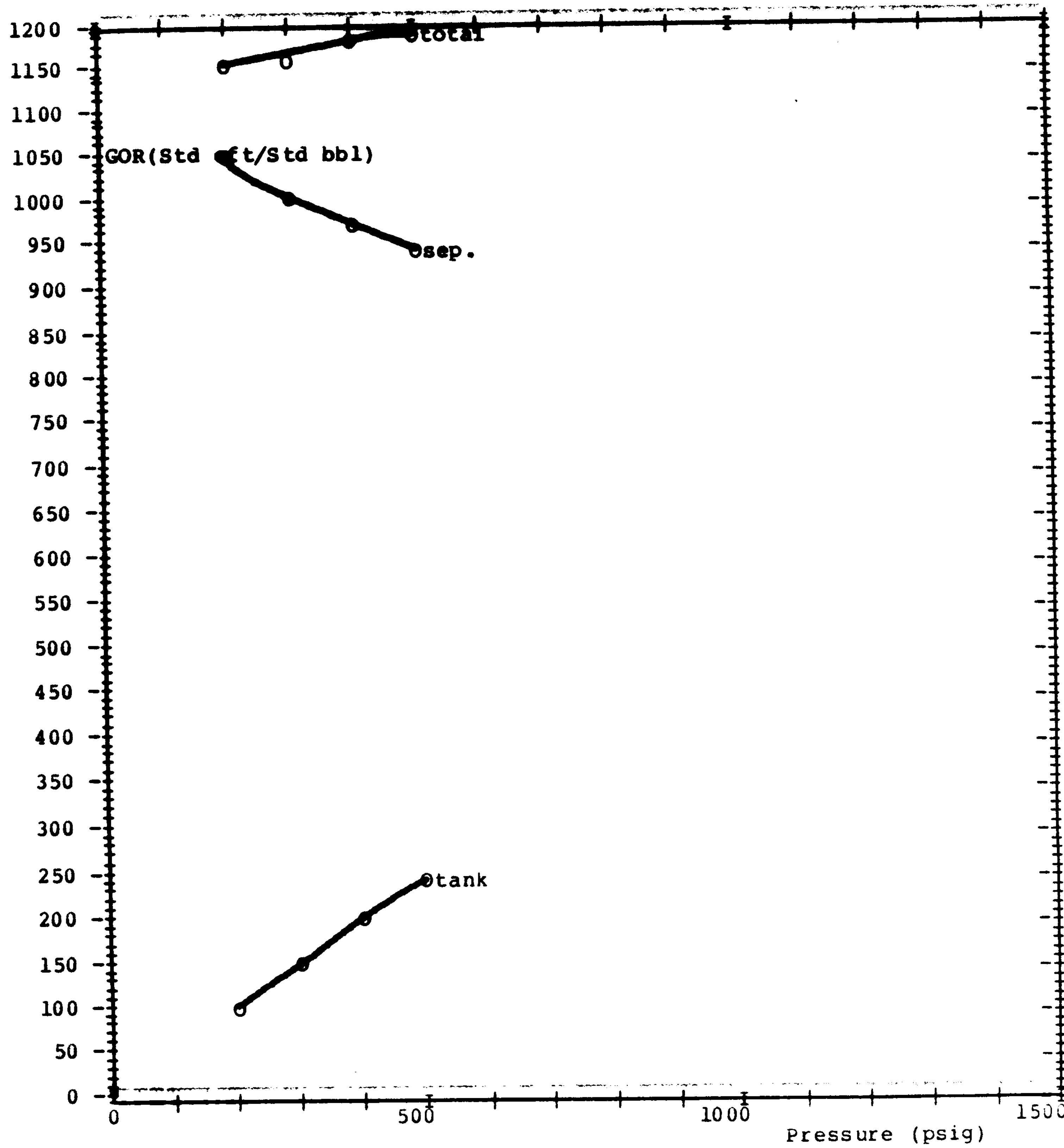
SEPARATION TESTS OF RESERVOIR FLUID

gas oil ratios

Separator temperature :125 F



Oil P.V.T. Software Version 2.1,00

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SEPARATION TESTS OF RESERVOIR FLUID

