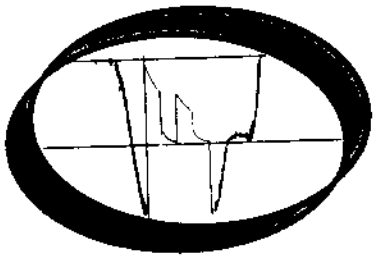
Formation Testing Service Report



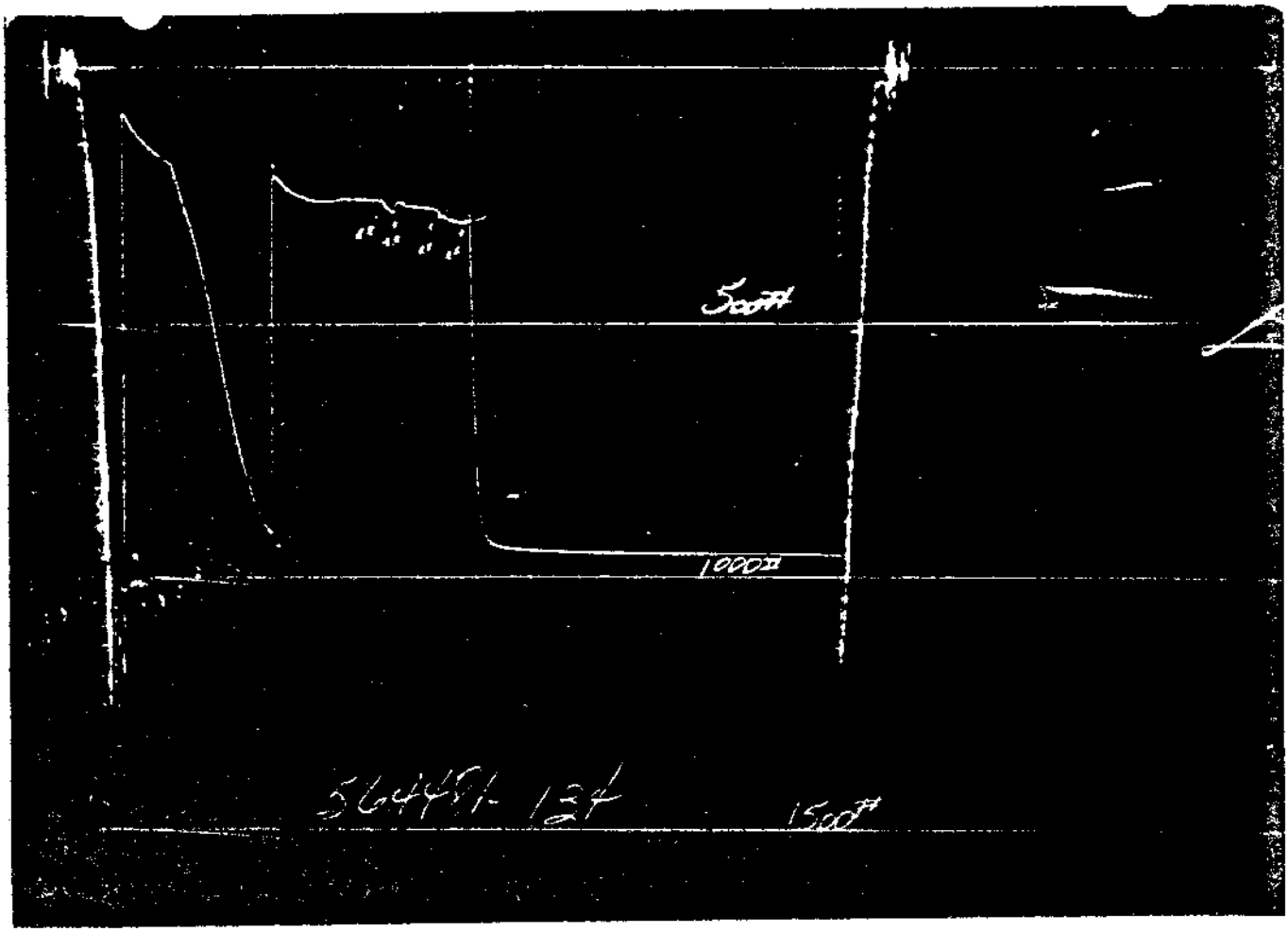
HALLIBURTON SERVICES

DUNCAN, OKLAHOMA

NOMENCLATURE

b	= Approximate Radius of Investigation	Feet
b_1	= Approximate Radius of Investigation (Net Pay Zone h_1)	Feet
D.R.	= Damage Ratio	——
El	= Elevation	Feet
GD	= B.T. Gauge Depth (From Surface Reference)	Feet
h	= Interval Tested	Feet
h_1	= Net Pay Thickness	Feet
K	= Permeability	md
K_1	= Permeability (From Net Pay Zone h_1)	md
m	= Slope Extrapolated Pressure Plot (Psi^2/cycle Gas)	psi/cycle
OF_1	= Maximum Indicated Flow Rate	MCF/D
OF_2	= Minimum Indicated Flow Rate	MCF/D
OF_3	= Theoretical Open Flow Potential with/Damage Removed Max.	MCF/D
OF_4	= Theoretical Open Flow Potential with/Damage Removed Min.	MCF/D
P_s	= Extrapolated Static Pressure	Psig.
P_F	= Final Flow Pressure	Psig.
P_{of}	= Potentiometric Surface (Fresh Water *)	Feet
Q	= Average Adjusted Production Rate During Test	bbls/day
Q_1	= Theoretical Production w/Damage Removed	bbls/day
Q_g	= Measured Gas Production Rate	MCF/D
R	= Corrected Recovery	bbls
r_w	= Radius of Well Bore	Feet
t	= Flow Time	Minutes
t_e	= Total Flow Time	Minutes
T	= Temperature Rankine	°R
Z	= Compressibility Factor	——
μ	= Viscosity Gas or Liquid	CP
Log	= Common Log	

