FOSSIL ENERGY

DOE/BC/14936-10 (Appendix III)
(DE98000476)

GEOLOGIC AND ENGINEERING CHARACTERIZATION OF GERALDINE FORD FIELD, REEVES AND CULBERSON COUNTIES, TEXAS - SPECIAL CORE-ANALYSIS DATA

Topical Report - 1997

By
Shirley P. Dutton
Mohammad A. Malik
George B. Asquith
Mark D. Barton
Andrew G. Cole
John Gogas
Sigrid J. Clift
Jose I Guzman

April 1998

Performed Under Contract No. DE-FC22-95BC14936

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas

National Petroleum Technology Office
U. S. DEPARTMENT OF ENERGY
Tulsa, Oklahoma

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Prepared for
U.S. Department of Energy
Assistant Secretary for Fossil Energy

Jerry Casteel, Project Manager
National Petroleum Technology Office
P.O. Box 3628
Tulsa, OK 74101

Prepared by:
Bureau of Economic Geology
The University of Texas at Austin
University Station, Box X
Austin, TX 78713-7508

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ROUTINE CORE DATA

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2

INTERVAL CORED 2,573 - 2,606
DATE CORED January 16, 1958
CORING FLUID Salt-Base Mud

DIVISION Western
DISTRICT Monahans
COUNTY Culberson

DEPTH	CORE NO.	POROSITY, %	PERMEABILITY, MD	FORM. FACTOR	CORE WATER SATURATION, %	CORE OIL SATURATION, %
2,573	GF-2	10.2	0.0732*			
2,573	GF-3	9.84	0.110*			
2,575	GF-4	15.6	1.03			
2,575	GF-5	14.7	0.645*	38.1		
2,575	GF-6	15.0	1.13			
2,583	GF-8-A	26.2	112			
2,583	GF-8-B	26.7	116			
2,583	GF-9	25.9	101			
2,583	GF-10	25.2	95.4	12.7		
2,583	GF-11	25.8	105			
2,593	GF-12	23.8	44.5			
2,593	GF-13	24.5	42.7			
2,593	GF-14	22.3	24.0			
2,593	GF-15	21.8	24.4			
2,599	GF-16	26.0	65.3	13.9		
2,599	GF-17	23.4	43.8			
2,599	GF-18	25.1	51.4			
2,605	GF-20	13.5	1.81			
2,605	GF-21	9.07	1.06*	67.5		
2,605	GF-22	8.79	0.0587*			

*Gas permeability uncorrected for gas slippage.

A - Unmounted core for oil-water relative permeability.

B - Same core as "A" mounted in lucite for gas-oil relative permeability.

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BY W. D. McRae APPROVED W.M.Stevenson,Jr.
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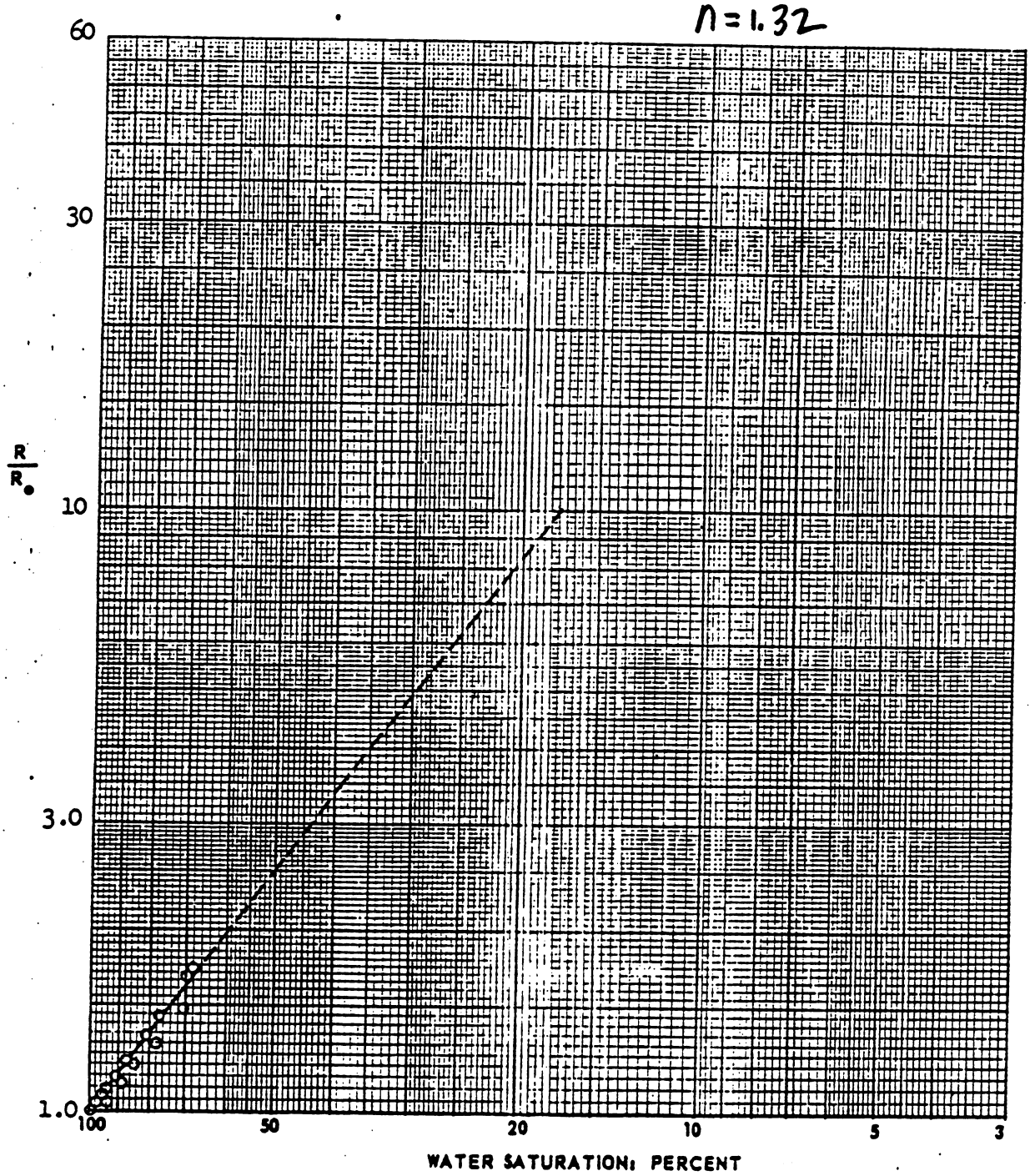
AVERAGE DESATURATION EXPONENT

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH 2,575-2,599 ft
DESATURATION EXPONENT 1.32

DATA FROM 3 CORES
NOTE: R/R_o = RATIO OF RESISTIVITY OF SAND SATURATED AT LEVEL UNDER CONSIDERATION TO RESISTIVITY OF SAND SATURATION 100%.



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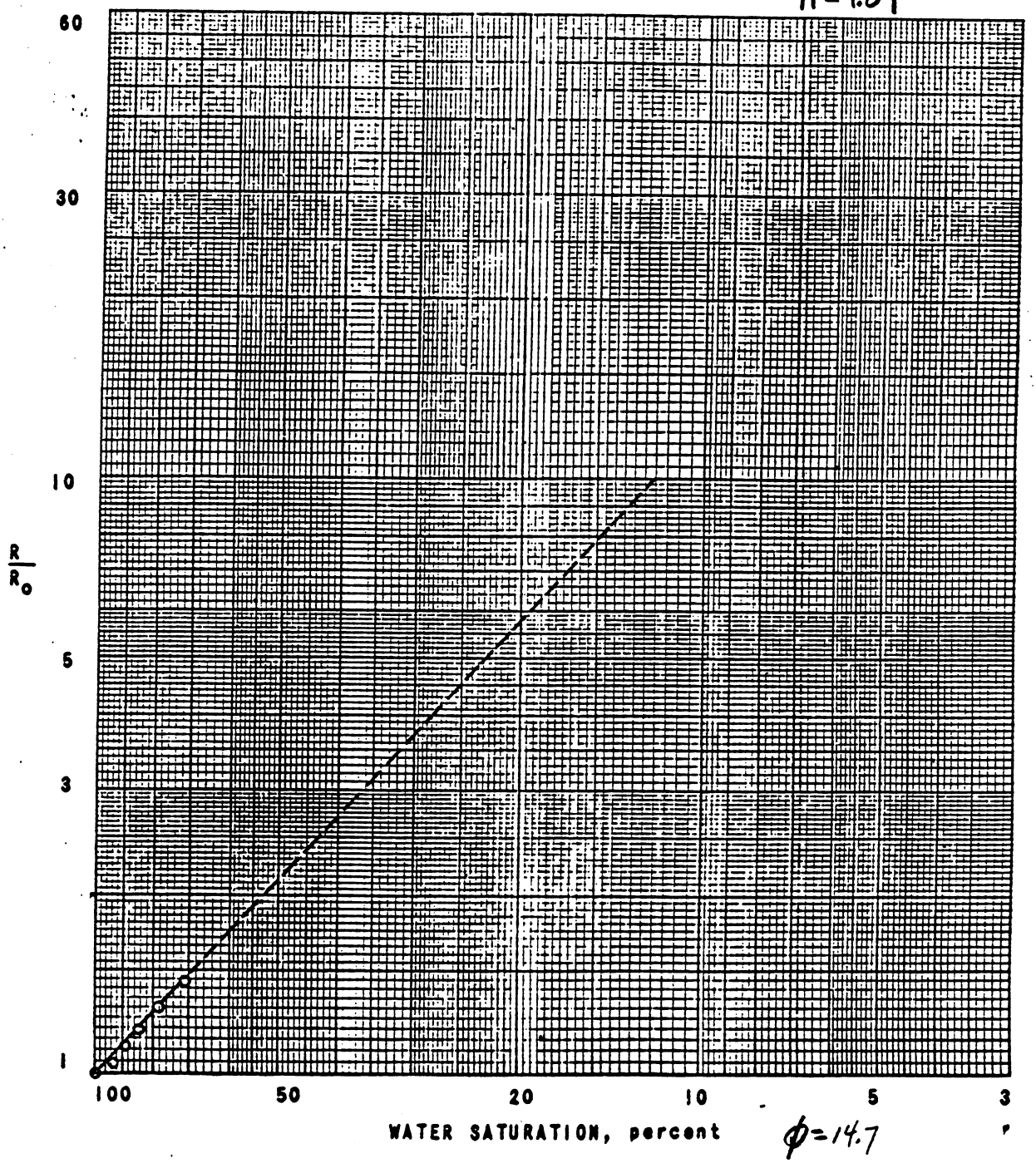
RESISTIVITY RATIO VS WATER SATURATION

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,575
POROSITY, % 14.7
PERMEABILITY, md 0.645

CORE GF-5
DESATURATION EXPONENT 1.09
NOTE: R/R_o = RATIO OF RESISTIVITY OF SAND SATURATED AT LEVEL UNDER CONSIDERATION TO RESISTIVITY OF SAND SATURATED 100%.

n = 1.09



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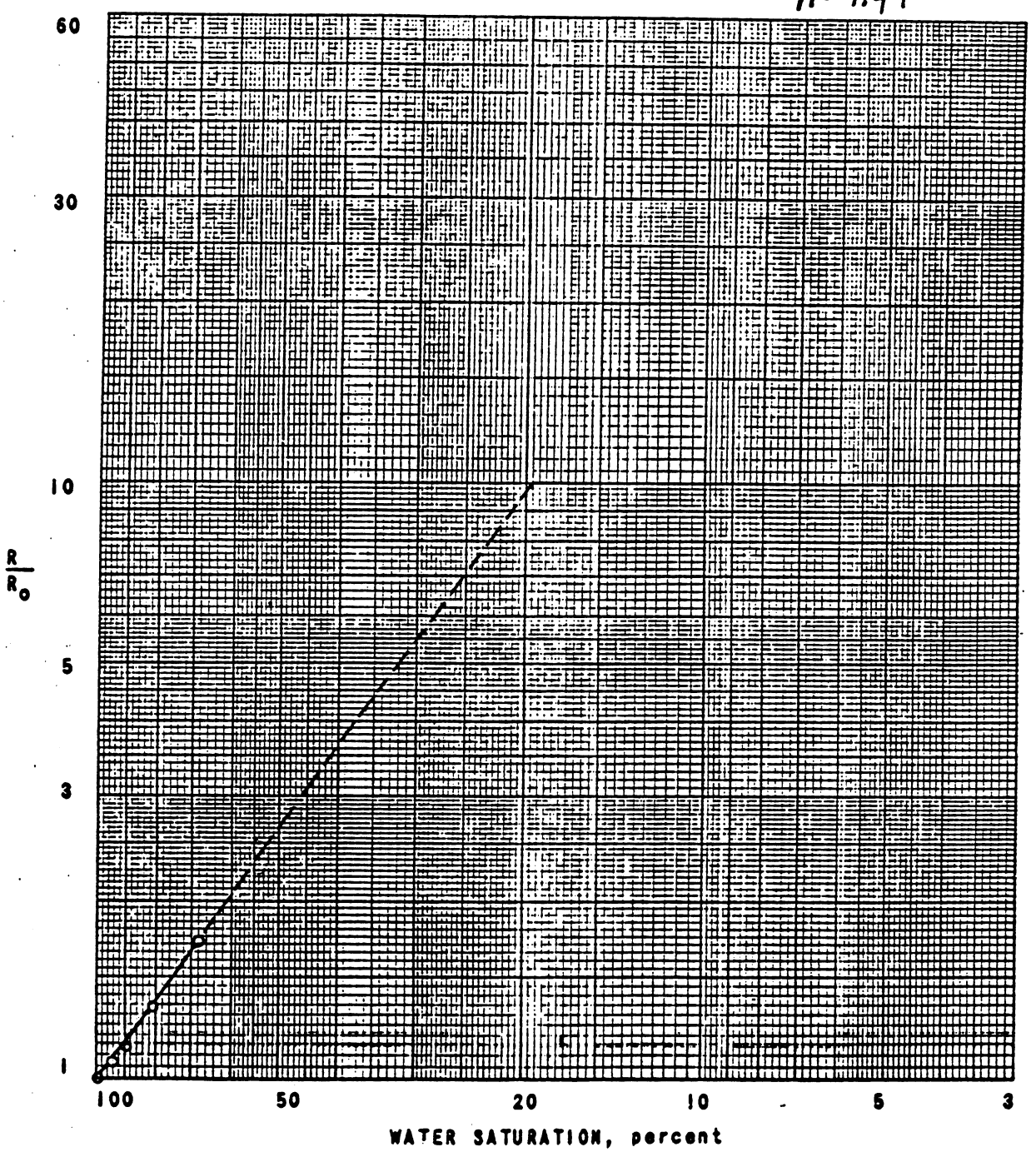
RESISTIVITY RATIO VS WATER SATURATION

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583
POROSITY, % 25.2
PERMEABILITY, md 95.4

CORE GF-10
DESATURATION EXPONENT 1.41 2
NOTE: R/R_o = RATIO OF RESISTIVITY OF SAND SATURATED AT LEVEL UNDER CONSIDERATION TO RESISTIVITY OF SAND SATURATED 100%.

n = 1.41



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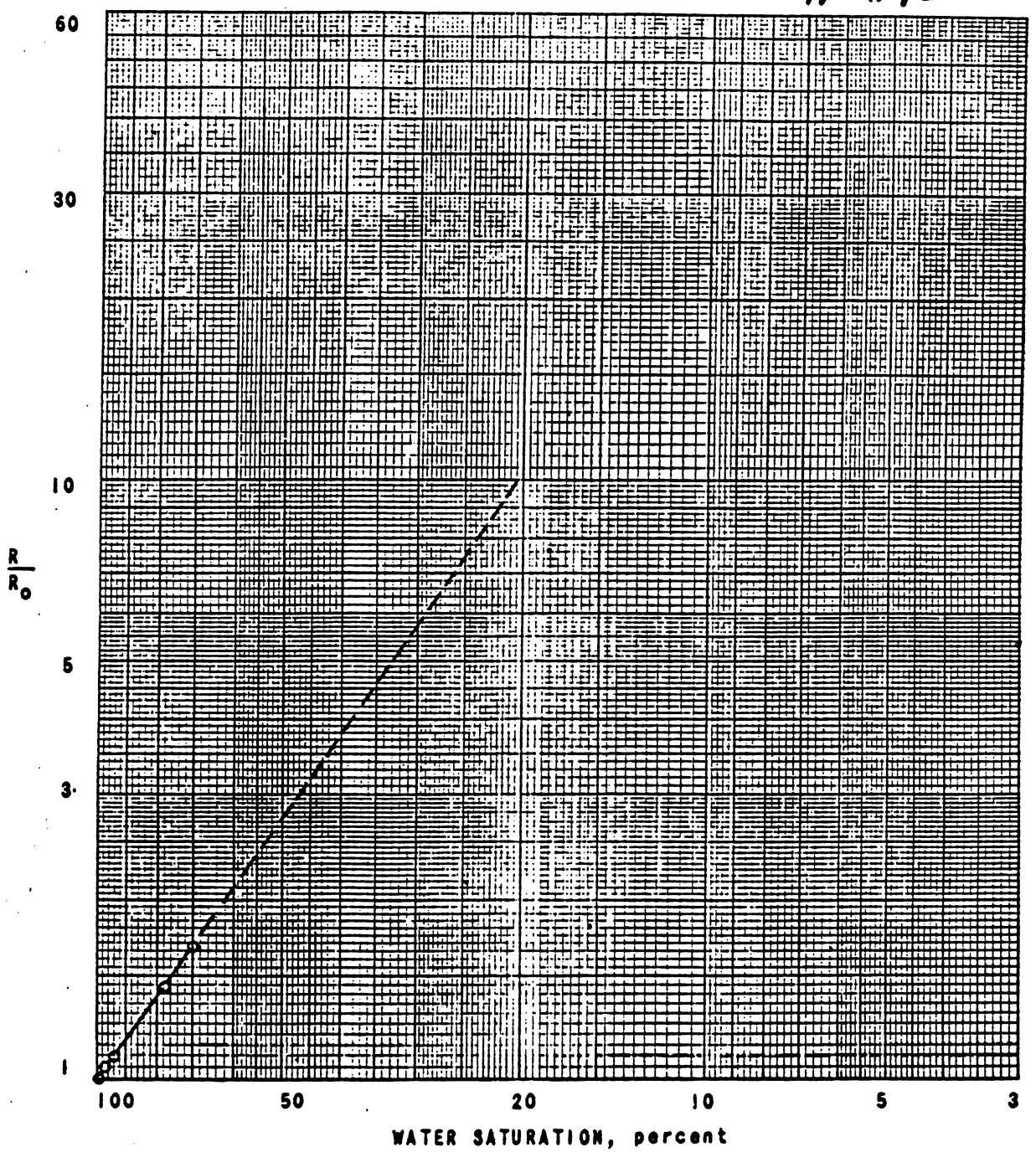
RESISTIVITY RATIO VS WATER SATURATION

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,599
POROSITY, % 26.0
PERMEABILITY, md 65.3

CORE GF-16
DESATURATION EXPONENT 1.46
NOTE: R/R_o = RATIO OF RESISTIVITY OF SAND SATURATED AT LEVEL UNDER CONSIDERATION TO RESISTIVITY OF SAND SATURATED 100%.