Separator temperature: 125 F

Separator gas oil ratio

For 200 <= P < = 500

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

where:

a = 1.52026274140E-03
b = -6.37160630977E 00
c = 1.08043215953E 03
d = -5.63155148283E-03

Tank gas oil ratio

For 200 <= P < = 500

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

where:

a = -9.07709654771E-04
b = 5.47429220628E-01
c = -9.78282661737E 00
d = -1.69062695669E-03

Total gas oil ratio

For 200 <= P < = 500

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

where:

a = 9.29364906858E-04
b = 7.02802753308E 00
c = 1.13282160051E 03
d = 6.20445410802E-03

FLOPETROL JOHNSTON

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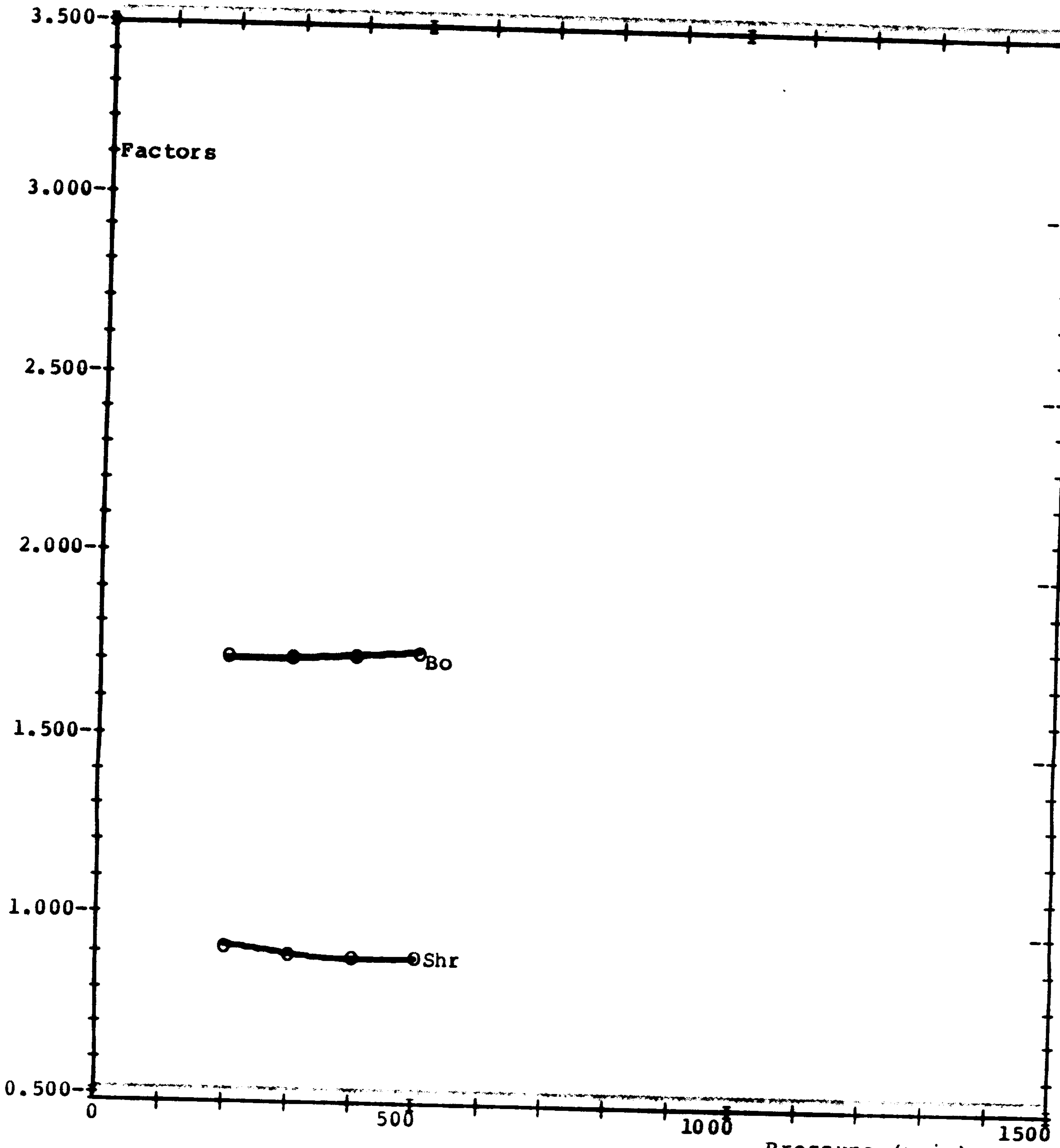
SEPARATION TESTS OF RESERVOIR FLUID