* Potentiometric Surface Reference to Rotary Table When Elevation Not Given, Fresh Water Corrected to 100° F.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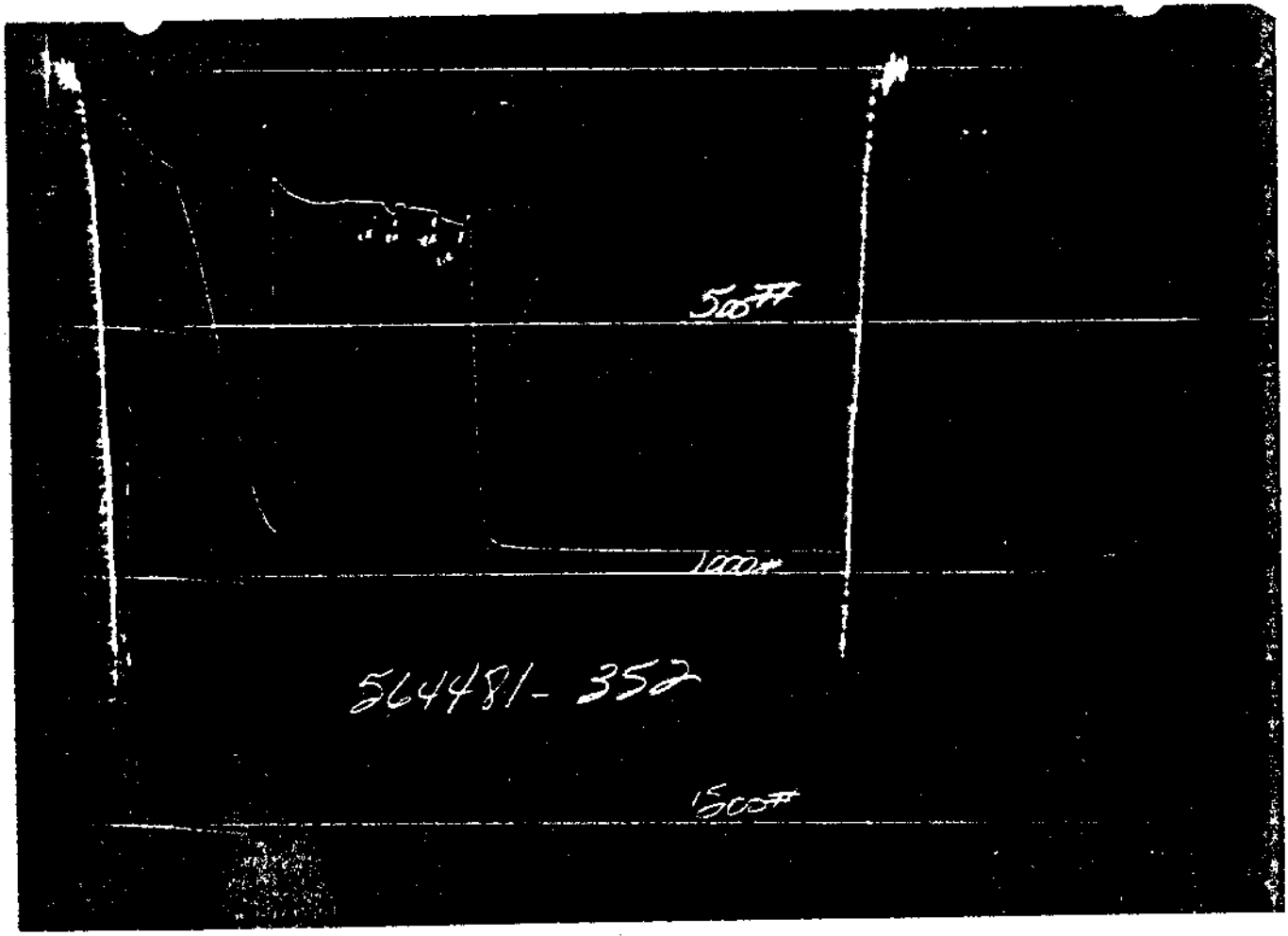
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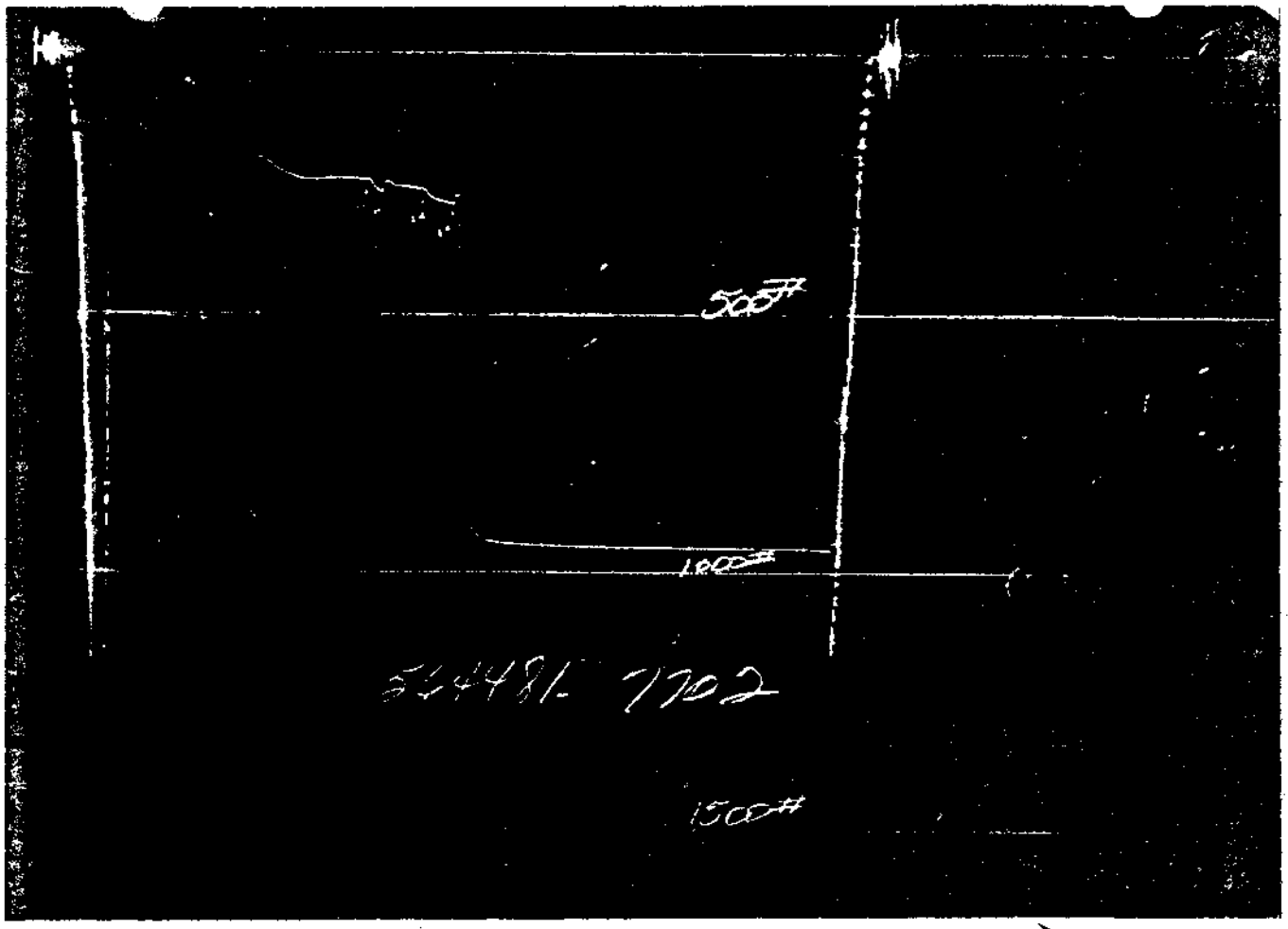
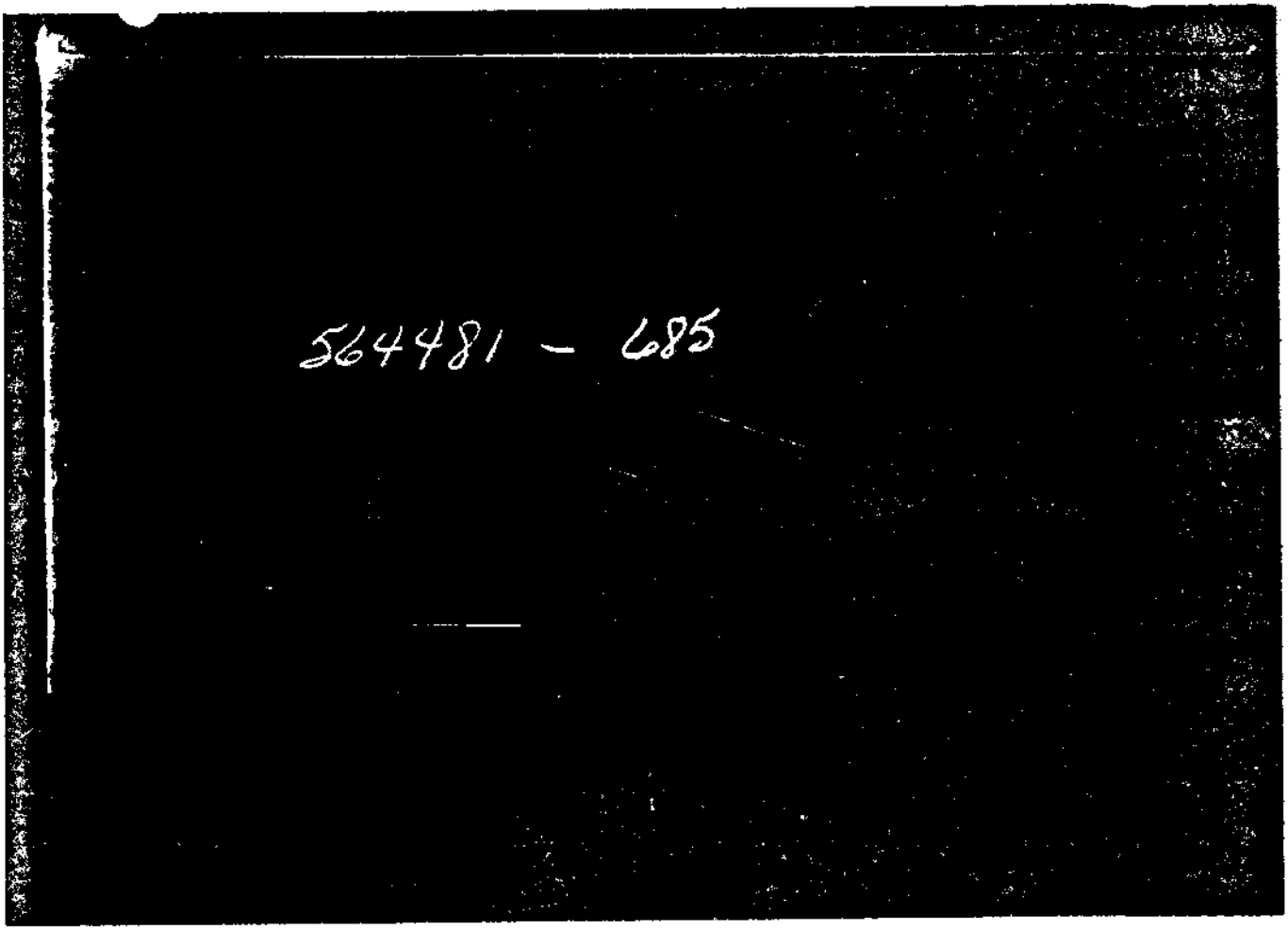