$n = 1.46$



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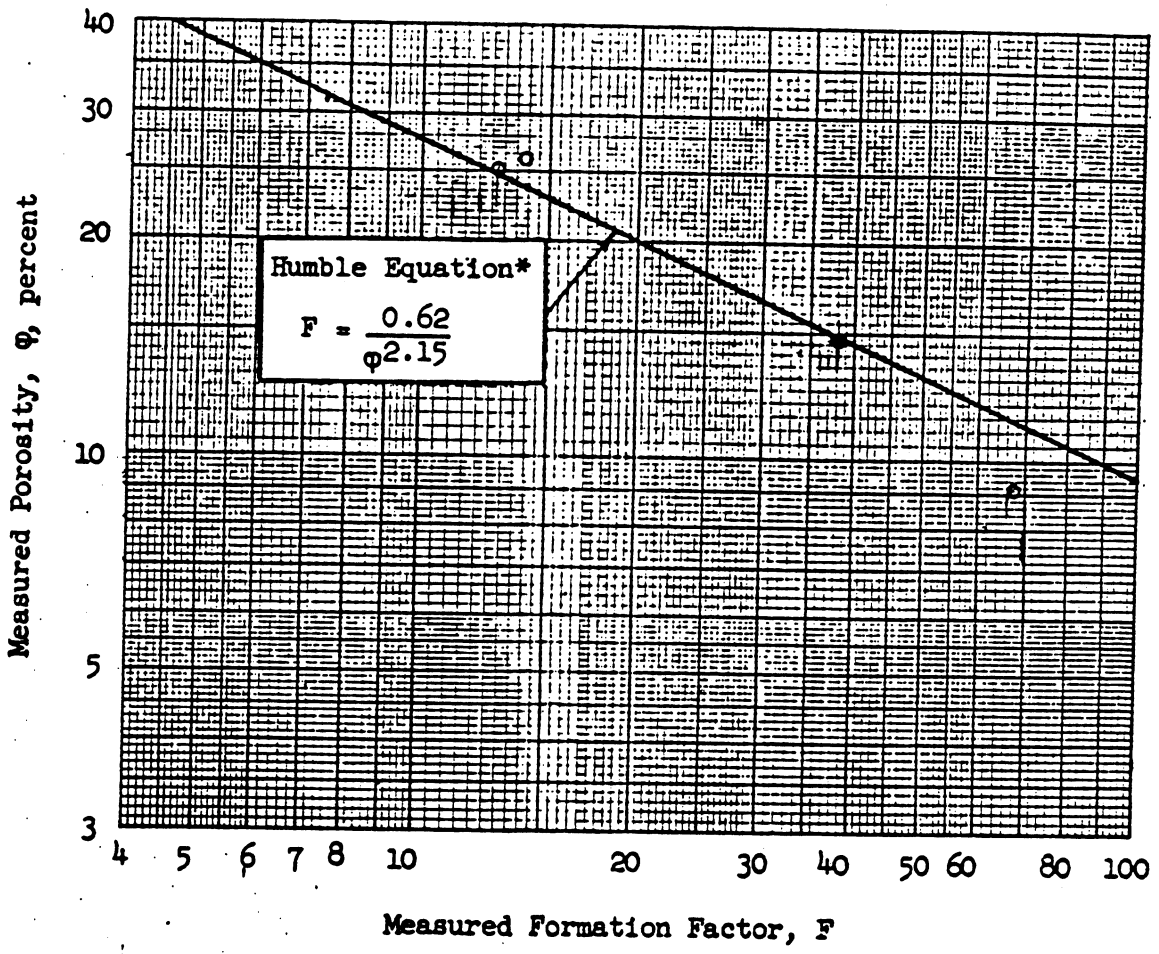
MEASURED POROSITY VERSUS MEASURED FORMATION FACTOR

TXL "L" 2 Geraldine Ford, Delaware Sand



*The Humble equation is presented for comparative purposes only and may not necessarily be the best equation for this reservoir.

Basic Core Data-Res. Eng. Laboratory Humble Oil & Refining Co.
By W. D. McRae Approved W. M. Stevenson, Jr. - 6-Core Report 232

IPF = 1580 + 18BW 8.8

GOR = 627 40° API

Drilling Mud Resistivity Measurements

Well: TXL "L" 2

Field: Geraldine Ford

Type Mud: Salt Base

Date Sample Obtained: Unknown

Mud Temperature = 74.6 F

Resistivity of Mud, R_m = 0.054 ohmmeter at 74.6 F

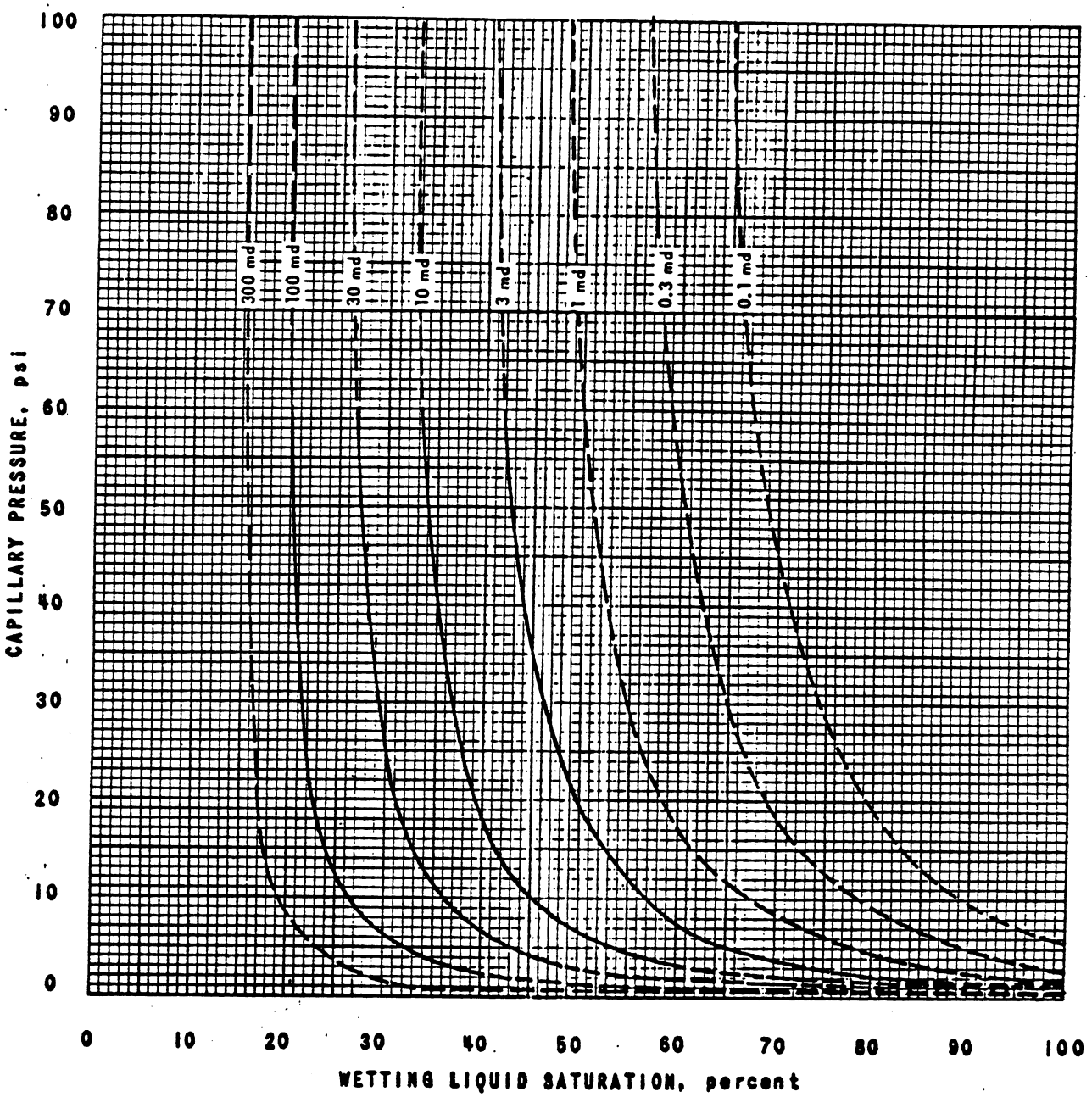
Resistivity of Mud Filtrate, R_{mf} = 0.0426 ohmmeter at 74.6 F

Resistivity of Mud Cake, R_{mc} = 0.102 ohmmeter at 74.6 F

LABORATORY FLUID DISTRIBUTION CURVES

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
CORED INTERVAL 2,573-2,606 ft

DATA FROM 6 CORES
PERMEABILITY RANGE, md. 1.13 TO 116
METHOD Centrifuge, Air Kerosene

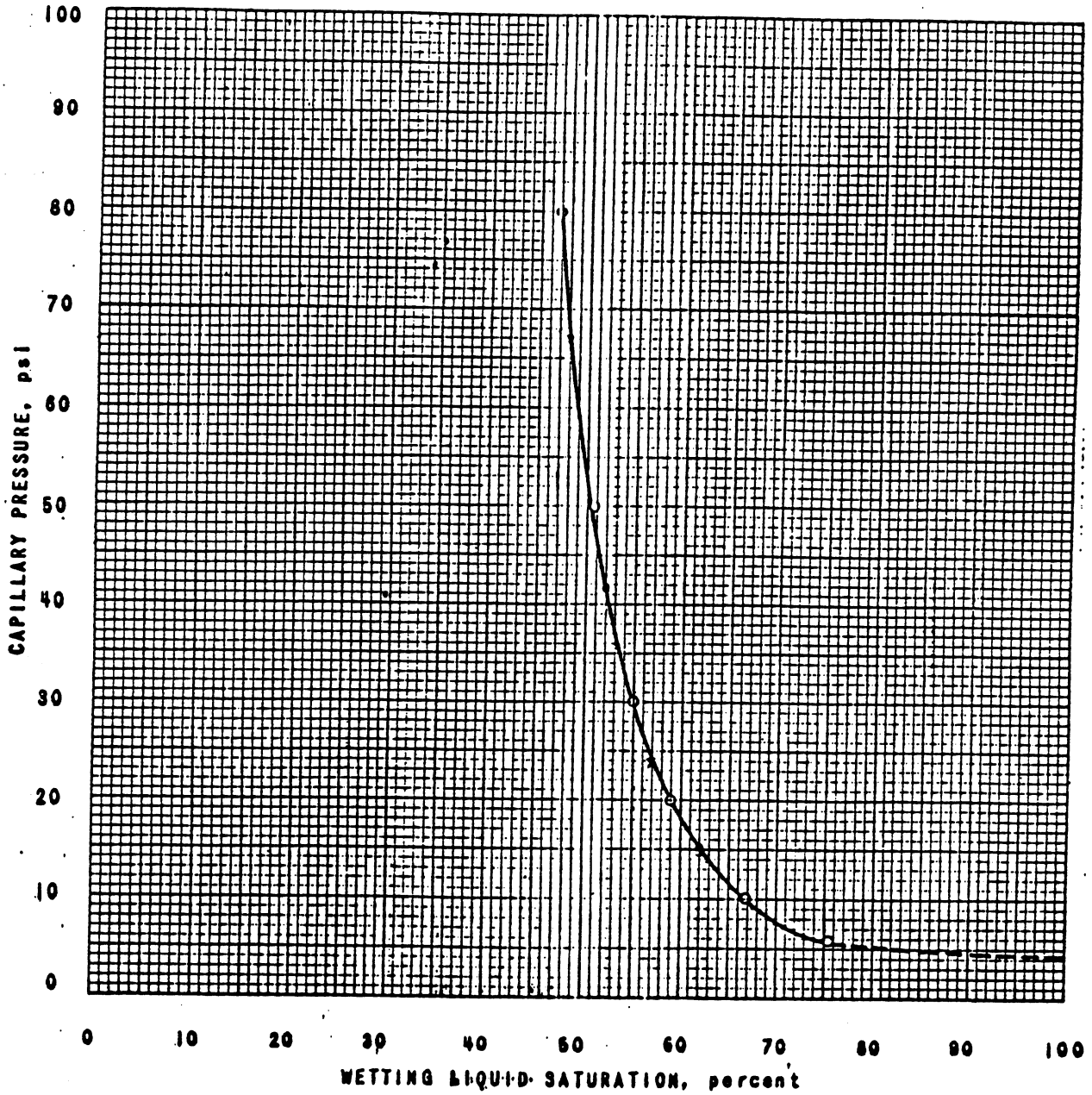


Note: Dashed lines indicate extrapolated data.

CAPILLARY PRESSURE CURVE

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,575

CORE GF-6
PERMEABILITY, md 1.13
POROSITY, % 15.0
METHOD Centrifuge, Air-Kerosene



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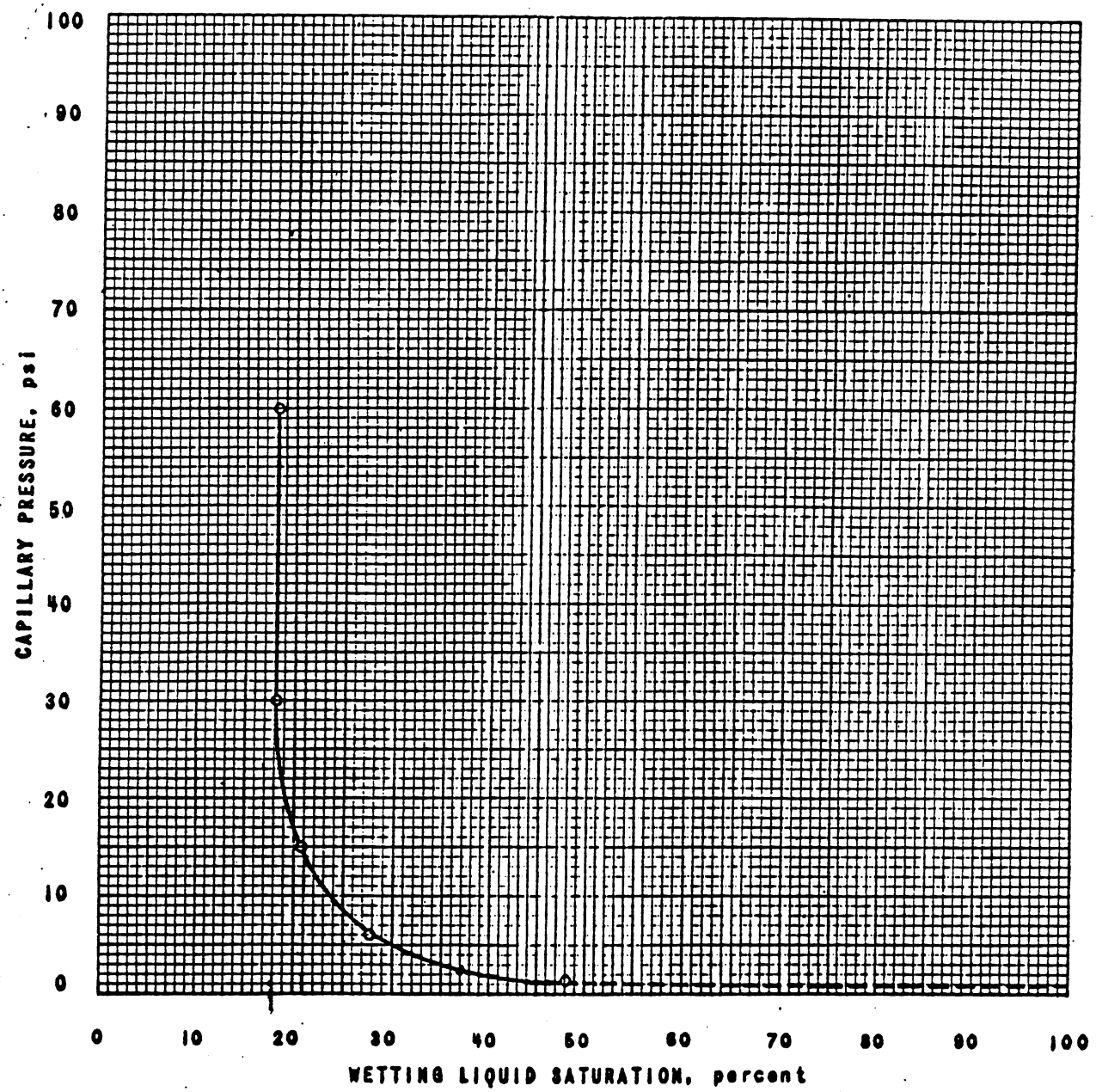
CAPILLARY PRESSURE CURVE

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583

CORE GF-8-B
PERMEABILITY, md 116
POROSITY, % 26.7
METHOD Centrifuge, Air-Kerosene