oil volume and shrinkage factors

Separator temperature :125 F



Oil P.V.T. Software Version 2.1,00

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SEPARATION TESTS OF RESERVOIR FLUID

Separator temperature: 125 F

Oil volume factor

For 200 <= P < = 500

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

where:

a = -8.51202376555E-07
b = -1.07659285321E-02
c = 1.66051007877E 00
d = -6.53501016962E-03

Shrinkage factor

For 200 <= P < = 500

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

where:

a = 1.00000001359E-07
b = -2.50000009001E-04
c = 9.89999999962E-01
d = -9.44000001981E-12

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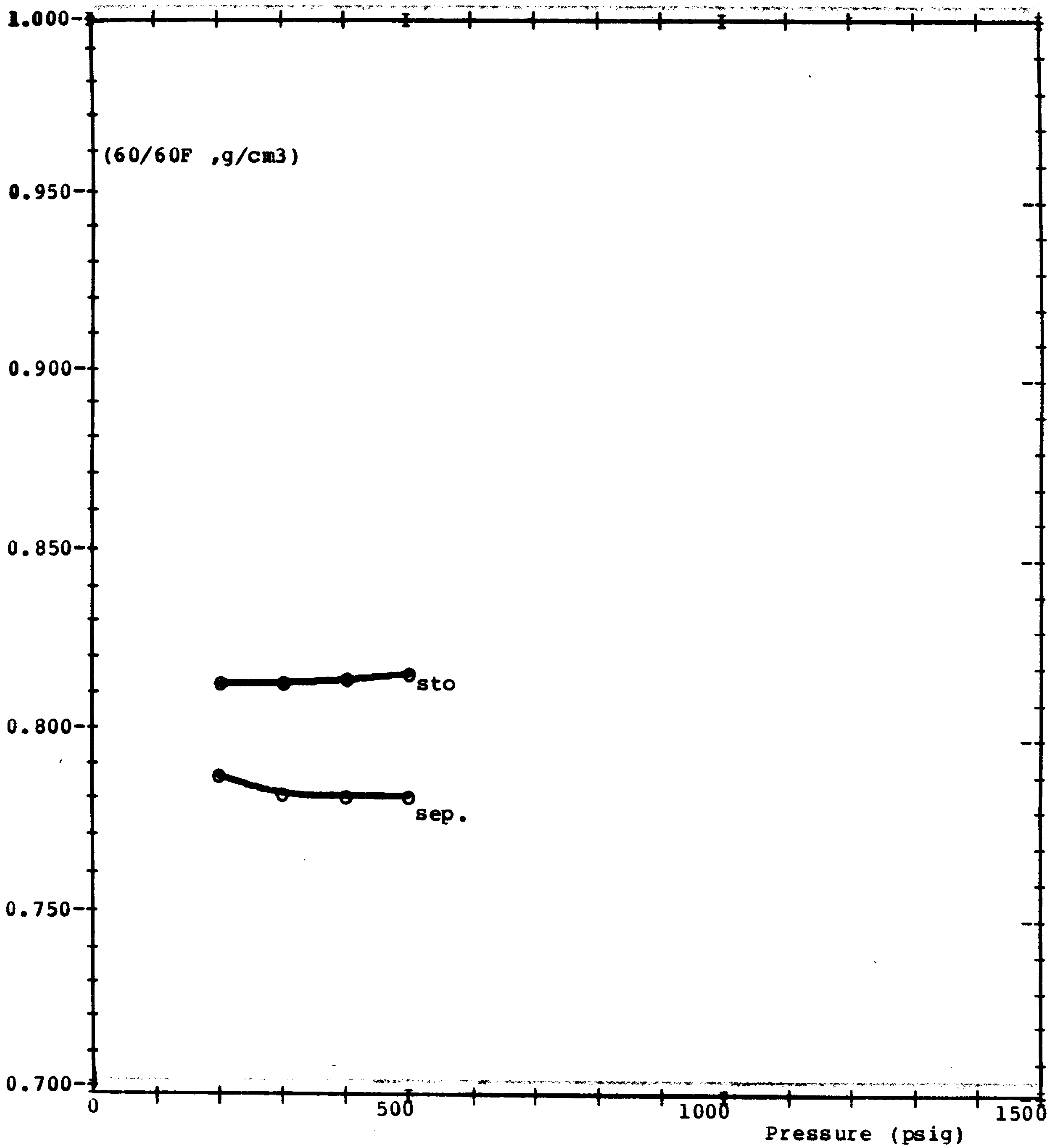
SEPARATION TESTS OF RESERVOIR FLUID