PRESSURE

TIME



Each Horizontal Line Equal to 1000 p.s.i.

FLUID SAMPLE DATA

Sampler Pressure _____ P.S.I.G. at Surface
Recovery: Cu. Ft. Gas _____
cc. Oil _____
cc. Water _____
cc. Mud _____
Tot. Liquid cc. _____
Gravity _____ ° API @ _____ °F.
Gas/Oil Ratio _____ cu. ft./bbl.

	RESISTIVITY	CHLORIDE CONTENT
Recovery Water	____ @ ____ °F.	____ ppm
Recovery Mud	____ @ ____ °F.	____ ppm
Recovery Mud Filtrate	____ @ ____ °F.	____ ppm
Mud Pit Sample	____ @ ____ °F.	____ ppm
Mud Pit Sample Filtrate	____ @ ____ °F.	____ ppm

Mud Weight 10.1 vis 38 sec.

Date 4-20-80 Ticket Number 564481
Kind of D.S.T. CASED HOSE Halliburton Location ANCHORAGE
Tester K.C. MC WILLIAMS Witness JIM RIDER
Drilling Contractor BRINKERHOFF DRILLING COMPANY IC SM

EQUIPMENT & HOLE DATA

Formation Tested Sag River
Elevation 30' Kelly bushing Ft.
Net Productive Interval 68' Ft.
All Depths Measured From Kelly bushing
Total Depth 2313' Ft.
Main Hole/Casing Size 7"
Drill Collar Length 322' I.D. 2.25"
Drill Pipe Length 1750' I.D. 2.764"
Packer Depth(s) 2117' Ft.
Depth Tester Valve 2095' Ft.