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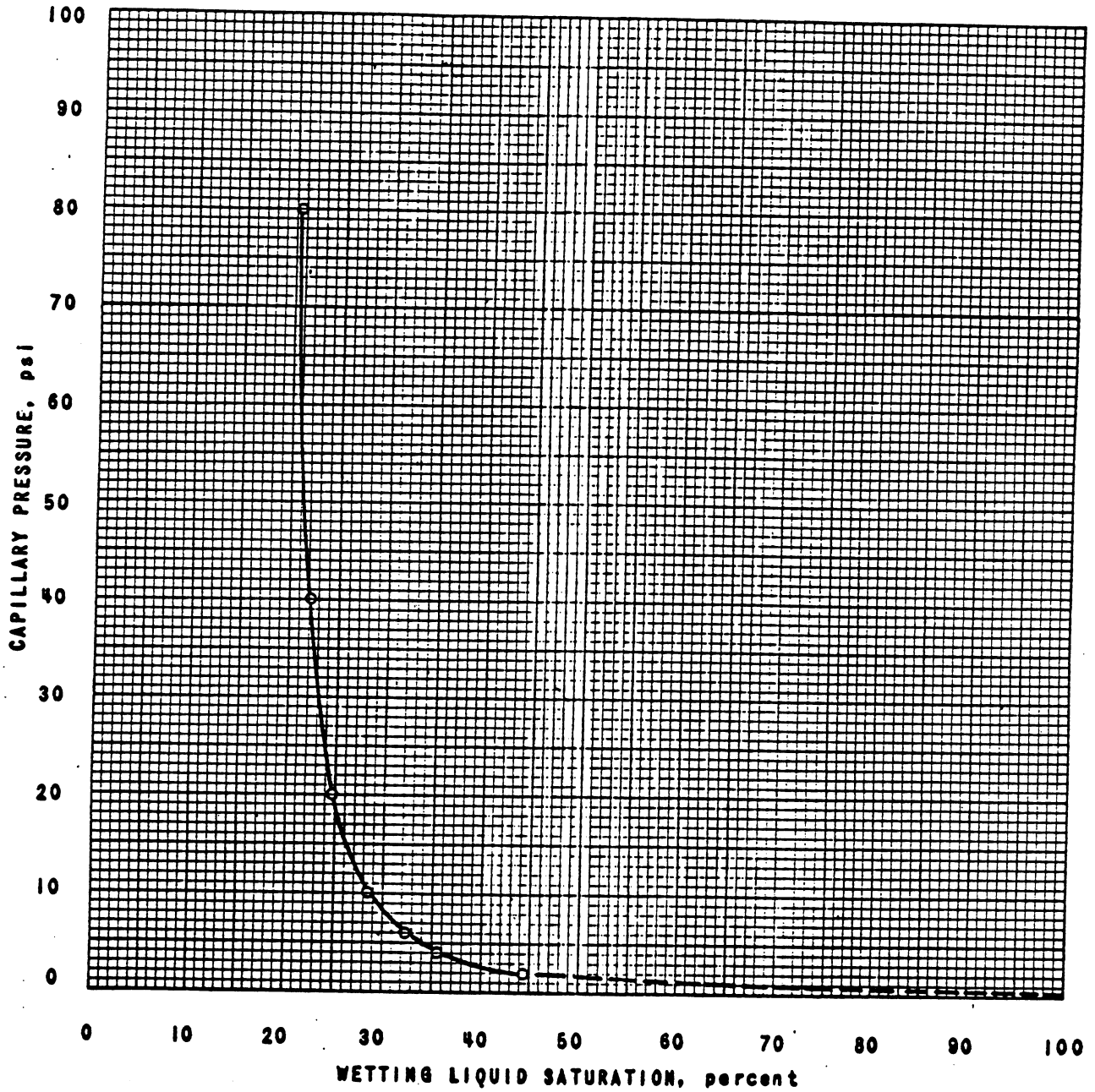
CAPILLARY PRESSURE CURVE

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583

CORE GF-10
PERMEABILITY, md 95.4
POROSITY, % 25.2
METHOD Centrifuge, Air-Kerosene



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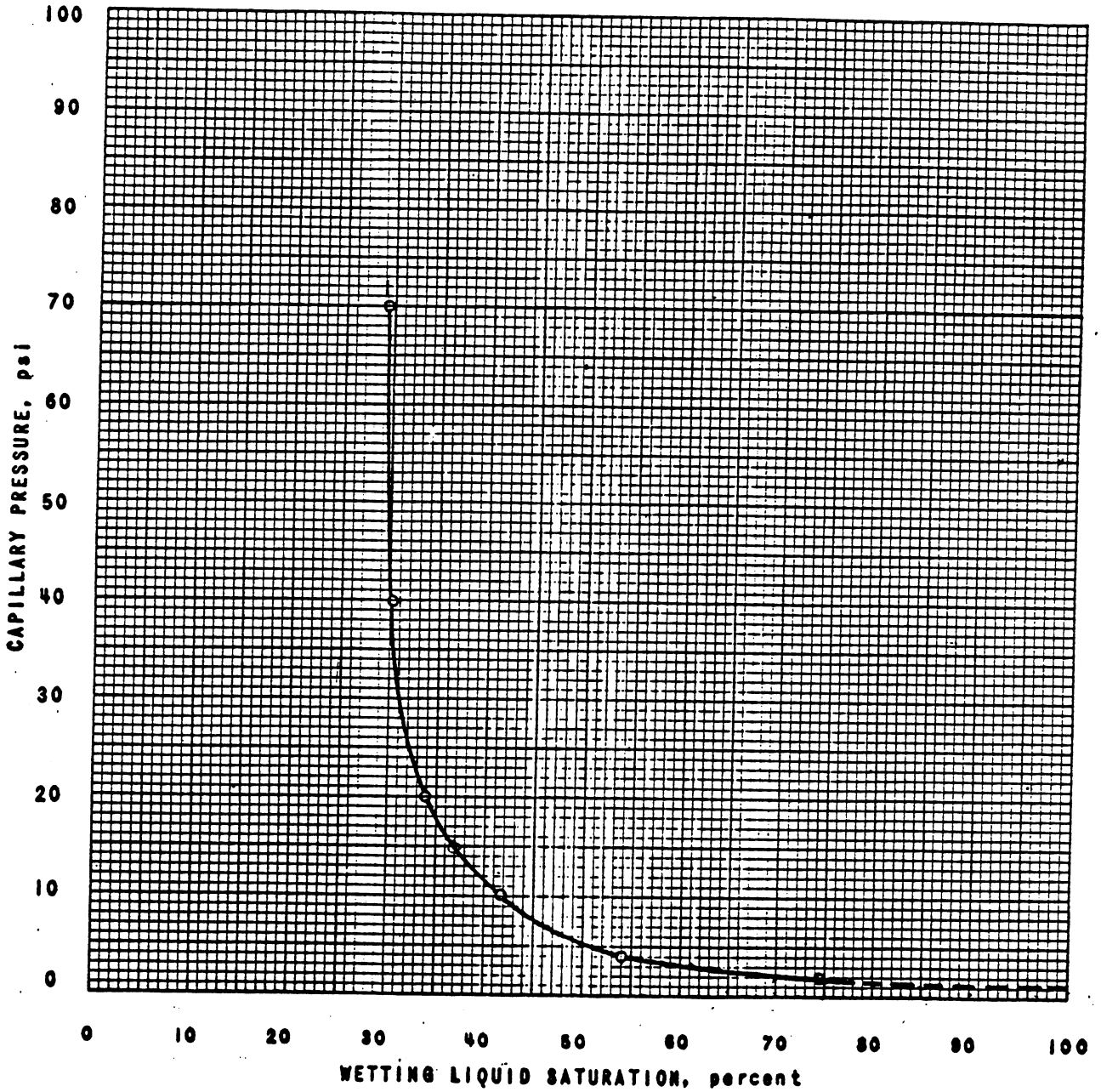
CAPILLARY PRESSURE CURVE

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2'
DEPTH, ft 2,593

CORE GF-14
PERMEABILITY, md 24.0
POROSITY, % 22.3
METHOD Centrifuge, Air-Kerosene



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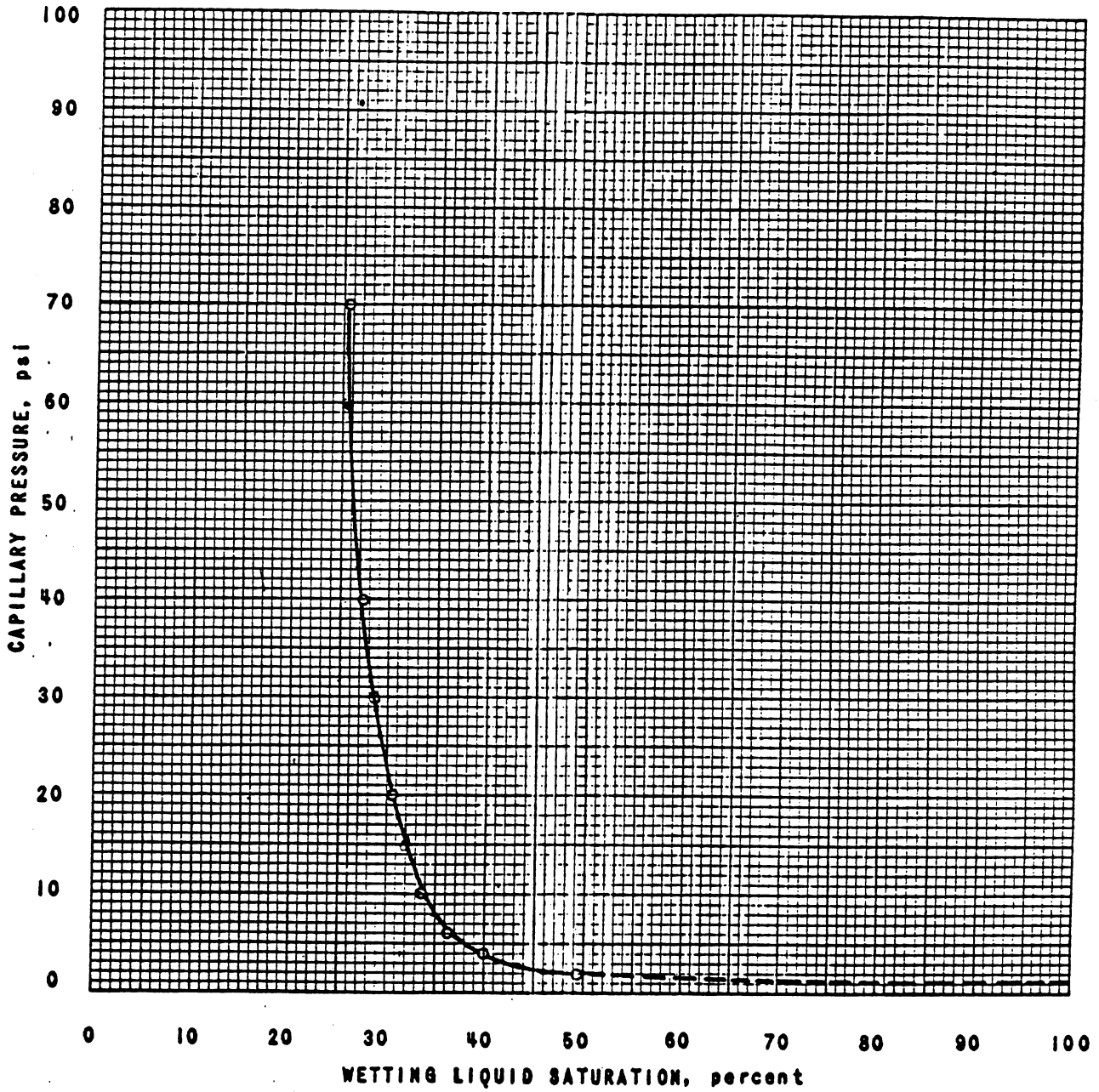
CAPILLARY PRESSURE CURVE

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,599

CORE GF-18
PERMEABILITY, md 51.4
POROSITY, % 25.1
METHOD Centrifuge-Air-Kerosene



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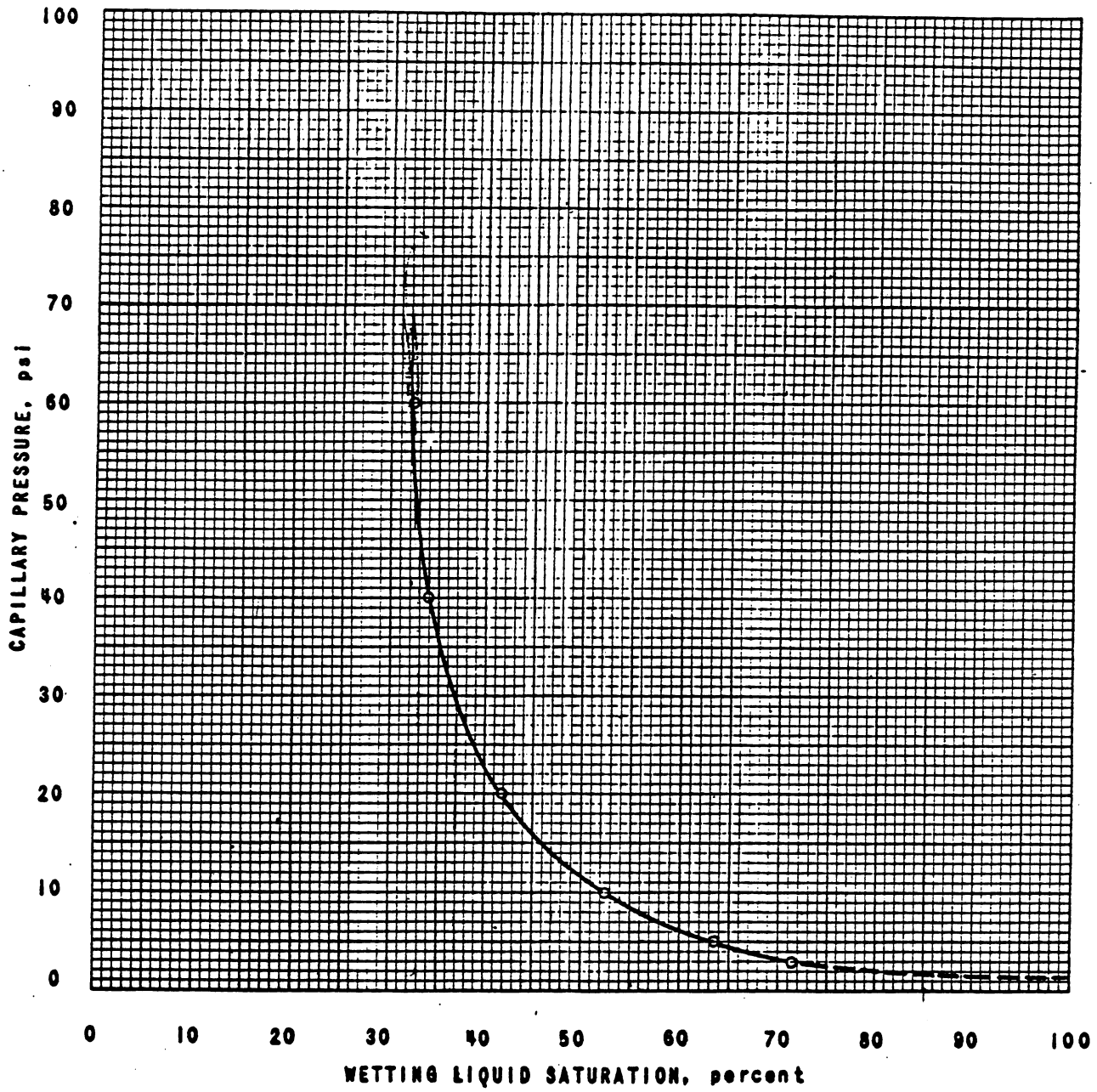
CAPILLARY PRESSURE CURVE

FIELD	Geraldine Ford	CORE	GF-20
RESERVOIR	Delaware Sand	PERMEABILITY, md	1.81
WELL	TXL "L" 2	POROSITY, %	13.5
DEPTH, ft	2,605	METHOD	Centrifuge, Air-Kerosene



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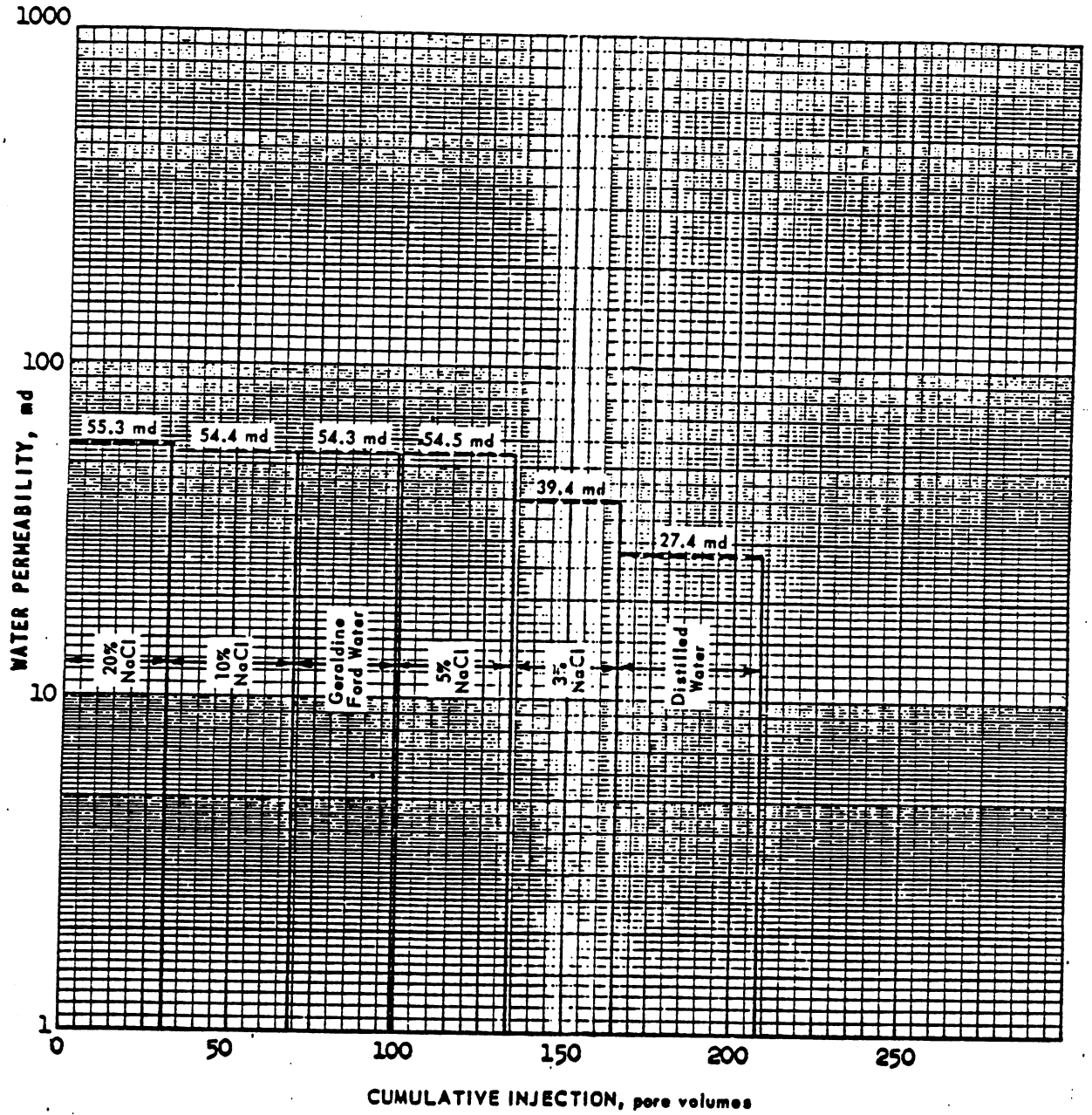
INJECTIVITY TEST

