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CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS
August 29, 1958

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FILE 007

RESERVOIR FLUID DIVISION

The California Standard Company
Virden, Manitoba, Canada

Attention: Mr. J. G. Trowell

Subject: Reservoir Fluid Study
Calstan W. Routledge
Providence No. 1-20 Well
West Routledge Field
Manitoba, Canada
Our File Number: RFL 1136

Gentlemen:

Subsurface fluid samples were collected from the subject well on July 16, 1958 by a representative of Core Laboratories-Canada, Ltd. The results of fluid studies performed using these samples are transmitted to you in the following report.

During a constant composition expansion, the saturation pressure of the fluid was measured to be 154 psig at the reservoir temperature of 89° F. The reservoir pressure measured immediately prior to sampling was 974 psig at a depth of 2030 feet KB. Comparison of these two pressure values demands the conclusion that the reservoir exists in a highly undersaturated condition. The undersaturated condition is also indicated by the static pressure traverse which indicates the fluid level in the tubing to be at the surface.

Differential pressure depletion at the reservoir temperature of 89° F. evolved 84 standard cubic feet of gas per barrel of residual oil. The accompanying formation volume factor was measured to be 1.067 barrels of saturated fluid per barrel of residual oil. Under similar depletion conditions, the viscosity of the liquid phase was found to vary from a minimum of 3.00 centipoises at saturation pressure to a maximum of 5.23 centipoises at atmospheric pressure.

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Calstan W. Routledge Providence No. 1-20 Well

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To determine the effects of changes in surface separation pressure upon the produced fluid, flash vaporization tests were performed at four operating pressures and atmospheric temperature. While the fluid is relatively insensitive to changes in separation pressure, slight benefit may be achieved by operation of field separators in a range of 20 to 30 psig.

It was a pleasure to perform this study for you. Should any questions arise, please do not hesitate to contact us.

Very truly yours,

Core Laboratories, Inc.
Reservoir Fluid Division

A handwritten signature in dark ink, appearing to read 'P. L. Moses', with a stylized flourish at the end.

P. L. Moses,
Operations Supervisor

PLM:lm
10 cc. - Addressee

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Page 1 of 10File RFL 1136Company The California Standard Company Date Sampled July 16, 1958Well Providence No. 1-20 County _____Field West Routledge State Manitoba, Canada**FORMATION CHARACTERISTICS**

Formation Name	<u>Mississippian</u>
Date First Well Completed	<u>December 31</u> , 19 <u>57</u>
Original Reservoir Pressure	<u>974</u> PSI @ <u>2100</u> ft.
Original Produced Gas-Oil Ratio	<u>90</u> cu. ft./bbl.
Production Rate	<u>240</u> bbl./d.
Separator Pressure and Temperature	_____ PSI, _____ ° F.
Oil Gravity at 60° F.	<u>32</u> ° API
Datum	<u>600</u> ft. subsea
Original Gas Cap	<u>None</u>

WELL CHARACTERISTICS

Elevation	<u>1433 Feet KB</u>
Total Depth	<u>2156</u> ft.
Completion Depth	<u>2054.5-2056.5, 2059.5-2064.5</u> ft.
Tubing Size and Depth	<u>2</u> in. to <u>2069</u> ft.
Productivity Index	_____ bbl./d./PSI @ _____ bbl./d.
Last Reservoir Pressure	<u>974</u> PSI @ <u>2030 KB</u> ft.
Date	<u>July 16</u> , 19 <u>58</u>
Reservoir Temperature	<u>89</u> ° F. @ <u>2030 KB</u> ft.
Status of Well	<u>Shut-In 18 Hours</u>
Pressure Gauge	<u>Amerada (CLI)</u>
Normal Production Rate	<u>84</u> bbl./d.
Gas-Oil Ratio	<u>90</u> cu. ft./bbl.
Separator Pressure and Temperature	_____ PSI, _____ ° F.
Base Pressure	_____ PSI Abs.
Well Making Water	<u>0.2</u> % Cut

SAMPLING CONDITIONS

Sampled at	<u>1950 Feet KB</u>
Status of Well	<u>Shut-In 18 Hours</u>
Gas-Oil Ratio	_____ cu. ft./bbl.
Separator Pressure and Temperature	_____ PSI, _____ ° F.
Tubing Pressure	<u>238</u> PSI
Casing Pressure	_____ PSI
Core Laboratories Engineer	<u>AK</u>
Type Sampler	<u>Perco</u>

REMARKS:

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VOLUMETRIC DATA OF Reservoir Fluid SAMPLE

1. Saturation pressure (bubble-point pressure) 154 PSI @ 89 ° F.
2. Thermal expansion of saturated oil @ 5000 PSI — $\frac{V @ 89 \text{ } ^\circ\text{F}}{V @ 75 \text{ } ^\circ\text{F.}}$ — 1.00634
3. Compressibility of saturated oil @ reservoir temperature: Vol./Vol./PSI:
 - From 5000 PSI to 3000 PSI — 4.76×10^{-6}
 - From 3000 PSI to 1000 PSI — 5.53×10^{-6}
 - From 1000 PSI to 154 PSI — 6.51×10^{-6}
4. Specific volume at saturation pressure: cu. ft./# 0.01948 @ 89 ° F.

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Reservoir Fluid **SAMPLE TABULAR DATA**

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATION ● 89 ° F., RELATIVE VOLUME OF OIL AND GAS, V/V _{SAT.}	VISCOSITY OF OIL ● 89 ° F., CENTIPOISES	DIFFERENTIAL LIBERATION ● 89 ° F.		
			GAS/OIL RATIO LIBERATED PER BARREL OF RESIDUAL OIL	GAS/OIL RATIO IN SOLUTION PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME, V/V _R
5000	0.9741				1.039
4500	0.9762				1.042
4000	0.9785				1.044
3500	0.9809				1.047
3000	0.9834				1.049
2500	0.9860				1.052
2000	0.9885				1.055
1960		3.48			
1500	0.9913	3.35			1.058
1000	0.9944	3.21			1.061
800	0.9957				1.062
700	0.9963				1.063
600	0.9969				1.064
500	0.9975				1.064
490		3.07			
400	0.9983				1.065
300	0.9990				1.066
270		3.02			
200	0.9996				1.067
154	1.0000	3.00	0	84	1.067
147	1.0044				
140	1.0093				
138	1.0143				
134	1.0215				
130	1.0315	2.99			
120	1.0519				
115			2	82	1.066
108	1.0917				
90	1.1520				
78	1.2528		8	76	1.065
65	1.4039				
60		3.06			

v — Volume at given pressure

V_{SAT.} — Volume at saturation pressure at the specified temperature.V_R — Residual Oil Volume at 14.7 PSI absolute and 60° F.

These analyses, opinions or interpretations are based on observations and material supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but

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Reservoir Fluid **SAMPLE TABULAR DATA**

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATION ● 89 ° F. RELATIVE VOLUME OF OIL AND GAS. V/V_{SAT} .	VISCOSITY OF OIL ● 89 ° F. CENTIPOISES	DIFFERENTIAL LIBERATION ● 89 ° F.		
			GAS/OIL RATIO LIBERATED PER BARREL OF RESIDUAL OIL	GAS/OIL RATIO IN SOLUTION PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME V/V_R
55	1.6097				
45	1.9639				
44			18	66	1.063
30	2.9030	3.16	27	57	1.060
0		5.23	84	0	1.013
				@ 60° F. = 1.000	

Gravity of residual oil = 34.7° API @ 60° F.
 Specific gravity of liberated gas = 1.447

- V — Volume at given pressure
 V_{SAT} — Volume at saturation pressure at the specified temperature.
 V_R — Residual Oil Volume at 14.7 PSI absolute and 60° F.

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SEPARATOR TESTS OF Reservoir Fluids SAMPLE

SEPARATOR PRESSURE. PSI GAUGE	SEPARATOR TEMPERATURE. ° F.	SEPARATOR GAS/OIL RATIO <i>See Foot Note (1)</i>	STOCK TANK GAS/OIL RATIO <i>See Foot Note (1)</i>	STOCK TANK GRAVITY. ° API @ 60° F.	SHRINKAGE FACTOR. $V_R/V_{SAT.}$ <i>See Foot Note (2)</i>	FORMATION VOLUME FACTOR. $V_{SAT.}/V_R$ <i>See Foot Note (3)</i>	SPECIFIC GRAVITY OF FLASHED GAS
0	76	85		34.7	0.932	1.073	1.474
20	76	44	26	35.2	0.943	1.061	
40	76	26	46	35.1	0.942	1.062	
80	76	10	68	35.0	0.936	1.068	

- (1) Separator and stock tank Gas/Oil Ratio in cubic feet of gas @ 60° F. and 14.7 PSI absolute per barrel of stock tank oil @ 60° F.
- (2) Shrinkage Factor: $V_R/V_{SAT.}$ is barrels of stock tank oil @ 60° F. per barrel of saturated oil @ 154 PSI gauge and 89° F.
- (3) Formation Volume Factor: $V_{SAT.}/V_R$ is barrels of saturated oil @ 154 PSI gauge and 89° F. per barrel of stock tank oil @ 60° F.