Cushion TYPE AMOUNT Ft. Depth Back Pres. Valve Surface Choke 1" Bottom Choke 1/2"

Recovered 60 Feet of slightly oil & gas cut mud
Recovered Feet of
Recovered Feet of
Recovered Feet of
Recovered Feet of

Meas. From Tester Valve

Remarks SEE PRODUCTION TEST DATA SHEET

TEMPERATURE	Gauge No. 7702 Depth: 2098 Ft.	Gauge No. 685 Depth: 2102 Ft.	Gauge No. 134 Depth: 2139 Ft.	TIME (00:00-24:00 hrs.)
	48 Hour Clock	48 Hour Clock	48 Hour Clock	Tool
Est. 65 °F.	Blanked Off no	Blanked Off no	Blanked Off yes	Opened 1210
Actual °F.	Pressures	Pressures	Pressures	Opened Bypass 1710

		Field	Office	Field	Office	Field	Office	Reported Minutes	Computed Minutes
Initial Hydrostatic		1149	1147.4			1163	1171.5		
First Period	Flow Initial	68	69.2			88	90.5	——	——
	Flow Final	170	167.6	Clock stopped		181	188.3	120	119
	Closed in	902	900.5			909	914.3	240	242
Second Period	Flow Initial	199	199.1			206	211.8	——	——
	Flow Final	276	271.6			289	287.5	480	478
	Closed in	960	958.9			958	959.3	900	901
Third Period	Flow Initial							——	——
	Flow Final								
	Closed in								
Final Hydrostatic		1149	1135.8			1163	1164.7	——	——

Legal Location Sec. - Twp. - Rng.: SOUTH BARROW
Lease Name: 20
Well No.: 1
Test No.: 2117 - 2313'
Tested Interval: HUSKY OIL NPR-4 OPERATIONS
Lease Owner/Company Name
Field Area
County: NORTH SLOPE
State: ALASKA

FORM 101-82 — PRINTED IN U.S.A.

FORMATION TEST DATA

LITTLE'S 111033 75C 2/80

C-15

FLUID SAMPLE DATA

Sampler Pressure _____ P.S.I.G. at Surface
Recovery: Cu. Ft. Gas _____
cc. Oil _____
cc. Water _____
cc. Mud _____
Tot. Liquid cc. _____
Gravity _____ ° API @ _____ °F.
Gas/Oil Ratio _____ cu. ft./bbl.

		RESISTIVITY		CHLORIDE CONTENT
Recovery Water	@	°F.		ppm
Recovery Mud	@	°F.		ppm
Recovery Mud Filtrate	@	°F.		ppm
Mud Pit Sample	@	°F.		ppm
Mud Pit Sample Filtrate	@	°F.		ppm

Mud Weight _____ vis _____ sec.

Date 4-20-80 Ticket Number 564481
Kind of D.S.T. CASED HOLE Halliburton Location ANCHORAGE
Tester K.C. MC WILLIAMS Witness JIM RIDER
Drilling Contractor BRINKERHOFF DRILLING COMPANY IC-SM

EQUIPMENT & HOLE DATA

Formation Tested _____
Elevation _____ Ft.
Net Productive Interval _____ Ft.
All Depths Measured From _____
Total Depth _____ Ft.
Main Hole/Casing Size _____
Drill Collar Length _____ I.D. _____
Drill Pipe Length _____ I.D. _____
Packer Depth(s) _____ Ft.
Depth Tester Valve _____ Ft.

Cushion TYPE AMOUNT _____ Ft. Depth Back Pres. Valve _____ Surface Choke _____ Bottom Choke _____

Recovered _____ Feet of _____
Recovered _____ Feet of _____
Recovered _____ Feet of _____
Recovered _____ Feet of _____
Recovered _____ Feet of _____

Meas. From Tester Valve

Remarks

Fourth gauge

TEMPERATURE	Gauge No. 352	Gauge No.	Gauge No.	TIME (00:00-24:00 hrs.)
	Depth: 2135 Ft.	Depth: Ft.	Depth: Ft.	
	48 Hour Clock	Hour Clock	Hour Clock	Tool Opened
Est. °F.	Blanked Off yes	Blanked Off	Blanked Off	
Actual °F.	Pressures	Pressures	Pressures	Opened Bypass

		Field	Office	Field	Office	Field	Office	Reported Minutes	Computed Minutes
Initial Hydrostatic			1170.1						
First Period	Flow Initial		87.4					—	—
	Flow Final		188.2						
	Closed in		915.8						
Second Period	Flow Initial		209.9					—	—
	Flow Final		286.9						
	Closed in		961.1						
Third Period	Flow Initial							—	—
	Flow Final								
	Closed in								
Final Hydrostatic			1162.2					—	—

Legal Location Sec. - Twp. - Rng.
Lease Name: SOUTH BARROW
Well No.: 20
Test No.: 1
Field Area
Tested Interval: 2117 - 2313'
County: NORTH SLOPE
State: ALASKA
Lease Owner/Company Name: HUSKY OIL NPR-4 OPERATIONS

FORM 181—R2 — PRINTED IN U.S.A.