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583

CORE GF-9
PERMEABILITY, md 101
POROSITY, percent 25.9



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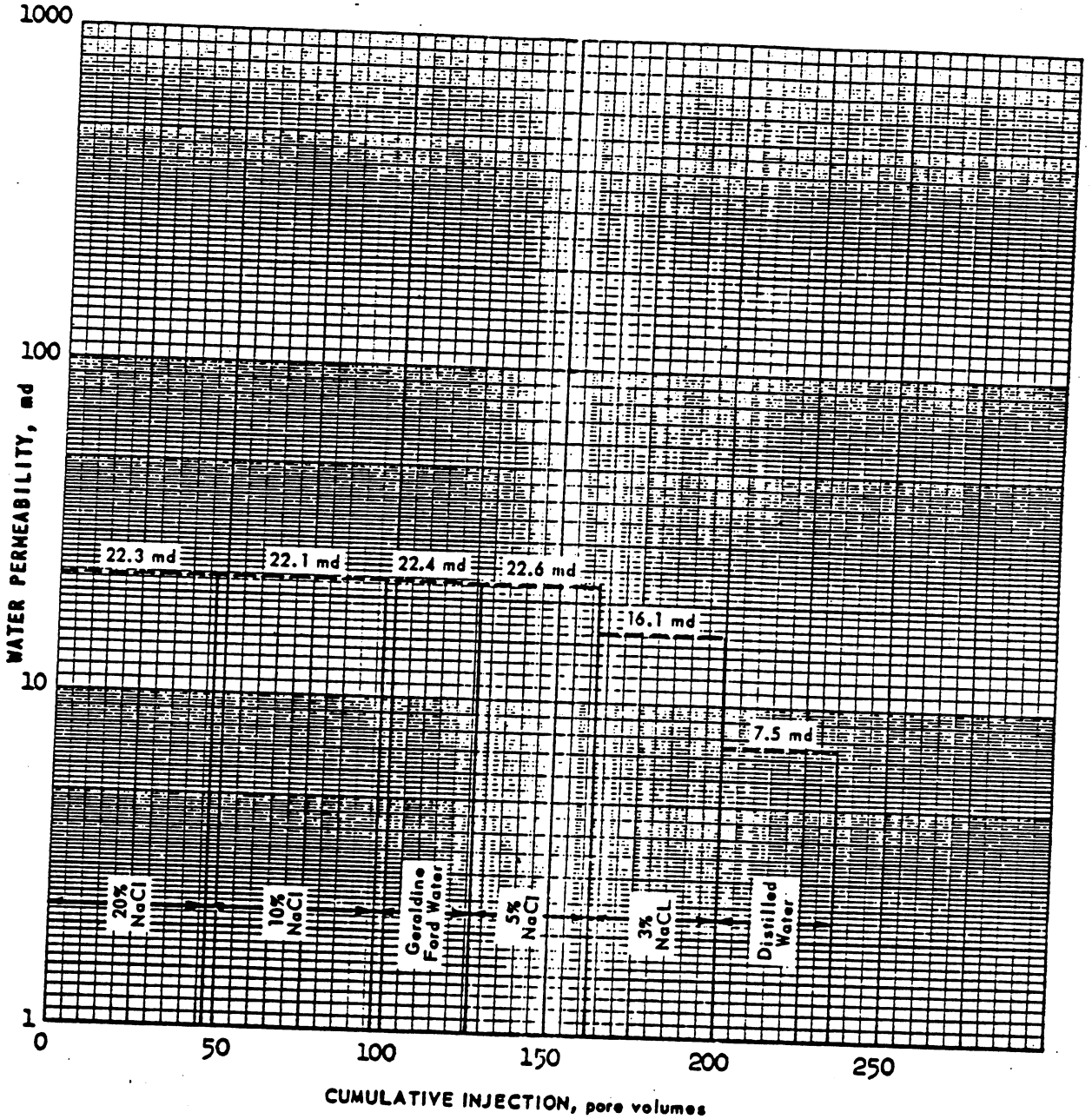
INJECTIVITY TEST

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,593

CORE GF-13
PERMEABILITY, md. 42.7
POROSITY, percent 24.5



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LABORATORY WATERFLOOD SUMMARY

FIELD Geraldine Ford WELL TXL "L" 2

RESERVOIR Delaware Sand CORED INTERVAL, ft 2,573 - 2,606

The procedure for determining oil-water relative permeability relations in the Laboratory consists of oil flooding a preserved core until a minimum water saturation is reached and then waterflooding to a residual oil saturation. Occasionally, insufficient data are obtained during the waterflood to permit the calculation of relative permeability relations. This may occur, for example, as a result of technical difficulties or because of calculation procedures which require significant oil production after water breakthrough. Under these circumstances, the only data obtained are the water saturation and the permeability to oil at the beginning of the waterflood, the final oil saturation, and the permeability to water at the end of the waterflood. These data represent the initial and final points usually found on oil-water relative permeability curves. * Presented below for comparative purposes are these values obtained on all waterfloods, along with the number of pore volumes of water injected, and the viscosity ratio of the fluids used.

*It is pointed out that a 20-centipoise oil and a 1-centipoise water (approximately) are used in the waterflood and a large number of pore volumes of water are generally injected. Injection is continued until the rate of change of oil saturation with water injected is very small or negligible, indicating that, for laboratory conditions, residual oil has been closely approximated. On the other hand, the actual field values of the viscosity ratio and pore volumes of water injected may differ greatly from laboratory conditions, thus possibly rendering actual field values of residual oil different from laboratory obtained values. These limitations should be well in mind before quantitative significance is attached to final oil saturation values which are reported in tabular form below.

Core Number	Depth, Feet	Porosity, %	Absolute Permeability, md	Initial Water Saturation % Pore Volume	Permeability to Oil at Initial Water Saturation, md	Final Oil Saturation % Pore Volume	Permeability to Water at Final Oil Saturation, md	Oil-Water Viscosity Ratio, cp/cp	Total Water Injected, Pore Volumes
GF-4	2,575	15.6	1.03	46.9	0.797	29.9	0.0096	18.6	1.94
GF-8-A	2,583	26.2	112	38.2	92.7	21.4	6.49	19.2	23.8
GF-11	2,583	25.8	105	36.3	100	19.9	5.14	18.1	33.7
GF-12	2,593	23.8	44.5	40.1	33.5	21.6	1.13	18.6	10.2
GF-15*	2,593	21.8	24.4	-	14.5	27.3	0.318	16.1	0.152
GF-16	2,599	26.0	65.3	39.2	39.8	23.3	2.30	17.4	25.1
GF-20**	2,605	13.5	1.81	67.5	0.961	25.5	-	-	7.25

*Because of technical difficulties, oil-water relative permeability data were not obtainable on this core; however, the data summarized are presented for comparative purposes.

**Oil-water relative permeability data were not calculable on this core because there was very little oil production after water breakthrough during waterflooding.

Basic Core Data-Reservoir Engineering Laboratory
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Core Report 232

OIL-WATER RELATIVE PERMEABILITY DATA

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,575
WATER SALINITY, ppm NaCl 100,000

CORE GF-4
PERMEABILITY, md 1.03
POROSITY, % 15.6
OIL VISCOSITY, cp 20.4
WATER VISCOSITY, cp 1.10

WATER SATURATION, %	OIL-WATER REL. PERMEABILITY RATIO	RELATIVE PERMEABILITY TO WATER, %	EFFECTIVE PERMEABILITY TO WATER, md	RELATIVE PERMEABILITY TO OIL, %	EFFECTIVE PERMEABILITY TO OIL, md
46.9	-	-	-	77.4	0.797
47.9	52.5	-	-	-	-
49.1	38.8	-	-	-	-
50.0	32.1	-	-	-	-
51.0	26.5	-	-	-	-
53.2	18.9	-	-	-	-
57.1	10.8	0.226	0.00233	-	-
61.8	5.28	0.609	0.00627	3.22	0.0331
70.1		0.932	0.00960	-	-

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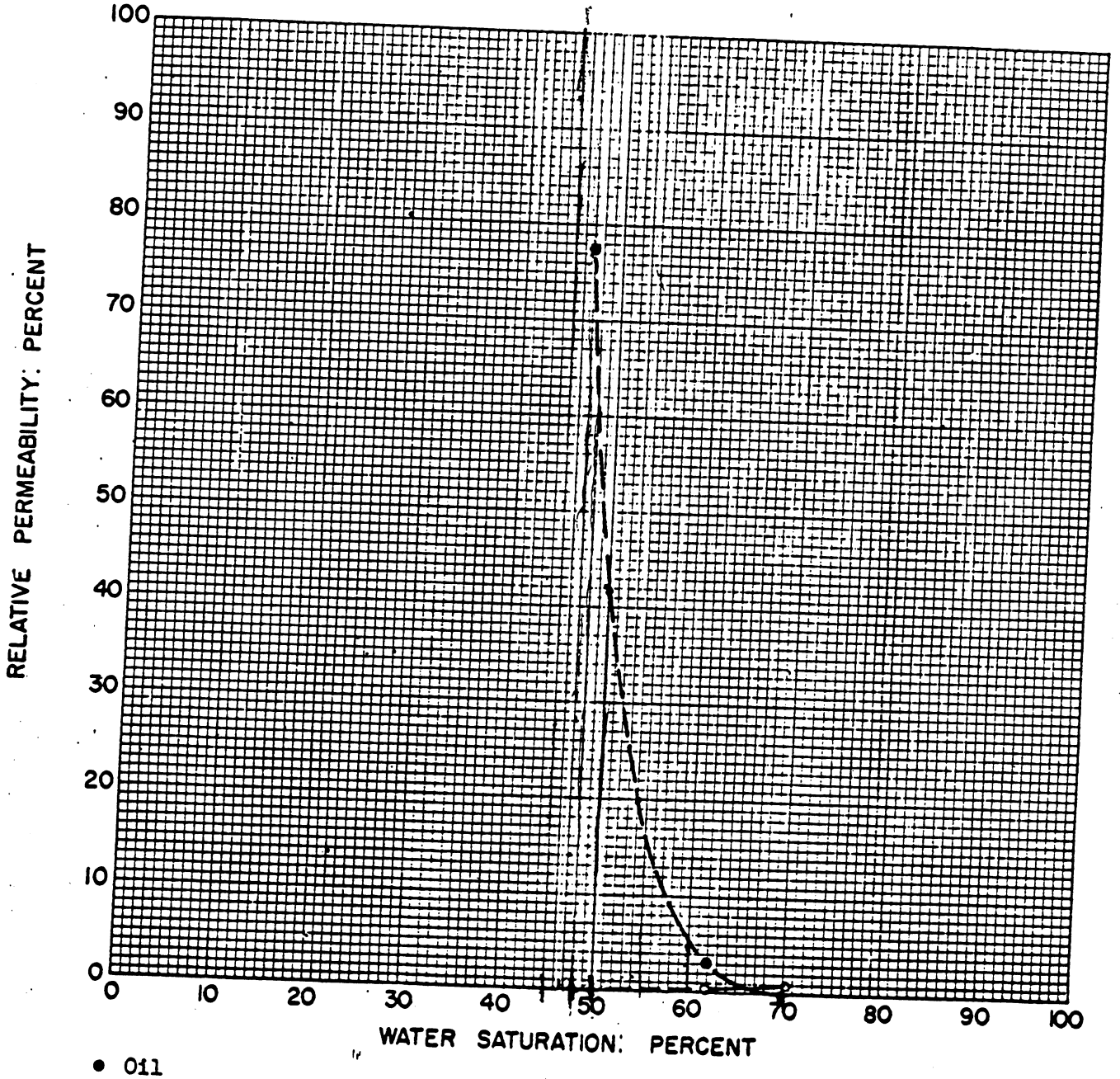
OIL · WATER RELATIVE PERMEABILITY

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH 2,575 ft

CORE GF-4
PERMEABILITY, MD. 1.03
POROSITY, % 15.6
OIL VISCOSITY, CP. 20.4
WATER VISCOSITY, CP. 1.10



● Oil
○ Water

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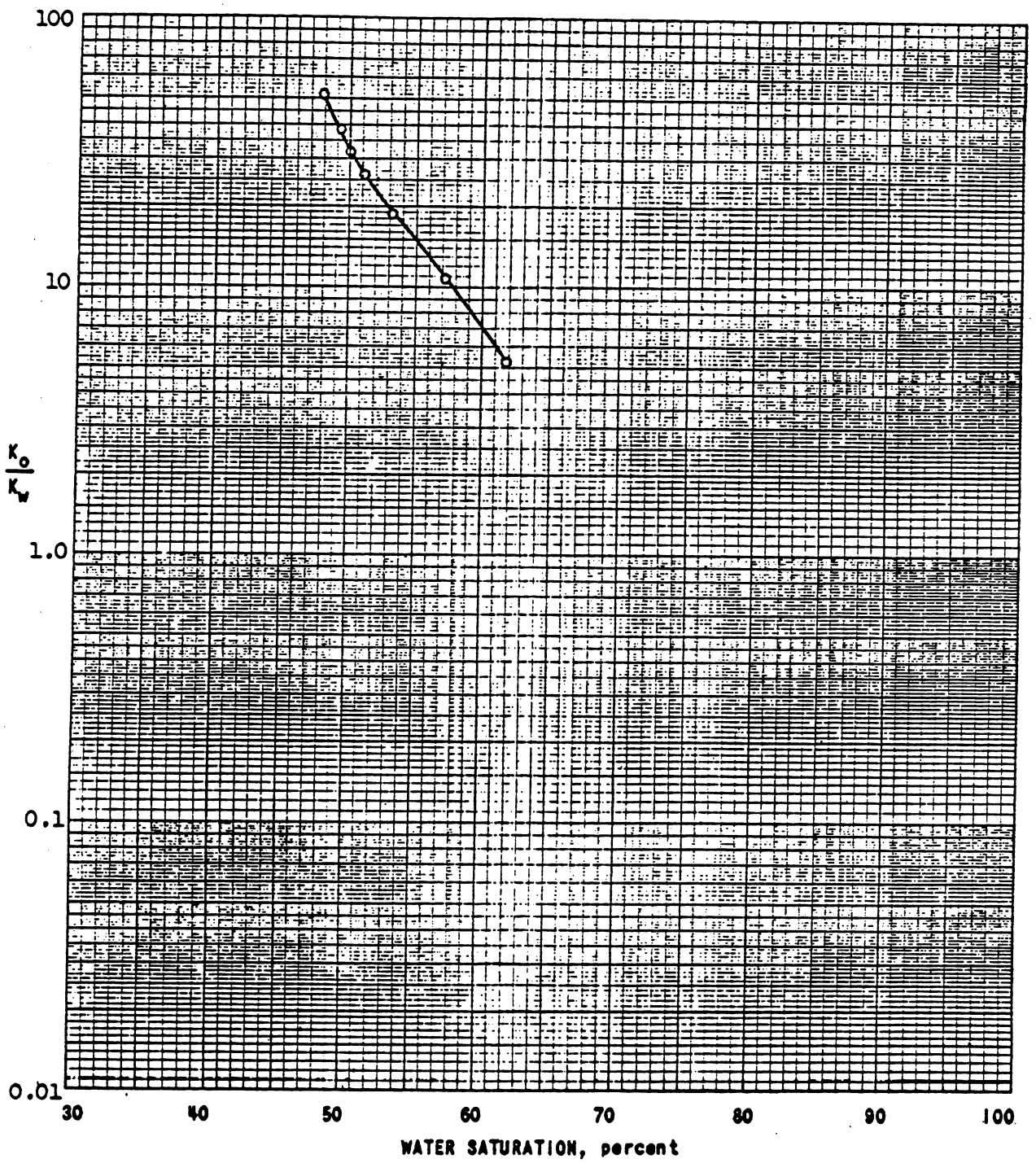
OIL-WATER RELATIVE PERMEABILITY RATIO

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,575

CORE GF-4
PERMEABILITY, md 1.03
POROSITY, % 15.6



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OIL-WATER RELATIVE PERMEABILITY DATA

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583
WATER SALINITY, ppm NaCl 100,000

CORE GF-8-A
PERMEABILITY, md 112
POROSITY, % 26.2
OIL VISCOSITY, cp 20.9
WATER VISCOSITY, cp 1.08

WATER SATURATION, %	OIL-WATER REL. PERMEABILITY RATIO	RELATIVE PERMEABILITY TO WATER, %	EFFECTIVE PERMEABILITY TO WATER, md	RELATIVE PERMEABILITY TO OIL, %	EFFECTIVE PERMEABILITY TO OIL, md
38.2	-	-	-	82.8	92.7
59.8	5.63	-	-	-	-
63.5	2.53	-	-	-	-
65.5	1.48	-	-	-	-
67.0	0.943	2.26	2.53	2.13	2.39
68.3	0.619	3.03	3.39	1.87	2.10
69.7	0.401	3.29	3.68	1.32	1.48
71.2	0.244	3.45	3.86	0.841	0.942
72.8	0.132	3.77	4.22	0.497	0.556
74.5	0.0606	4.40	4.93	0.267	0.299
76.1	0.0226	5.13	5.75	0.116	0.130
77.7	0.00644	5.52	6.18	0.0356	0.0398
78.6		5.79	6.49	-	-