separator liquid density and stock tank oil gravity

Separator temperature :125 F



SEPARATION TESTS OF RESERVOIR FLUID

Separator temperature: 125 F

Stock tank oil gravity

For 200 <= P < = 500

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

where:

a = 1.86249999818E-07
b = 4.98399999580E-03
c = 8.24549999977E-01
d = 6.24999999465E-03

Separator oil density

For 200 <= P < = 500

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

where:

a = 2.27787782353E-07
b = 1.43065072972E-02
c = 8.68217184832E-01
d = 1.86913263282E-02

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TABLE 12

SEPARATION TESTS OF RESERVOIR FLUID

Molecular composition of separator gases (mole percent)

Pressure (psig)	500	400	300	200
Temperature (F)	125	125	125	125
Nitrogen	0.00	0.00	0.00	0.00
Carbon dioxide	3.19	3.20	3.20	3.10
Hydrocarbons:				
Methane	76.39	75.05	73.56	71.26
Ethane	11.45	11.85	12.22	12.67
Propane	6.11	6.66	7.24	8.26
I - Butane	0.85	0.95	1.10	1.31
N - Butane	1.31	1.48	1.72	2.14
I - Pentane	0.28	0.33	0.39	0.50
N - Pentane	0.27	0.31	0.36	0.47
Hexanes	0.10	0.11	0.13	0.17
Heptanes plus	0.05	0.06	0.08	0.12
TOTAL	100.00	100.00	100.00	100.00
Molecular weight	21.586	21.979	22.452	23.225
Gravity (Air=1)	0.745	0.758	0.775	0.801
Molecular weight of heptanes plus	103.0	102.5	103.7	103.7

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TABLE 13

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	2.76	2.79	2.53
Hydrocarbons:				
Methane	38.11	41.55	44.19	46.12
Ethane	18.19	17.71	16.86	15.77
Propane	21.86	20.82	19.94	19.15
I - Butane	4.81	4.45	4.31	4.28
N - Butane	8.82	7.85	7.63	7.69
I - Pentane	2.38	2.21	1.92	1.97
N - Pentane	2.24	1.90	1.72	1.79
Hexanes	0.81	0.62	0.53	0.56
Heptanes plus	0.19	0.13	0.11	0.14
TOTAL	100.00	100.00	100.00	100.00
Molecular weight	34.512	33.169	32.316	31.995
Gravity (Air=1)	1.191	1.145	1.115	1.104
Molecular weight of heptanes plus	102.4	102.4	102.8	102.2