FORMATION TEST DATA

LITTLE'S 111033 75C 2/80

15

Casing perfs. _____ Bottom choke 1/2" Surf. temp. _____ °F Ticket No. 564481

Gas gravity _____ Oil gravity _____ GOR _____

Spec. gravity _____ Chlorides _____ ppm Res. _____ @ _____ °F

INDICATE TYPE AND SIZE OF GAS MEASURING DEVICE USED _____

Date Time a.m. p.m.	Choke Size	Surface Pressure psi	Gas Rate MCF	Liquid Rate BPD	Remarks
0830					Made up tools
1030					Ran in hole
1210	1"				Tool opened with strong blow for
					first flow period.
1410					Closed tool for first closed in
					pressure period.
1810	1"				Opened with strong blow
1910					Gas to the surface
2240	1/16"	15			Choked down to 1/16"
2305	1"				Opened back to 1"
0050	1/8"				Choked down to 1/8"
0055	"	9			
0100	"	12			
0105	"	14			
0110	"	15			
0115	"	15.5			
0120	"	16			
0125	"	16.5			
0130	"	17			
0135	"	17.5			
0140	"	18			
0145	"	18			
0150	"	18.5			
0155	"	19			
0200	"	19.5			

Casing perfs.____ Bottom choke____ Surf. temp____ °F Ticket No.____

Gas gravity____ Oil gravity____ GOR____

Spec. gravity____ Chlorides____ ppm Res.____ @____ °F

INDICATE TYPE AND SIZE OF GAS MEASURING DEVICE USED____

Date Time a.m. p.m.	Choke Size	Surface Pressure psi	Gas Rate MCF	Liquid Rate BPD	Remarks
					Opened back to 1" choke
0210					Closed DCIP for final closed in
					pressure period.
1605					Dropped bar & reversed out
1710					Unseated packer and pulled out of
					hole.

FORM 152-R1—PRINTED IN U.S.A.

PRODUCTION TEST DATA

LITTLE'S 96672 5M 8/7

HUSKY OIL NPR-4 OPERATIONS
Lease Owner/Company Name

564481
Ticket Number

B.T.	7702	B.T. 685	B.T. 352
Depth	2098	Depth 2101'	Depth 2135'

	48 Hour			48 Hour			48 Hour		
	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.
	FIRST FLOW PERIOD						FIRST FLOW PERIOD		
P-0	.0000		69.2				.0000		87.4
1	.0324		92.5*				.0319		112.6*
2	.0665		113.3				.0655		134.8
3	.1006		130.3				.0991		151.1
4	.1348		145.3				.1327		165.5
5	.1689		156.9				.1663		176.8
6	.2030		167.6	No readings			.2000		188.2
	20 minute intervals						20 minute intervals		
	*First interval is			Clock stopped			*First interval is		
	equal to 19 minutes.						equal to 19 minutes.		
	FIRST CIP PERIOD						FIRST CIP PERIOD		
0	.0000		167.6				.0000		188.2
1	.0304	.885	217.5**				.0303	.881	241.6**
2	.0574	.657	261.5				.0573	.652	284.0
3	.0845	.532	302.0				.0843	.528	327.4
4	.1115	.450	349.2				.1112	.447	377.2
5	.1386	.392	404.6				.1382	.389	431.4
6	.1656	.347	468.6				.1652	.345	495.5
7	.1927	.312	532.2				.1922	.310	559.9
8	.2197	.284	600.4				.2192	.282	623.7
9	.2467	.261	662.0				.2461	.258	685.6
10	.2738	.241	720.6				.2731	.239	741.6
11	.3008	.224	772.1				.3001	.222	793.7
12	.3279	.209	817.5				.3271	.207	838.0
13	.3549	.196	854.2				.3541	.194	874.5
14	.3819	.185	881.2				.3810	.183	899.1
15	.4090	.175	900.5				.4080	.173	915.8
	16 minute intervals						16 minute intervals		
	**First interval is						**First interval is		
	equal to 18 minutes.						equal to 18 minutes.		
	SECOND FLOW PERIOD						SECOND FLOW PERIOD		
0	.0000		199.1				.0000		209.9
1	.0473		212.2***				.0469		233.2***
2	.1318		235.4				.1306		254.4
3	.2163		243.7				.2143		260.8
4	.3009		240.3				.2979		256.9
5	.3854		241.7				.3816		258.3
	(.4510-C		244.1)				(.4440-C		260.3)
6	.4699		257.7				.4653		274.1
	(.4980-C		268.3)				(.4930-C		284.5)
	(.5370-A		247.0)				(.5280-A		263.3)