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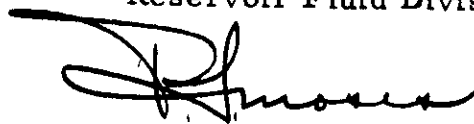
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 Field West Routledge State Manitoba, Canada

HYDROCARBON ANALYSIS OF Reservoir Fluid SAMPLE

COMPONENT	WEIGHT %	MOL %	DENSITY @ 60° F. GRAMS PER CUBIC CENTIMETER	° API @ 60° F.	MOLECULAR WEIGHT
Nitrogen	0.13	0.82			
Methane	0.07	0.79			
Ethane	0.81	4.73			
Propane	1.98	7.87			
Iso-butane	0.68	2.06			
N-butane	2.01	6.07			
Iso-pentane	0.73	1.79			
N-pentane	1.53	3.72			
Hexanes	3.02	6.15			
Heavier	<u>89.04</u>	<u>66.00</u>	0.8755	30.0	237
	100.00	100.00			

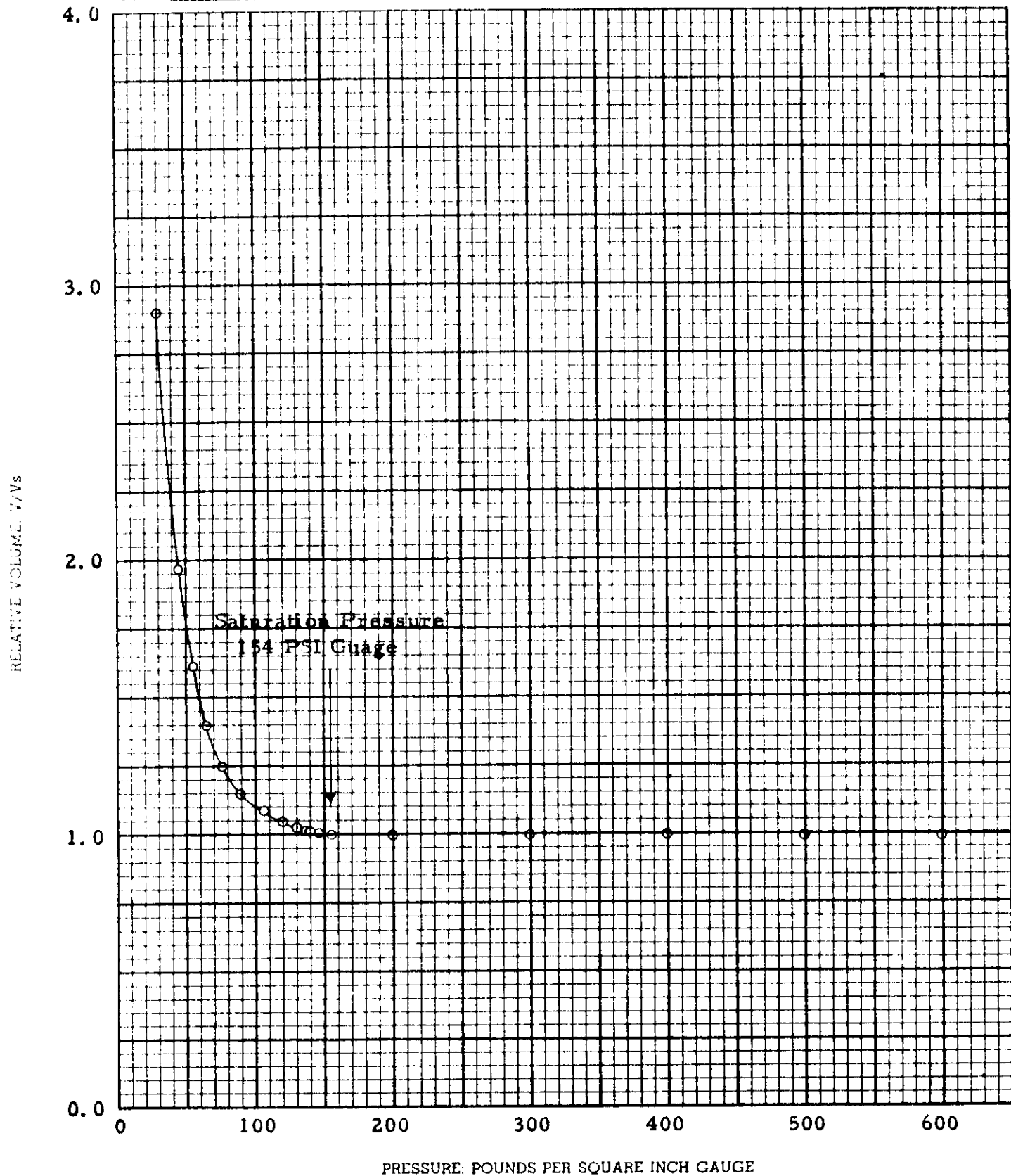
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P. L. Moses,
 Operations Supervisor