BASIC CORE DATA-RES. ENG. LABORATORY

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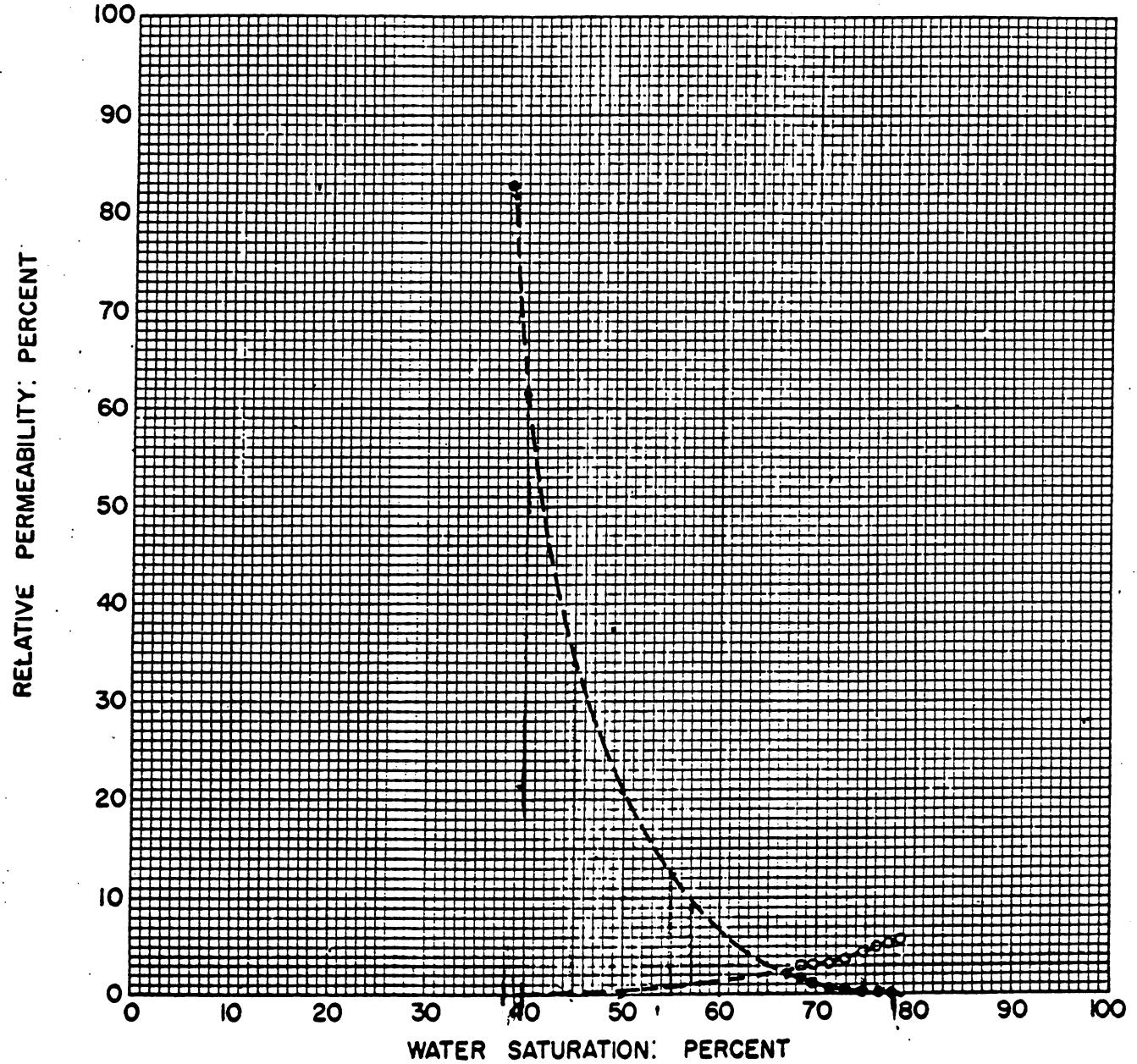
OIL · WATER RELATIVE PERMEABILITY

FIELD	Geraldine Ford	CORE	GF-8-A
RESERVOIR	Delaware Sand	PERMEABILITY, MD.	112
WELL	TXL "L" 2	POROSITY, %	26.2
DEPTH	2,583 ft	OIL VISCOSITY, CP.	20.9
		WATER VISCOSITY, CP.	1.08



● Oil
○ Water

57%

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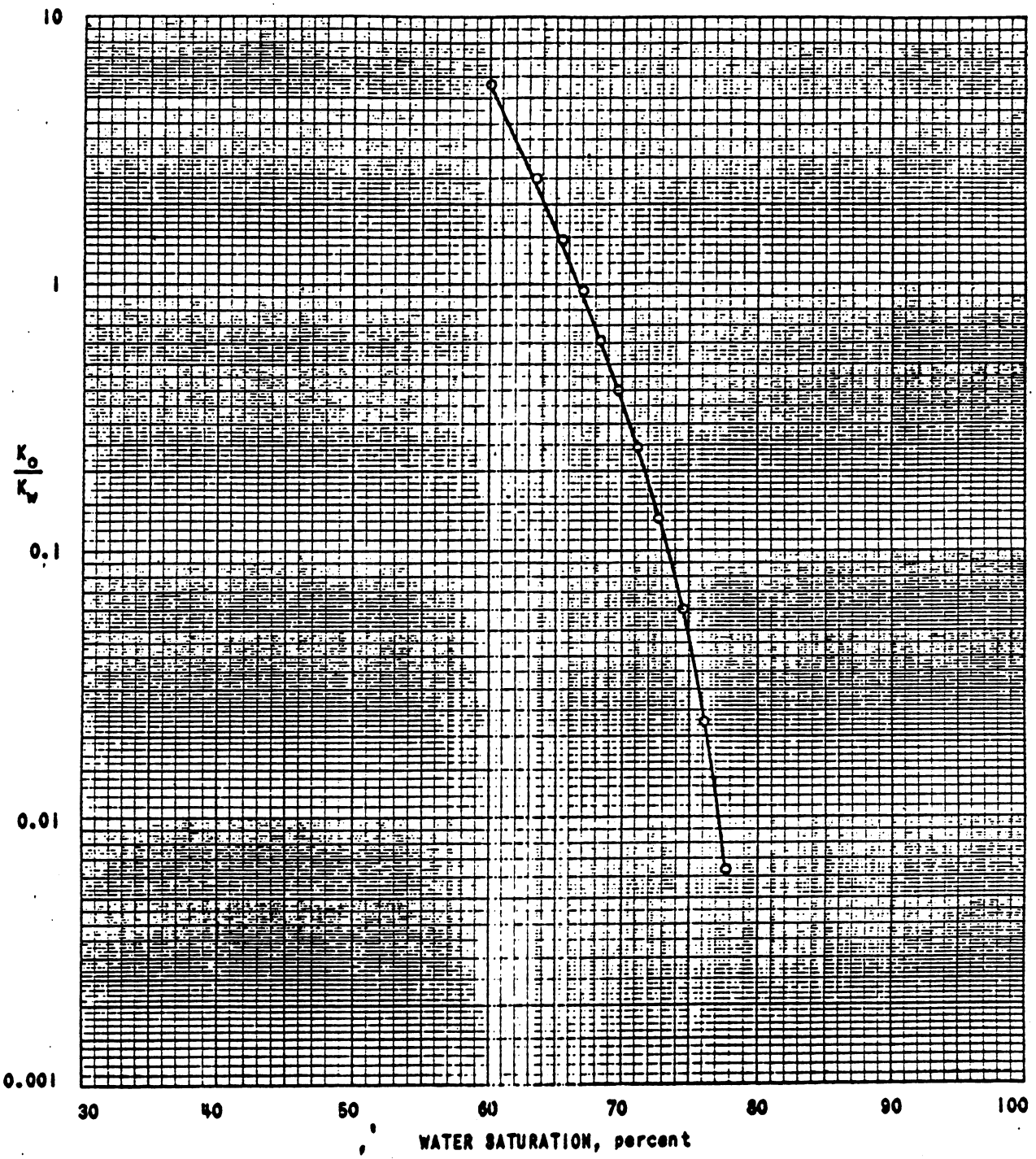
OIL-WATER RELATIVE PERMEABILITY RATIO

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583

CORE GF-8-A
PERMEABILITY, md 112
POROSITY, % 26.2



BASIC CORE DATA RES. ENG. LABORATORY
BY J.W. Walker APPROVED W.M. Stevenson, Jr.

HUMBLE OIL & REFINING CO.
CORE REPORT 232

OIL-WATER RELATIVE PERMEABILITY DATA

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583
WATER SALINITY, ppm NaCl Geraldine Ford Water

CORE GF-11
PERMEABILITY, md 105
POROSITY, % 25.8
OIL VISCOSITY, cp 20.4
WATER VISCOSITY, cp 1.13

WATER SATURATION, %	OIL-WATER REL. PERMEABILITY RATIO	RELATIVE PERMEABILITY TO WATER, %	EFFECTIVE PERMEABILITY TO WATER, md	RELATIVE PERMEABILITY TO OIL, %	EFFECTIVE PERMEABILITY TO OIL, md
36.3	-	-	-	95.2	100
72.0	0.233	-	-	-	-
72.1	0.221	-	-	-	-
72.6	0.184	-	-	-	-
73.4	0.138	-	-	-	-
74.4	0.0967	3.35	3.52	0.324	0.340
75.3	0.0645	3.62	3.80	0.233	0.245
76.2	0.0412	3.76	3.95	0.155	0.163
77.0	0.0250	3.93	4.13	0.0982	0.103
77.9	0.0140	4.22	4.43	0.0592	0.0621
78.7	0.00710	4.60	4.83	0.0326	0.0343
80.1	-	4.90	5.14	-	-

BASIC CORE DATA-RES. ENG. LABORATORY

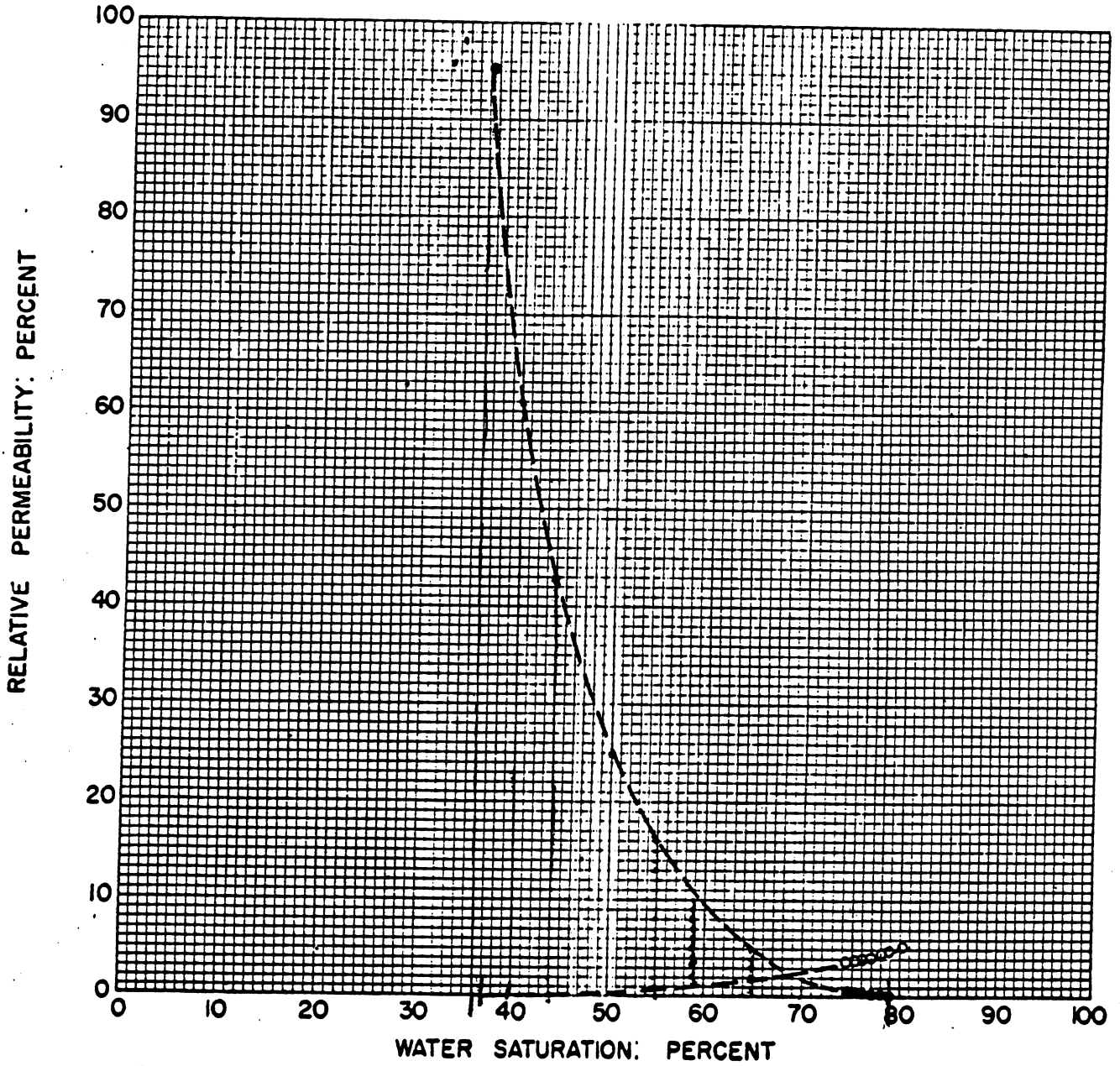
HUMBLE OIL & REFINING CO.

BY R. D. Rogers APPROVED W.M.Stevenson,Jr. -24- CORE REPORT 232

OIL WATER RELATIVE PERMEABILITY

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH 2,583 ft

CORE GF-11
PERMEABILITY, MD 105
POROSITY, % 25.8
OIL VISCOSITY, CP 20.4
WATER VISCOSITY, CP 1.13



● Oil
○ Water

59%

BASIC CORE DATA-RES. ENG. LABORATORY
BY W. D. McRae APPROVED W. M. Stevenson, Jr.

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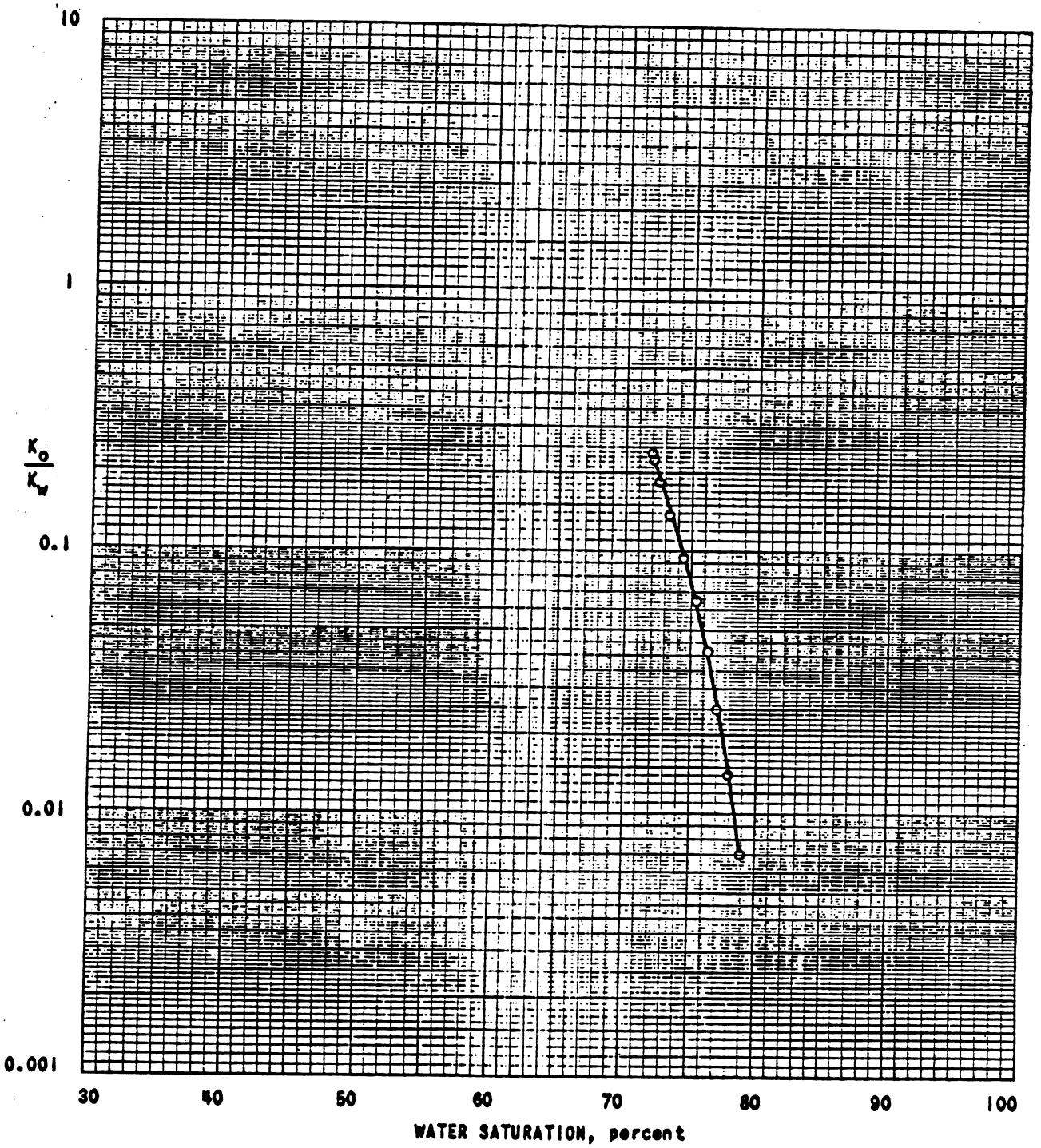
CORE REPORT 232

OIL-WATER RELATIVE PERMEABILITY RATIO

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583

CORE GF-11
PERMEABILITY, md 105
POROSITY, % 25.8



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HUMBLE OIL & REFINING CO.
CORE REPORT 232