Remarks: ***First interval is equal to 28 minutes. C = choke change
A = apparent choke change

HUSKY OIL NPR-4 OPERATIONS — Lease Owner/Company Name

564481 Page 2 — Ticket Number

	B.T. 7702	B.T. 685	B.T. 352
	Depth 2098	Depth 2101'	Depth 2135'
	48 Hour	48 Hour	48 Hour

	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.
	SECOND FLOW (CONT.)						SECOND FLOW (CONT.)		
P-7	.5544		254.8				.5490		271.2
8	.6389		259.6				.6327		275.6
	(.6710-C		262.5)				(.6650-C		277.6)
9	.7235		282.7				.7163		297.8
	(.7930-C		290.4)	No readings			(.7840-C		306.2)
10	.8080		271.6				.8000		286.9
	50 minute intervals			Clock stopped			50 minute intervals		
	SECOND CIP PERIOD						SECOND CIP PERIOD		
0	.0000		271.6				.0000		286.9
1	.0509	1.319	878.3				.0506	1.317	875.4
2	.1018	1.039	934.8				.1012	1.037	938.4
3	.1526	.882	943.0				.1517	.880	946.3
4	.2035	.776	945.9				.2023	.774	949.7
5	.2544	.697	947.3				.2529	.695	951.2
6	.3053	.635	948.8				.3035	.633	952.7
7	.3561	.584	949.7				.3541	.583	953.7
8	.4070	.542	950.7				.4046	.541	954.7
9	.4579	.506	951.7				.4552	.505	955.2
10	.5088	.475	952.6				.5058	.474	955.6
	30 minute intervals						30 minute intervals		
11	.6105	.424	953.1				.6070	.423	956.6
12	.7123	.384	953.6				.7082	.382	957.1
13	.8140	.351	954.1				.8094	.349	957.6
14	.9158	.323	954.6				.9106	.322	958.1
15	1.0175	.300	955.5				1.0118	.298	958.6
16	1.1193	.279	955.5				1.1130	.278	958.6
17	1.2210	.262	955.5				1.2142	.261	959.1
18	1.3228	.247	956.0				1.3154	.246	959.1
19	1.4245	.233	955.1				1.4166	.232	958.1
	60 minute intervals						60 minute intervals		
20	1.5280	.221	958.9				1.5190	.220	961.1
	61 minute interval						61 minute interval		

Remarks: C = choke change

HUSKY OIL NPR-4 OPERATIONS — 564481 Page 3

Lease Owner/Company Name — Ticket Number

B.T. 134 B.T. B.T.

Depth 2139' Depth Depth

48 Hour

	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.
	FIRST FLOW PERIOD								
P-0	.0000		90.5						
1	.0319		110.5*						
2	.0655		134.5						
3	.0991		152.1						
4	.1327		165.8						
5	.1663		177.5						
6	.2000		188.3						
	20 minute intervals								
	*First interval is								
	equal to 19 minutes.								
	FIRST CIP PERIOD								
0	.0000		188.3						
1	.0302	.882	237.7**						
2	.0570	.654	280.2						
3	.0839	.529	324.2						
4	.1107	.448	373.0						
5	.1376	.390	427.7						
6	.1644	.346	492.1						
7	.1912	.311	558.9						
8	.2181	.283	624.7						
9	.2449	.259	685.1						
10	.2718	.240	744.1						
11	.2986	.223	794.5						
12	.3254	.208	838.0						
13	.3523	.195	873.7						
14	.3791	.184	898.7						
15	.4060	.174	914.3						
	16 minute intervals								
	**First interval is								
	equal to 18 minutes.								
	SECOND FLOW PERIOD								
0	.0000		211.8						
1	.0470		230.9***						
2	.1309		254.3						
3	.2148		261.2						
4	.2987		257.3						
5	.3826		258.7						
	(.4470-C		260.2)						
6	.4665		273.4						
	(.4950-C		284.1)						
	(.5320-A		263.1)						

Remarks: ***First interval is equal to 28 minutes. C - choke change
A = apparent choke change

HUSKY OIL NPR-4 OPERATIONS
Lease Owner/Company Name

564481 Page 4
Ticket Number

B.T. 134 B.T. B.T.