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FLOPETROL JOHNSTON

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FLOPETROL JOHNSTON Schlumberger

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WELL : MANTA #1 ZONE 3

TABLE 14

VISCOSITY OF RESERVOIR FLUID

Pressure (psig)	Viscosity (centipoises)
5000	0.270
4500	0.265
4000	0.262
Pb = 3745	0.260
3000	0.290
2500	0.310
2000	0.340
1500	0.370
1000	0.410
500	0.460
200	0.510
0	0.810

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FLOPETROL JOHNSTON

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WELL : MANTA#1 ZONE 3

SAMPLE RECEPTION

	SCHL No 54 transfered in bottle 80291/375	SCHL No 54 chamber 783 transfered in bottle 1116/23
Opening pressure-psig	1815	1380
at temperature -F	72	72
Water content-cm3	NIL	NIL

FLASH FROM 5000 psig TO STOCK TANK CONDITIONS

GOR-scf/bbl	1327	1336
Oil gravity(60/60 F)	0.8216	0.8211
Pb at 222 F	3717	3745

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FLASH OF BOTTOM HOLE SAMPLE TO STOCK TANK CONDITIONS

Molecular composition of liberated gases-mole percent

	1116/23	80291/375
Nitrogen	0.00	0.00
Carbon dioxide	2.80	2.78
HYDROCARBONS		
Methane	63.55	63.99
Ethane	12.56	12.65
Propane	10.20	10.29
I-Butane	2.11	2.15
N-Butane	4.07	4.13
I-Pentane	1.45	1.40
N-Pentane	1.60	1.48
Hexanes	1.02	0.80
Heptanes	0.52	0.27
Octanes	0.12	0.06
Heptanes plus	0.64	0.33
TOTAL	100.00	100.00
Molecular weight	27.032	26.587
Gravity(Air=1)	0.933	0.9

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TABLE 15

MOLECULAR COMPOSITION OF STOCK TANK OIL

Components	Mole percent
Nitrogen	0.00
Carbon dioxide	0.00
Hydrocarbons:	
Methane	0.00
Ethane	0.01
Propane	0.30
I - Butane	0.20
N - Butane	0.66
I - Pentane	0.45
N - Pentane	0.56
Hexanes	2.04
Heptanes plus	95.78
TOTAL	100.00

Molecular weight of stock tank liquid : 218
Molecular weight of Heptanes plus in sto :225
Gravity of Heptanes plus in sto : 0.825 (60/60 F)

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TABLE 16

MOLECULAR COMPOSITION OF RESERVOIR FLUID

Components	Mole percent
Nitrogen	0.00
Carbon dioxide	2.04
Hydrocarbons:	
Methane	46.29
Ethane	9.15
Propane	7.51
I - Butane	1.59
N - Butane	3.14
I - Pentane	1.18
N - Pentane	1.32
Hexanes	1.30
Heptanes plus	26.48
TOTAL	100.00

Molecular weight of reservoir fluid : 79.0
Molecular weight of Heptanes plus in reservoir fluid : 222
Gravity of Heptanes plus in sto :0.825 (60/60 F)

This composition was calculated from separation at 0 psig and 70 F

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)
$c = -\frac{1}{V} x \frac{dV}{dP}$	:	Compressibility factor of reservoir fluid
$\alpha = \frac{1}{V} x \frac{dV}{dT}$	:	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 fac
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	:	$\frac{\text{Oil volume at standard conditions}}{\text{Oil volume at separator conditions}}$
$Z = \frac{PV}{nRT}$	:	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 pres

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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