OIL-WATER RELATIVE PERMEABILITY DATA

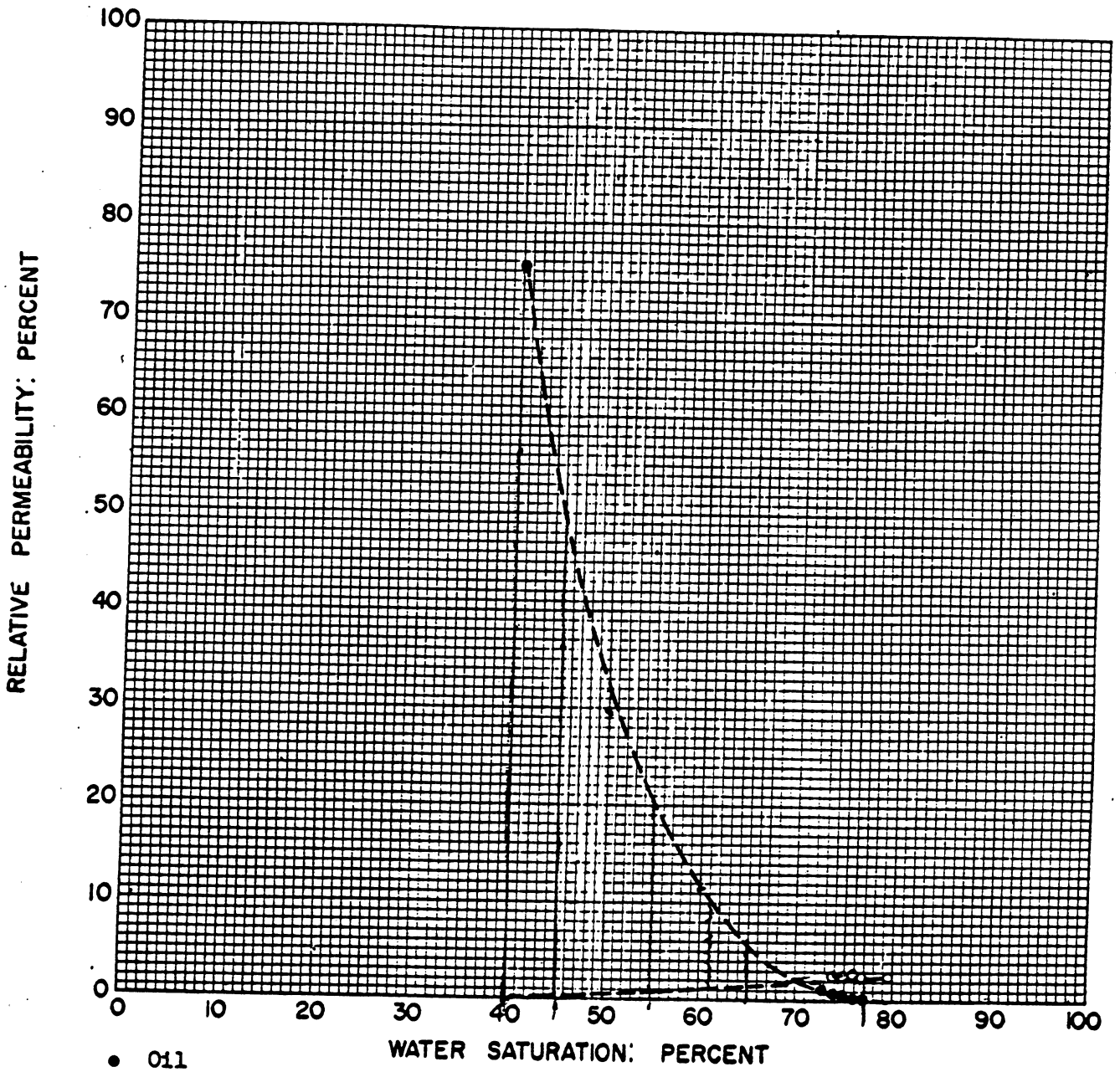
FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,593
WATER SALINITY, ppm NaCl 100,000

CORE GF-12
PERMEABILITY, md 44.5
POROSITY, % 23.8
OIL VISCOSITY, cp 20.3
WATER VISCOSITY, cp 1.09

WATER SATURATION, %	OIL-WATER REL. PERMEABILITY RATIO	RELATIVE PERMEABILITY TO WATER, %	EFFECTIVE PERMEABILITY TO WATER, md	RELATIVE PERMEABILITY TO OIL, %	EFFECTIVE PERMEABILIT TO OIL, md
40.1	-	-	-	75.3	-
62.4	6.22	-	-	-	33.5
69.4	1.09	-	-	-	-
70.4	0.827	-	-	-	-
71.3	0.636	-	-	-	-
72.1	0.486	-	-	-	-
72.9	0.369	-	-	1.25	0.556
73.8	0.268	2.64	1.18	0.707	0.314
74.7	0.176	2.77	1.23	0.487	0.217
75.7	0.0994	2.85	1.27	0.283	0.126
76.7	0.0464	2.73	1.22	0.127	0.0565
79.4	-	2.53	1.13	-	-

OIL WATER RELATIVE PERMEABILITY

FIELD	Geraldine Ford	CORE	GF-12
RESERVOIR	Delaware Sand	PERMEABILITY, MD.	44.5
WELL	TXL "L" 2	POROSITY, %	23.8
DEPTH	2,593 ft	OIL VISCOSITY, CP.	20.3
		WATER VISCOSITY, CP.	1.09



61%

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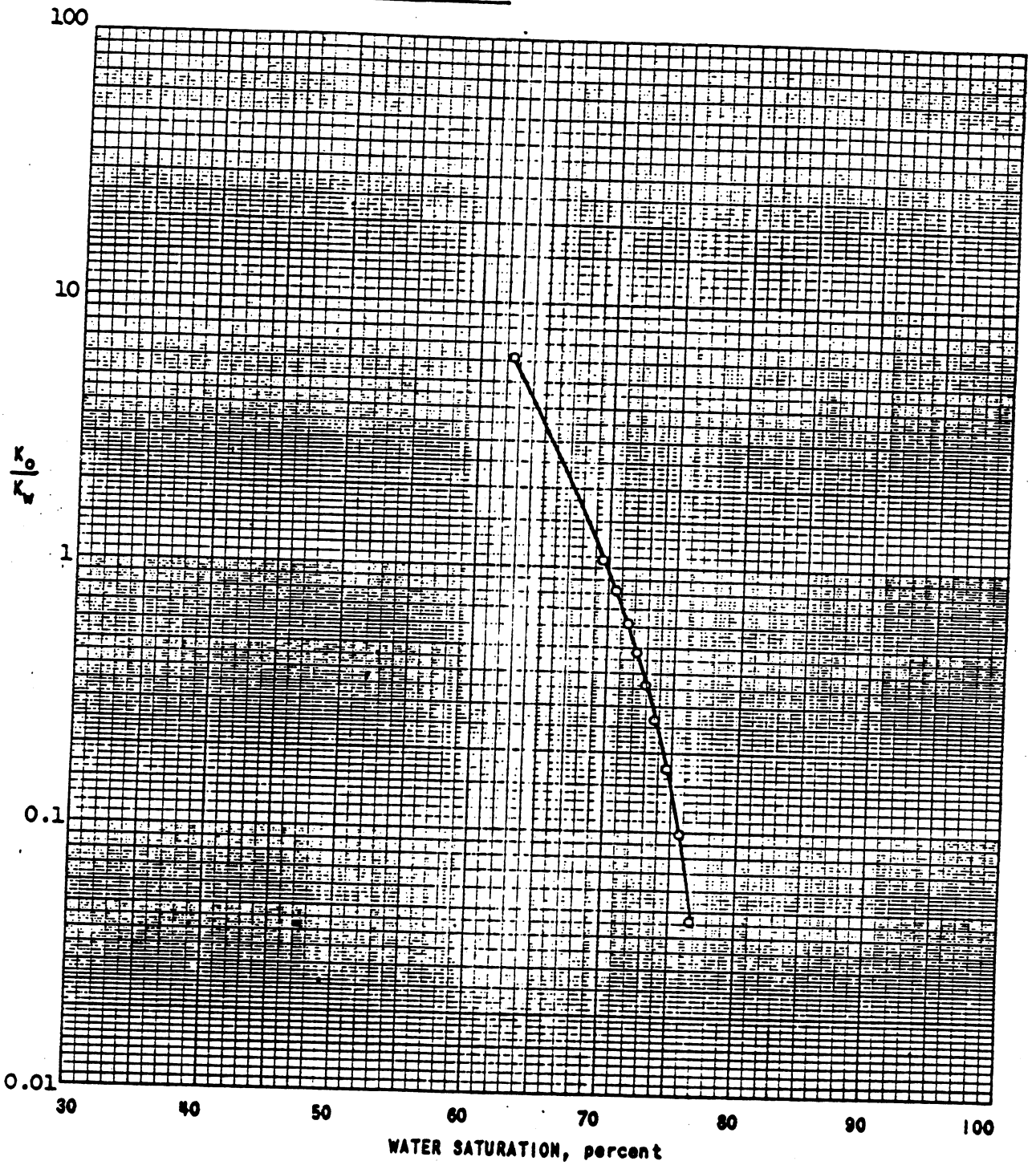
CORE REPORT 232

OIL-WATER RELATIVE PERMEABILITY RATIO

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,593

CORE GF-12
PERMEABILITY, md 44.5
POROSITY, % 23.8



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CORE REPORT 232

OIL-WATER RELATIVE PERMEABILITY DATA

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TXL "L" 2
DEPTH, ft: 2,599
WATER SALINITY, ppm NaCl: 100,000

CORE: GF-16
PERMEABILITY, md: 65.3
POROSITY, %: 26.0
OIL VISCOSITY, cp: 19.7
WATER VISCOSITY, cp: 1.13

WATER SATURATION, %	OIL-WATER REL. PERMEABILITY RATIO	RELATIVE PERMEABILITY TO WATER, %	EFFECTIVE PERMEABILITY TO WATER, md	RELATIVE PERMEABILITY TO OIL, %	EFFECTIVE PERMEABILITY TO OIL, md
39.2	-	-	-	60.9	39.8
71.5	0.435	-	-	-	-
71.9	0.364	1.24	0.810	0.457	0.299
72.8	0.260	-	-	-	-
73.5	0.186	-	-	-	-
73.9	0.140	-	-	-	-
74.4	0.103	1.49	0.971	0.153	0.0997
75.0	0.0630	1.67	1.09	0.105	0.0685
75.7	0.0288	1.72	1.13	0.0498	0.0325
76.2	0.00954	1.82	1.19	0.0173	0.0113
76.7	0.00204	2.55	1.66	0.00520	0.00340

BASIC CORE DATA-RES. ENG. LABORATORY

HUMBLE OIL & REFINING CO.

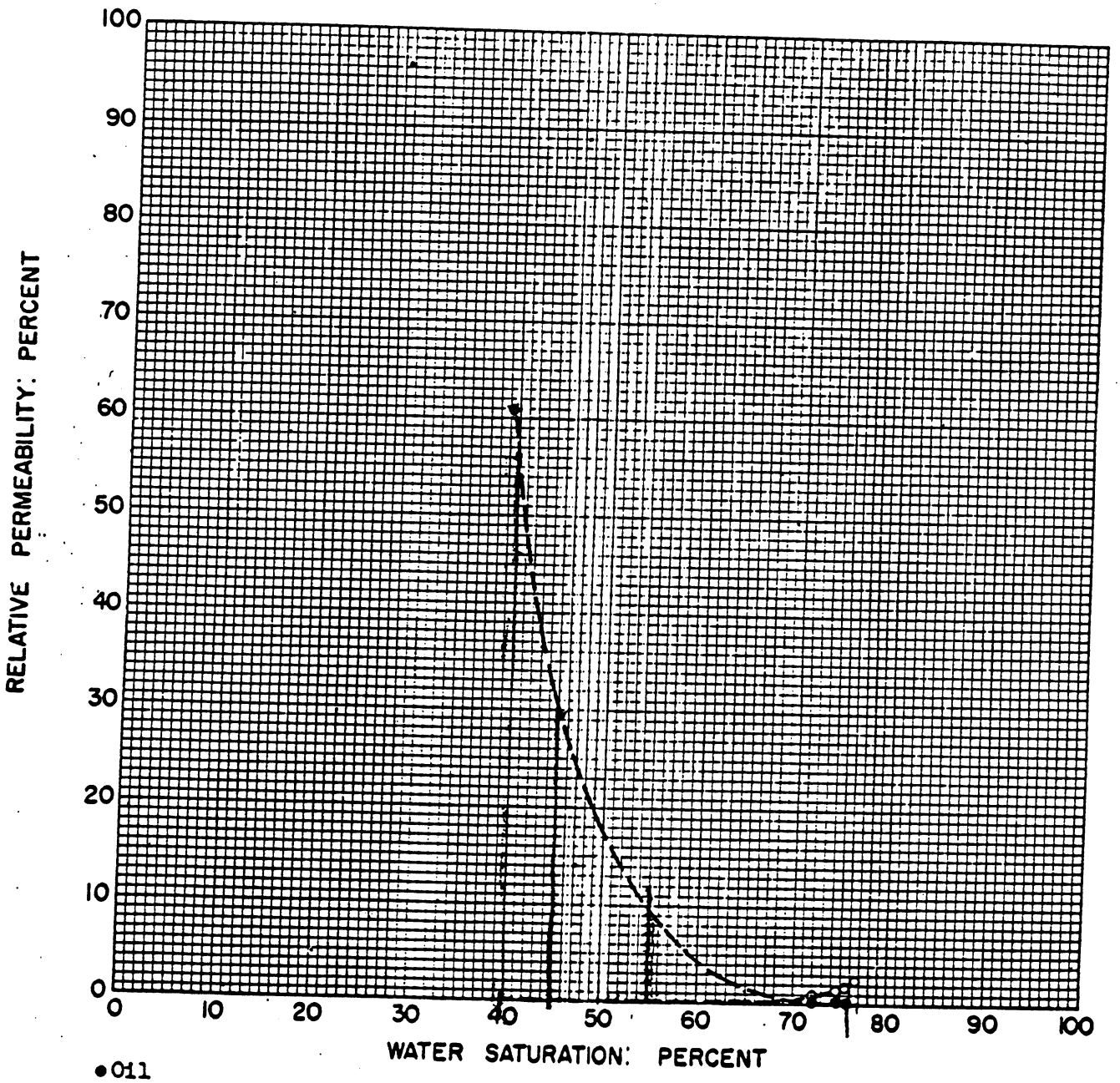
BY K. E. Taylor APPROVED W. M. Stevenson, Jr.

CORE REPORT 232

OIL WATER RELATIVE PERMEABILITY

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH 2,599 ft

CORE GF-16
PERMEABILITY, MD. 65.3
POROSITY, % 26.0
OIL VISCOSITY, CP. 19.7
WATER VISCOSITY, CP. 1.13



• Oil
○ Water

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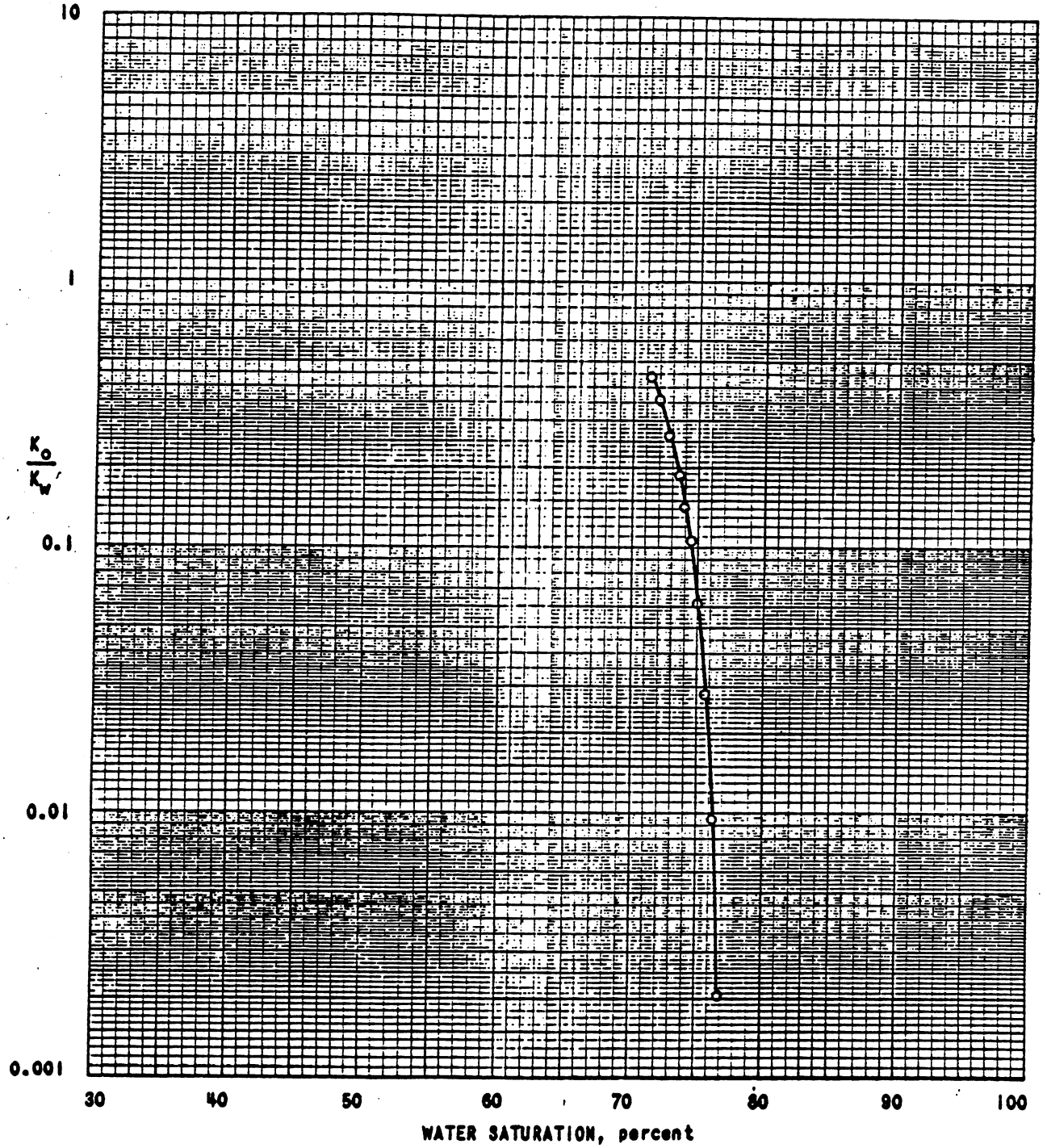
CORE REPORT 232