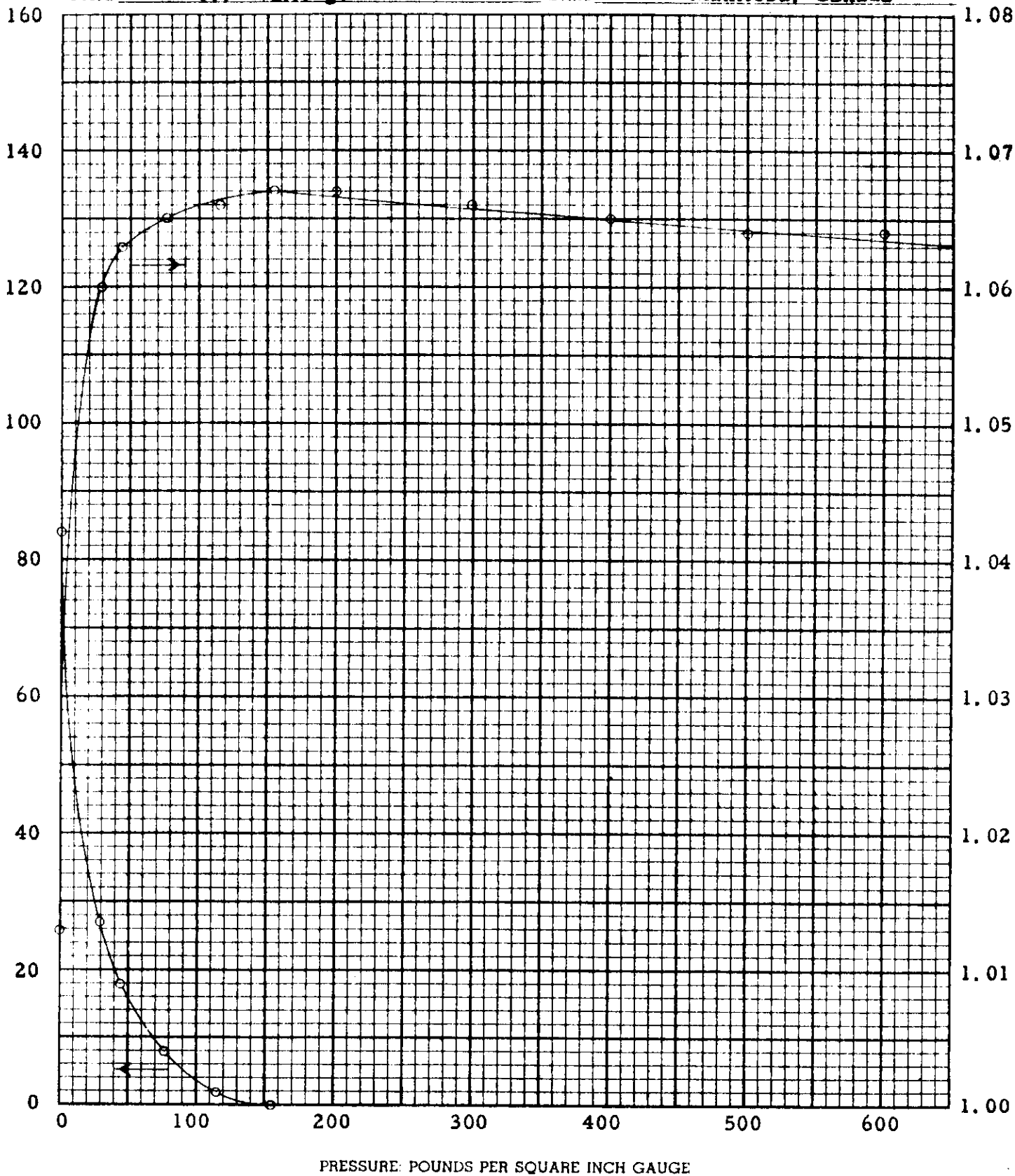
PRESSURE-VOLUME RELATIONS OF RESERVOIR FLUID