OIL-WATER RELATIVE PERMEABILITY RATIO

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,599

CORE GF-16
PERMEABILITY, md 65.3
POROSITY, % 26.0



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CORE REPORT 232

OIL-GAS RELATIVE PERMEABILITY DATA

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,575
METHOD Gas Drive

CORE GF-6
PERMEABILITY, md 1.13
POROSITY, % 15.0
OIL VISCOSITY, cp 1.91
GAS VISCOSITY, cp 0.018

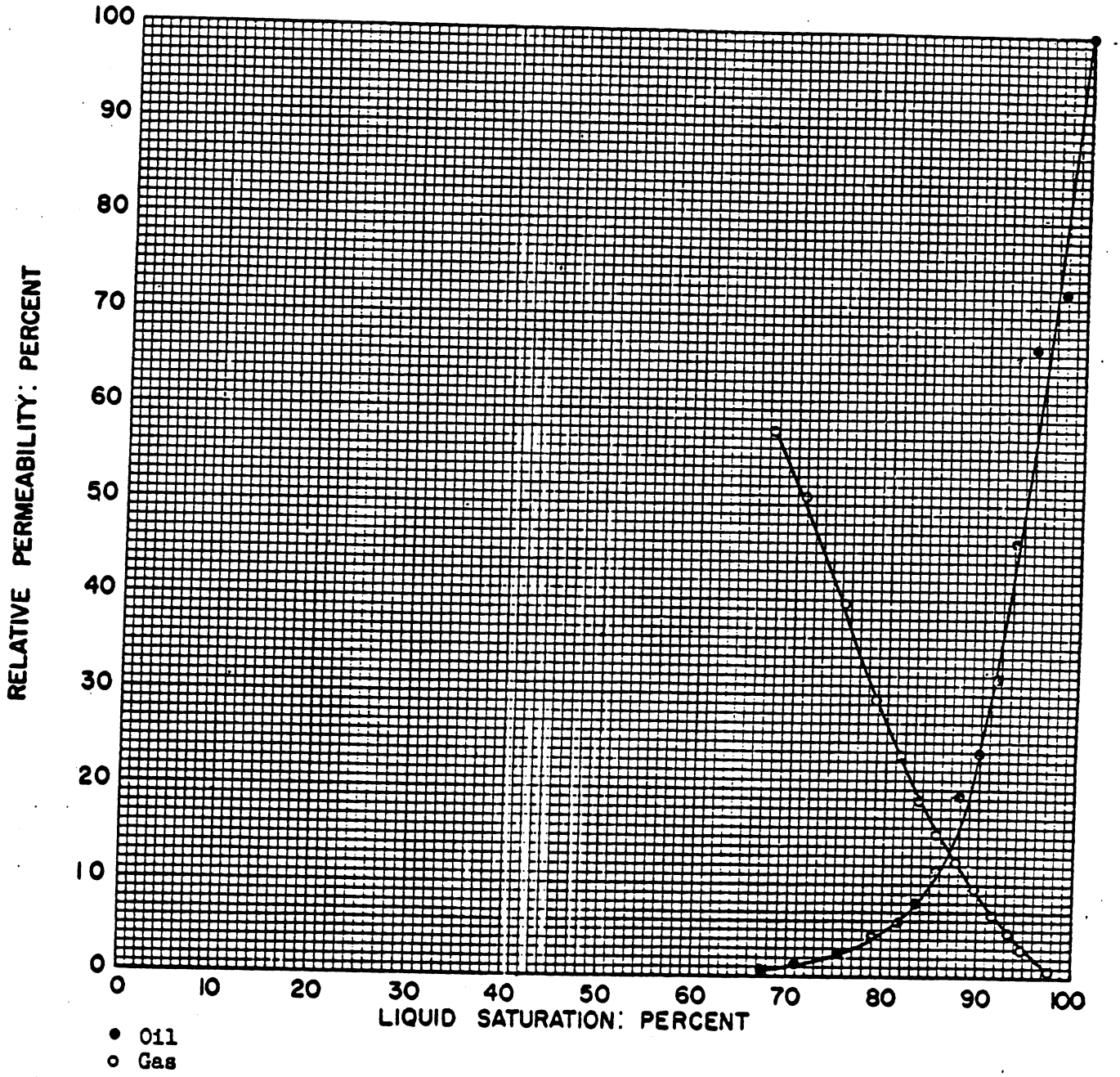
OIL SATURATION, %	EFFECTIVE OIL PERMEABILITY, md	RELATIVE OIL PERMEABILITY, %	EFFECTIVE GAS PERMEABILITY, md	RELATIVE GAS PERMEABILITY, %	OIL-GAS RELATIVE PERMEABILITY RATIO
100	1.13	100	-		-
97.8	0.818	72.4	0.00990	0.767	94.4
94.8	0.755	66.8	0.0383	2.97	22.5
93.2	0.520	46.0	0.0618	4.79	9.60
91.6	0.361	31.9	0.0883	6.84	4.66
89.8	0.270	23.9	0.122	9.46	2.53
87.8	0.217	19.2	0.157	12.2	1.57
85.5	0.129	11.4	0.196	15.2	0.750
83.4	0.0908	8.04	0.242	18.8	0.428
81.4	0.0665	5.88	0.303	23.5	0.250
78.8	0.0464	4.11	0.380	29.5	0.139
75.2	0.0262	2.32	0.510	39.5	0.0587
70.9	0.0147	1.30	0.655	50.8	0.0256
67.2	0.00735	0.650	0.743	57.6	0.0113
0	-	-	1.29	100	-

NOTE: Relative K_g was obtained by dividing the effective K_g by the K_g at 100 percent gas saturation.

Relative K_o was obtained by dividing the effective K_o by the absolute permeability measured at 100 percent oil saturation.

OIL—GAS RELATIVE PERMEABILITY

FIELD	Geraldine Ford	CORE	GF-6
RESERVOIR	Delaware Sand	PERMEABILITY, MD.	.13
WELL	TXL "L" 2	POROSITY, %	15.0
DEPTH	2,575 ft	OIL VISCOSITY, CP.	1.91
METHOD	Gas Drive	GAS VISCOSITY, CP.	0.018



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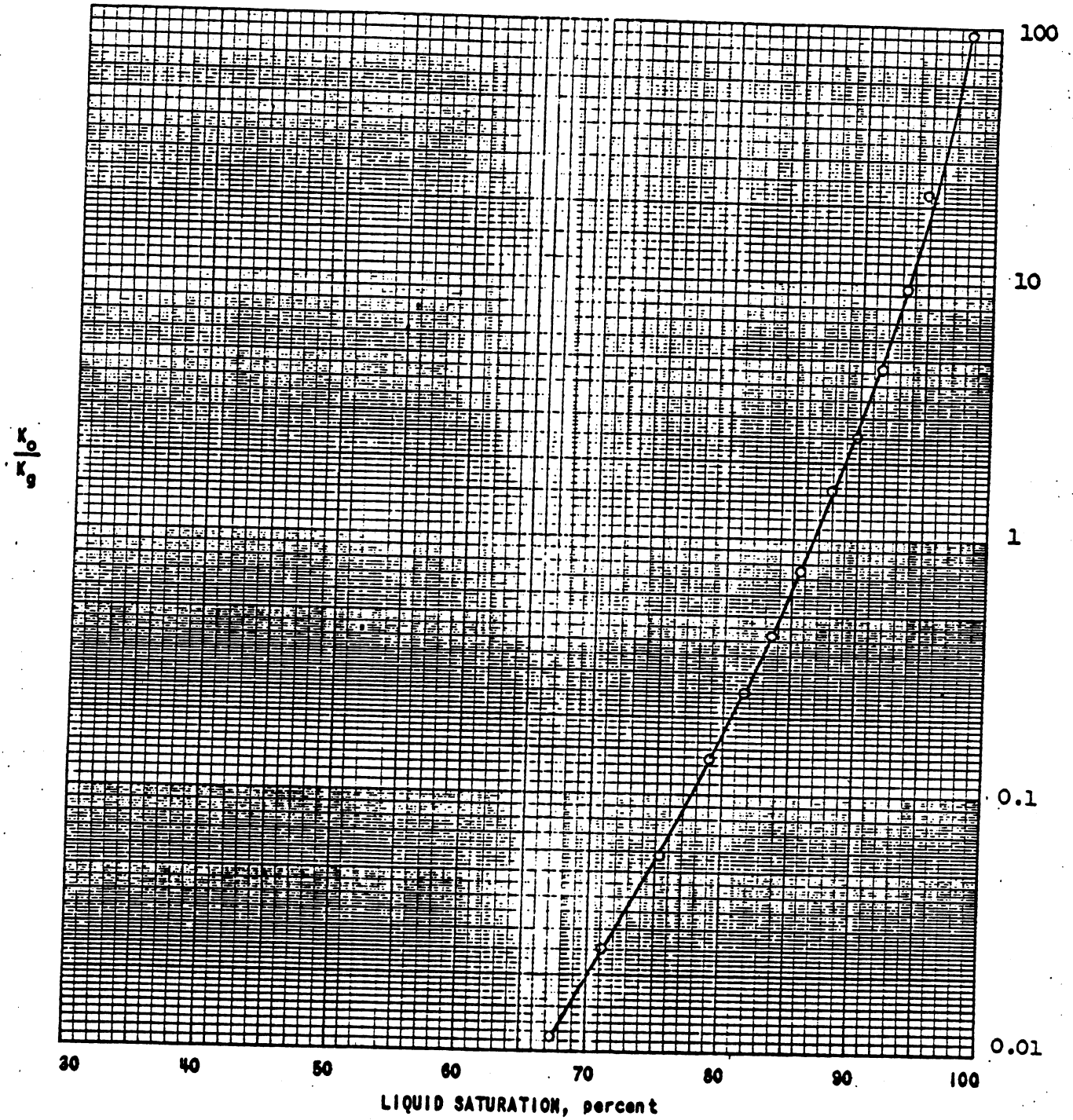
HUMBLE OIL & REFINING CO.

CORE REPORT 232

OIL-GAS RELATIVE PERMEABILITY RATIO

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,575

CORE GF-6
PERMEABILITY, md 1.13
POROSITY, % 15.0



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CORE REPORT 232

OIL-GAS RELATIVE PERMEABILITY DATA

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583
METHOD Hafford

CORE GF-8-B
PERMEABILITY, md 116
POROSITY, % 26.7
OIL VISCOSITY, cp 1.91
GAS VISCOSITY, cp 0.018

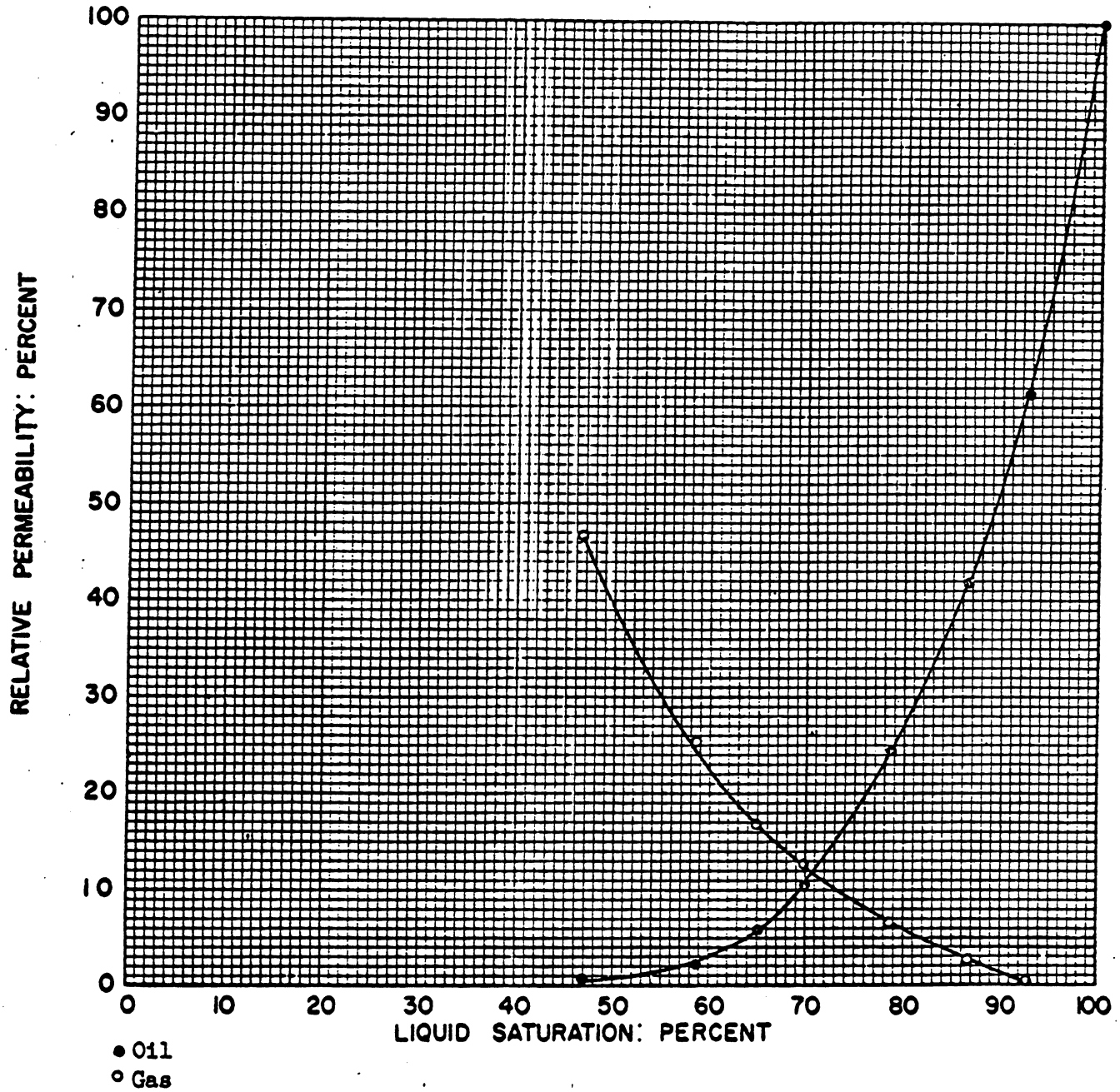
OIL SATURATION, %	EFFECTIVE OIL PERMEABILITY, md	RELATIVE OIL PERMEABILITY, %	EFFECTIVE GAS PERMEABILITY, md	RELATIVE GAS PERMEABILITY, %	OIL-GAS RELATIVE PERMEABILITY RATIO
100	116	-	-	-	-
92.5	70.9	61.1	0.101	0.0802	762
86.4	48.5	41.8	3.04	2.41	17.3
78.4	27.9	24.1	8.31	6.60	3.65
69.8	12.0	10.3	16.0	12.7	0.811
64.8	6.61	5.70	21.1	16.7	0.341
58.2	2.47	2.13	31.8	25.2	0.0845
46.5	0.702	0.605	58.6	46.5	0.0130
0	-	-	126	100	-

NOTE: Relative K_g was obtained by dividing the effective K_g by the K_g at 100 percent gas saturation.

Relative K_o was obtained by dividing the effective K_o by the absolute permeability measured at 100 percent oil saturation.

OIL GAS RELATIVE PERMEABILITY

FIELD	Geraldine Ford	CORE	GF-8-B
RESERVOIR	Delaware Sand	PERMEABILITY, MD.	116
WELL	TXL "L" 2	POROSITY, %	26.7
DEPTH	2,583 ft.	OIL VISCOSITY, CP.	1.91
METHOD	Hafford	GAS VISCOSITY, CP.	0.018



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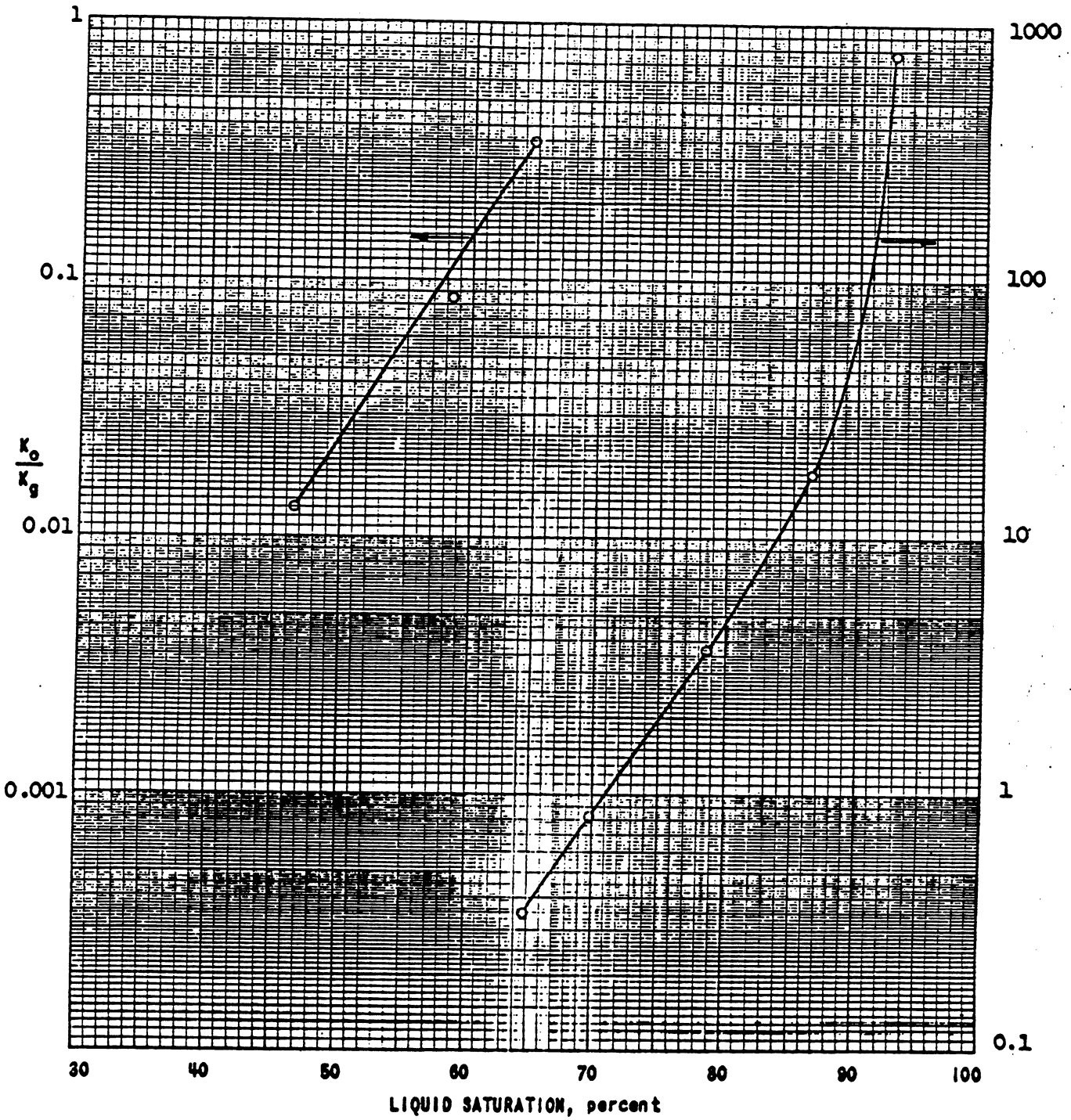
OIL-GAS RELATIVE PERMEABILITY RATIO

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,583

CORE GF-8-B
PERMEABILITY, md 116
POROSITY, % 26.7



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CORE REPORT 232

OIL-GAS RELATIVE PERMEABILITY DATA

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TXL "L" 2
DEPTH, ft: 2,593
METHOD: Hafford

CORE: GF-14
PERMEABILITY, md: 24.0
POROSITY, %: 22.3
OIL VISCOSITY, cp: 1.91
GAS VISCOSITY, cp: 0.018

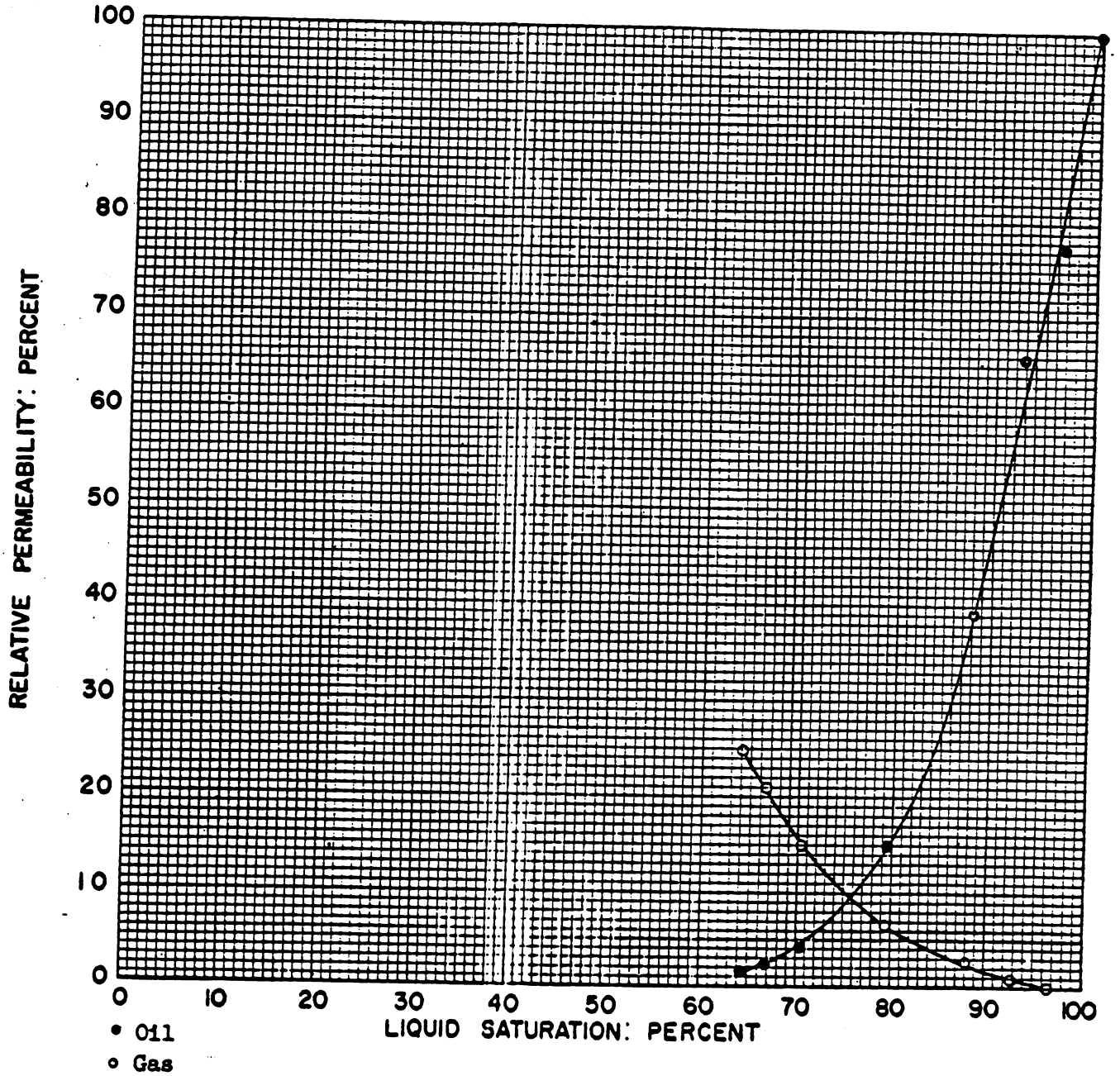
OIL SATURATION, %	EFFECTIVE OIL PERMEABILITY, md	RELATIVE OIL PERMEABILITY, %	EFFECTIVE GAS PERMEABILITY, md	RELATIVE GAS PERMEABILITY, %	OIL-GAS RELATIVE PERMEABILITY RATIO
100	24.0	100	-	-	-
96.7	18.6	77.5	0.00738	0.0274	2,830
92.9	15.8	65.8	0.219	0.814	80.8
88.1	9.37	39.0	0.727	2.70	14.4
79.4	3.55	14.8	1.79	6.65	2.23
70.3	0.995	4.15	4.02	14.9	0.279
66.7	0.531	2.21	5.63	20.9	0.106
64.1	0.320	1.33	6.65	24.7	0.0538
0	-	-	26.9	100	-

NOTE: Relative K_g was obtained by dividing the effective K_g by the K_g at 100 percent gas saturation.

Relative K_o was obtained by dividing the effective K_o by the absolute permeability measured at 100 percent oil saturation.

OIL—GAS RELATIVE PERMEABILITY

FIELD	Geraldine Ford	CORE	GF-14
RESERVOIR	Delaware Sand	PERMEABILITY, MD.	24.0
WELL	TXL "L" 2	POROSITY, %	22.3
DEPTH	2,593 ft	OIL VISCOSITY, CP.	1.91
METHOD	Hafford	GAS VISCOSITY, CP.	0.018



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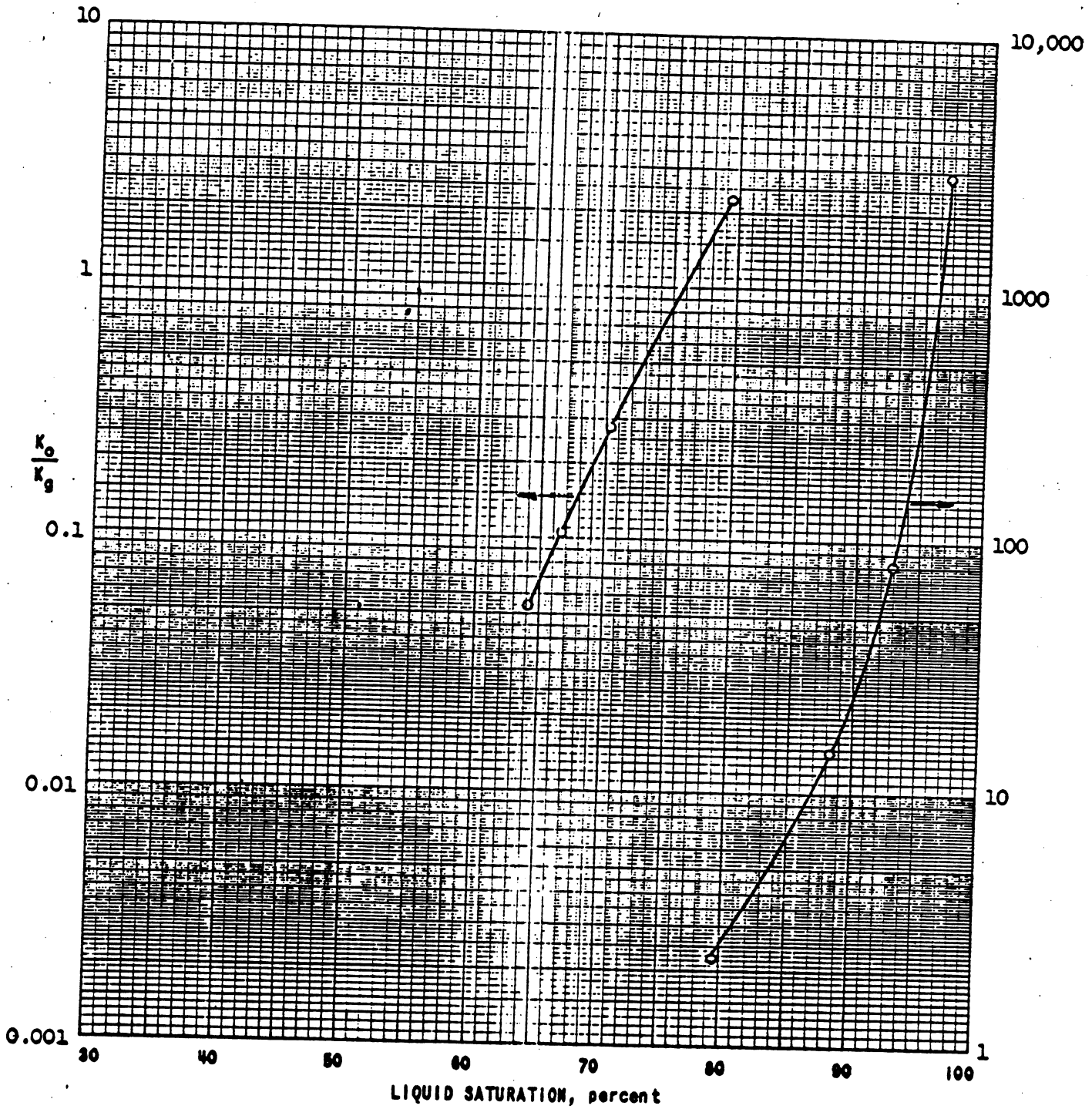
OIL-GAS RELATIVE PERMEABILITY RATIO

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,593

CORE GF-14
PERMEABILITY, md 24.0
POROSITY, % 22.3



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CORE REPORT 232

OIL-GAS RELATIVE PERMEABILITY DATA

FIELD: Geraldine Ford
RESERVOIR: Delaware Sand
WELL: TXL "L" 2
DEPTH, ft: 2,599
METHOD: Hafford

CORE: GF-18
PERMEABILITY, md: 51.4
POROSITY, %: 25.1
OIL VISCOSITY, cp: 1.91
GAS VISCOSITY, cp: 0.018

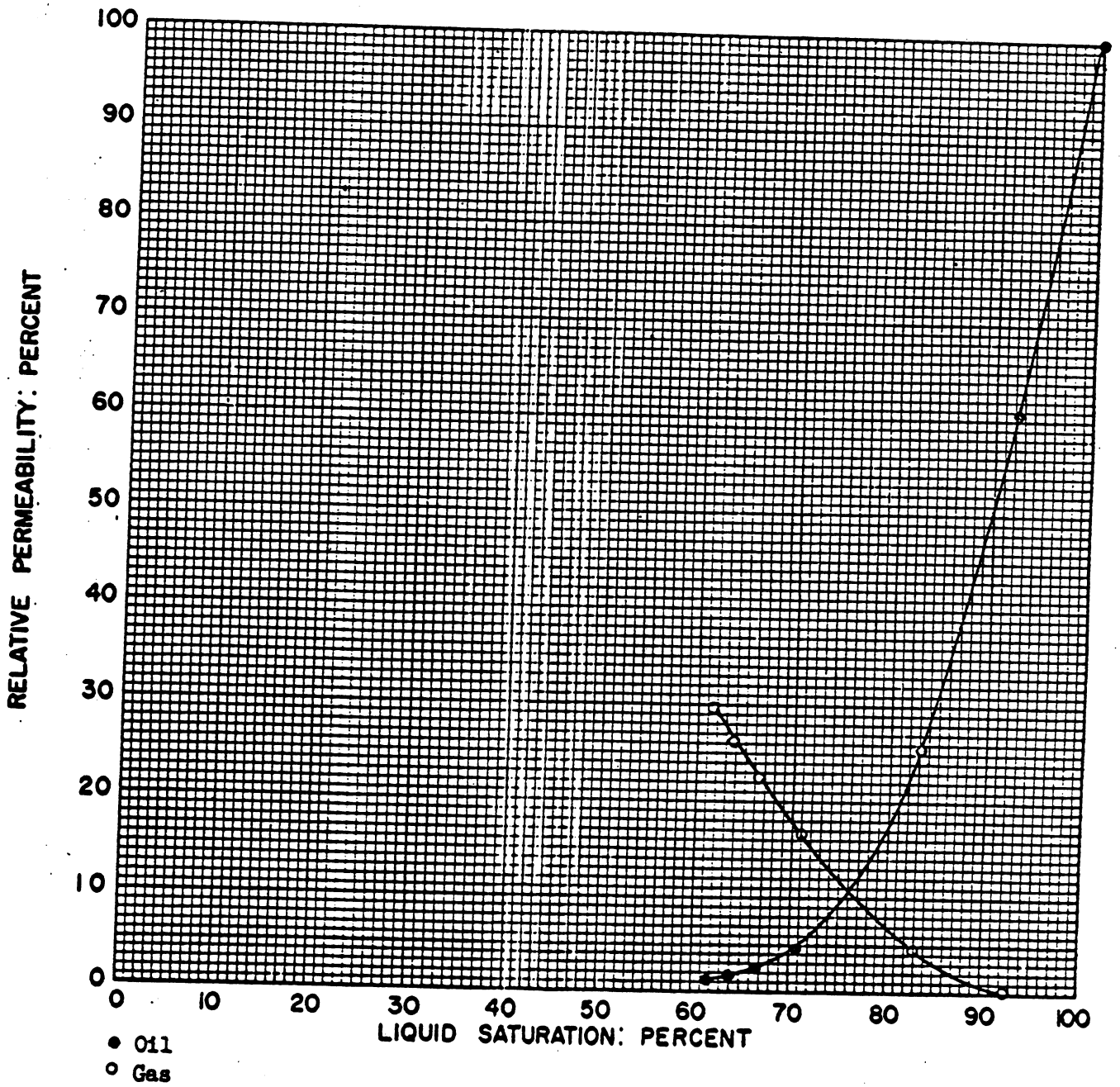
OIL SATURATION, %	EFFECTIVE OIL PERMEABILITY, md	RELATIVE OIL PERMEABILITY, %	EFFECTIVE GAS PERMEABILITY, md	RELATIVE GAS PERMEABILITY, %	OIL-GAS RELATIVE PERMEABILITY RATIO
100	51.4	100	-	-	-
92.1	31.2	60.7	0.0137	0.0241	2,520
82.9	13.0	25.3	2.58	4.54	5.57
70.8	2.36	4.59	9.51	16.7	0.275
66.2	1.36	2.65	12.8	22.5	0.118
63.6	0.867	1.69	14.9	26.2	0.0645
61.4	0.612	1.19	16.9	29.8	0.0399
0	-	-	56.8	100	-

NOTE: Relative K_g was obtained by dividing the effective K_g by the K_g at 100 percent gas saturation.

Relative K_o was obtained by dividing the effective K_o by the absolute permeability measured at 100 percent oil saturation.

O. GAS RELATIVE PERMEABILITY

FIELD	Geraldine Ford	CORE	GF-18
RESERVOIR	Delaware Sand	PERMEABILITY, MD.	51.4
WELL	TXL "L" 2	POROSITY, %	25.1
DEPTH	2,599 ft	OIL VISCOSITY, CP.	1.91
METHOD	Hafford	GAS VISCOSITY, CP.	0.018



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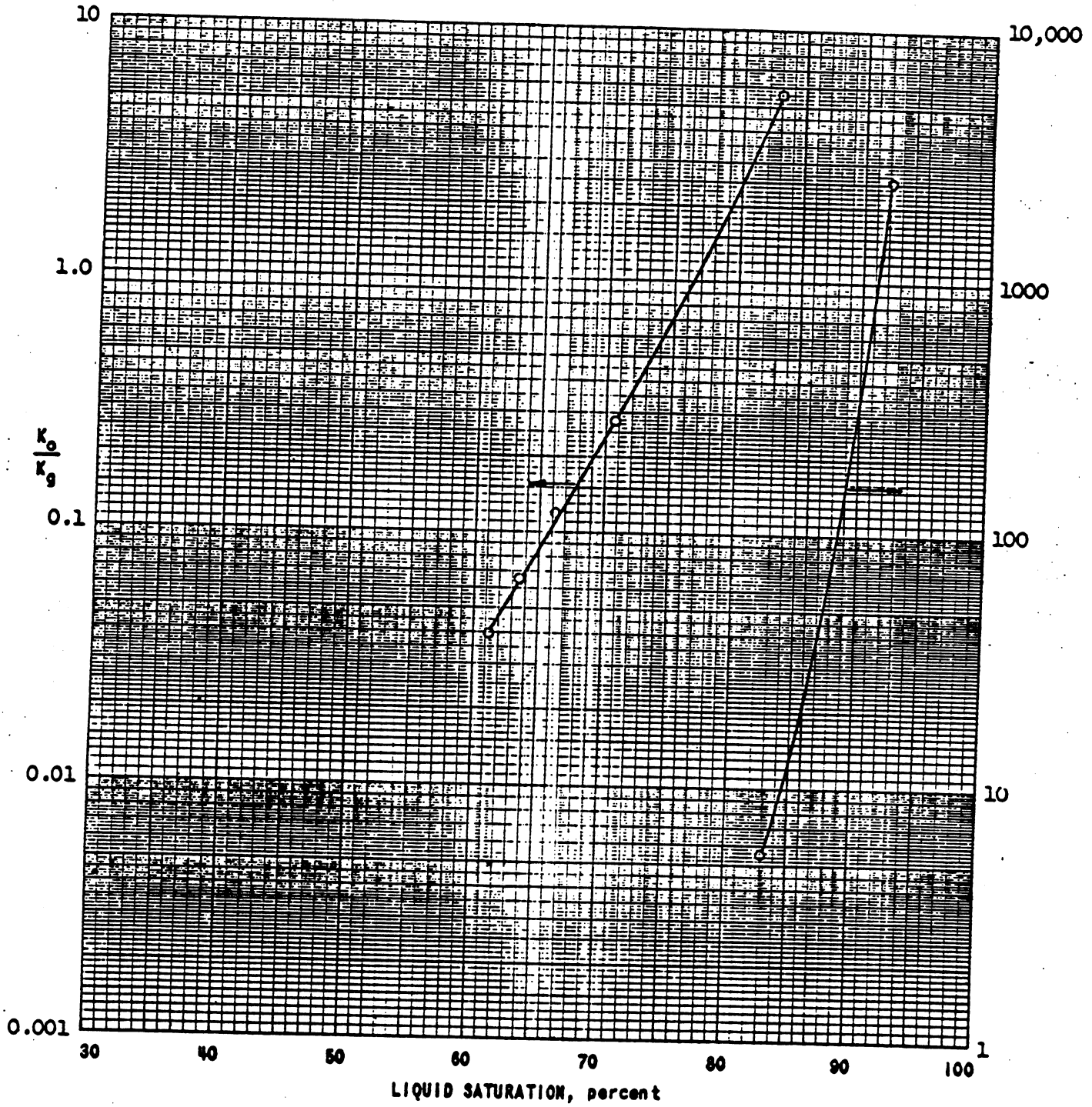
HUMBLE OIL & REFINING CO.

CORE REPORT 232

OIL-GAS RELATIVE PERMEABILITY RATIO

FIELD Geraldine Ford
RESERVOIR Delaware Sand
WELL TXL "L" 2
DEPTH, ft 2,599

CORE GF-18
PERMEABILITY, md 51.4
POROSITY, % 25.1



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CORE REPORT 232