Company The California Standard Co. Formation Mississippian
Well Providence No. 1-20 County _____
Field West Routledge State Manitoba, Canada



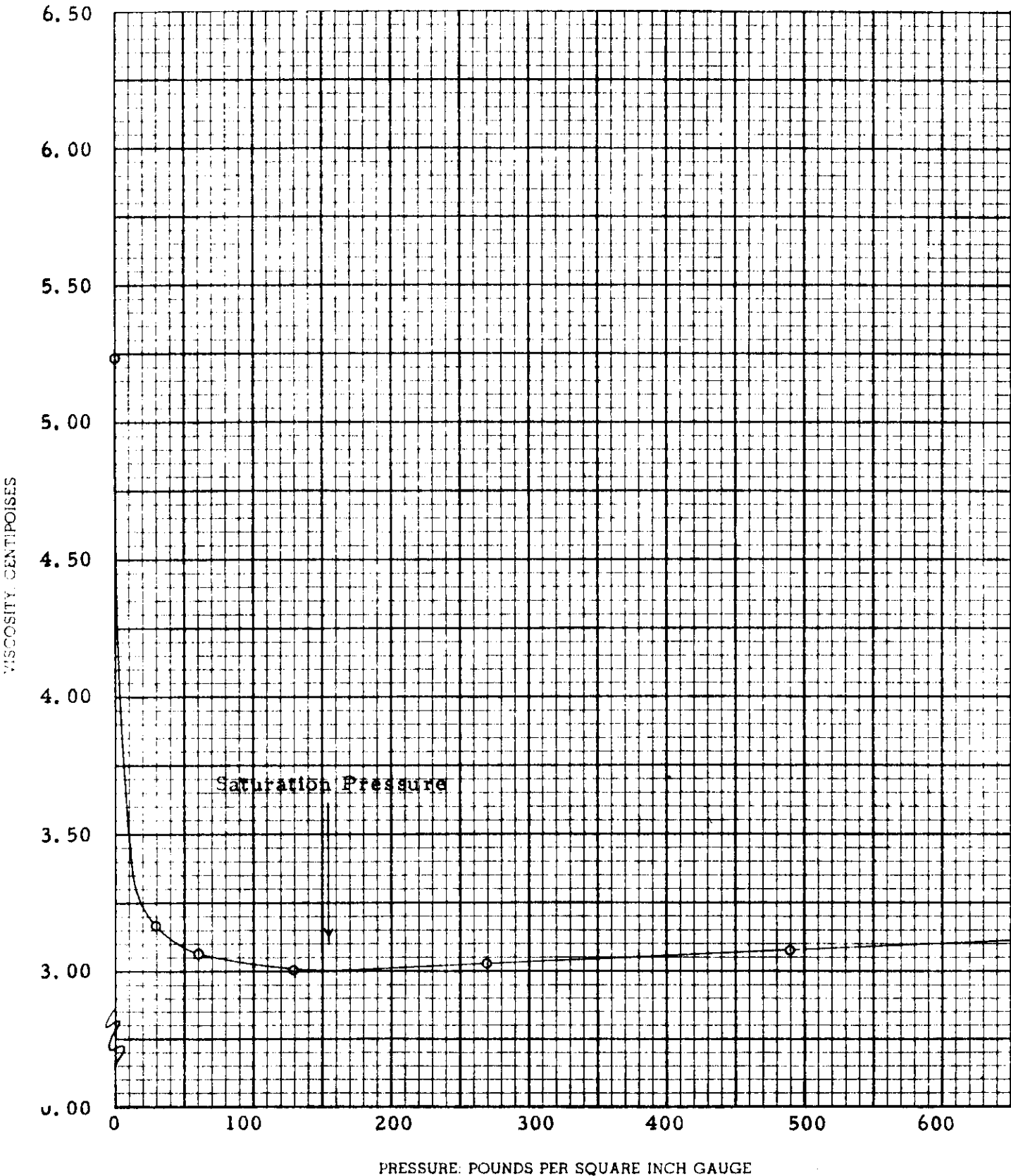
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID

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VISCOSITY OF RESERVOIR FLUID

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