Depth 2139' Depth Depth

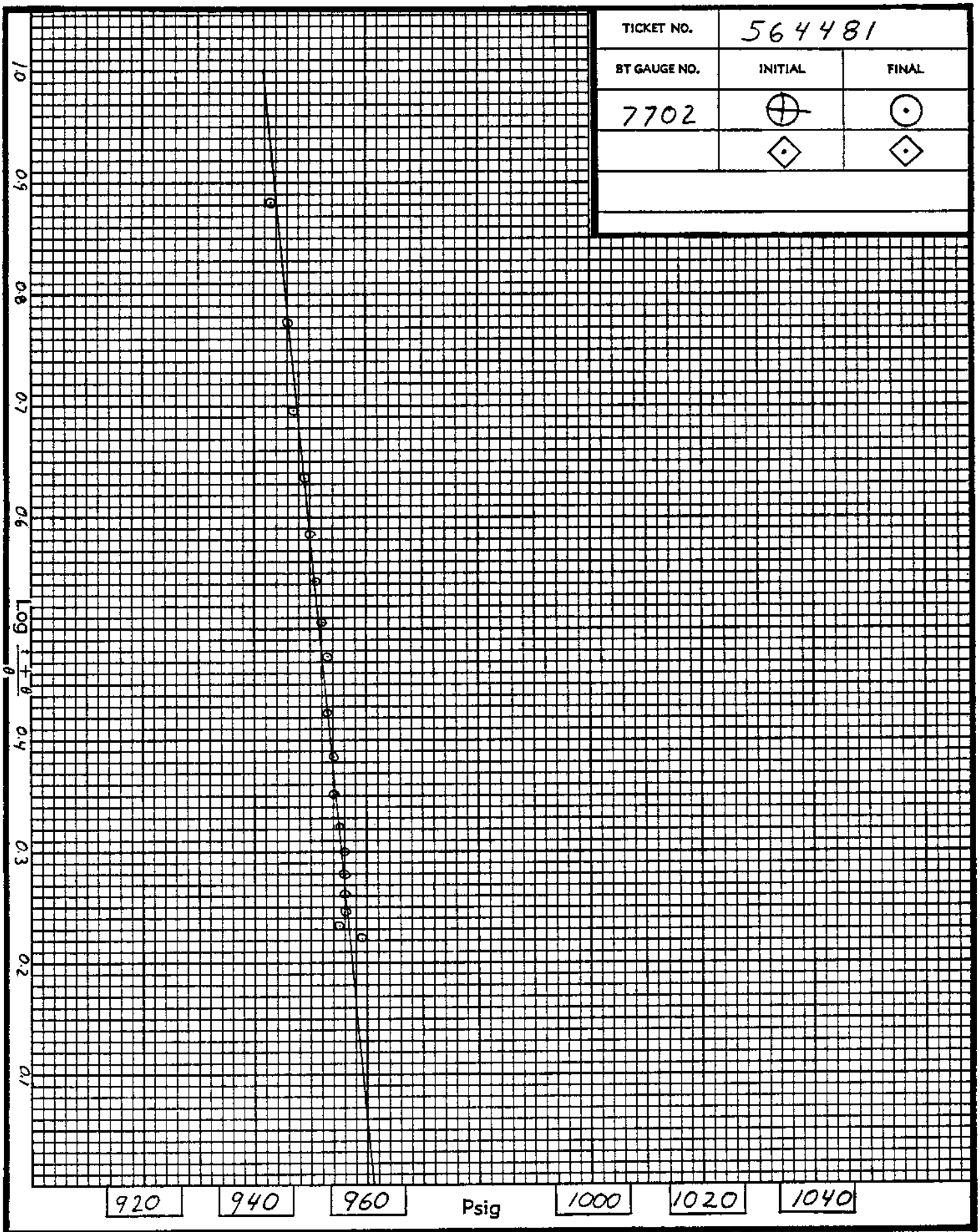
48 Hour

	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.	Time Defl. .000"	Log $\frac{t+\theta}{\theta}$	PSIG Temp. Corr.
	SECOND FLOW (CONT.)								
P-7	.5503		270.9						
8	.6342		274.9						
	(.6690-C		277.8)						
9	.7181		297.8						
	(.7870-C		306.1)						
10	.8020		287.5						
	50 minute intervals								
	SECOND CIP PERIOD								
0	.0000		287.5						
1	.0504	1.320	881.5						
2	.1008	1.039	936.8						
3	.1512	.822	944.2						
4	.2016	.776	947.1						
5	.2520	.697	949.1						
6	.3025	.635	950.0						
7	.3529	.584	951.0						
8	.4033	.542	952.5						
9	.4537	.506	953.0						
10	.5041	.475	953.9						
	30 minute intervals								
11	.6049	.424	954.4						
12	.7058	.384	955.4						
13	.8066	.352	955.9						
14	.9074	.323	955.9						
15	1.0082	.300	956.4						
16	1.1091	.280	956.4						
17	1.2099	.262	956.9						
18	1.3107	.247	957.4						
19	1.4115	.233	956.9						
	60 minute intervals								
20	1.5410	.221	959.3						
	61 minute interval								

Remarks: C = choke change

(15)

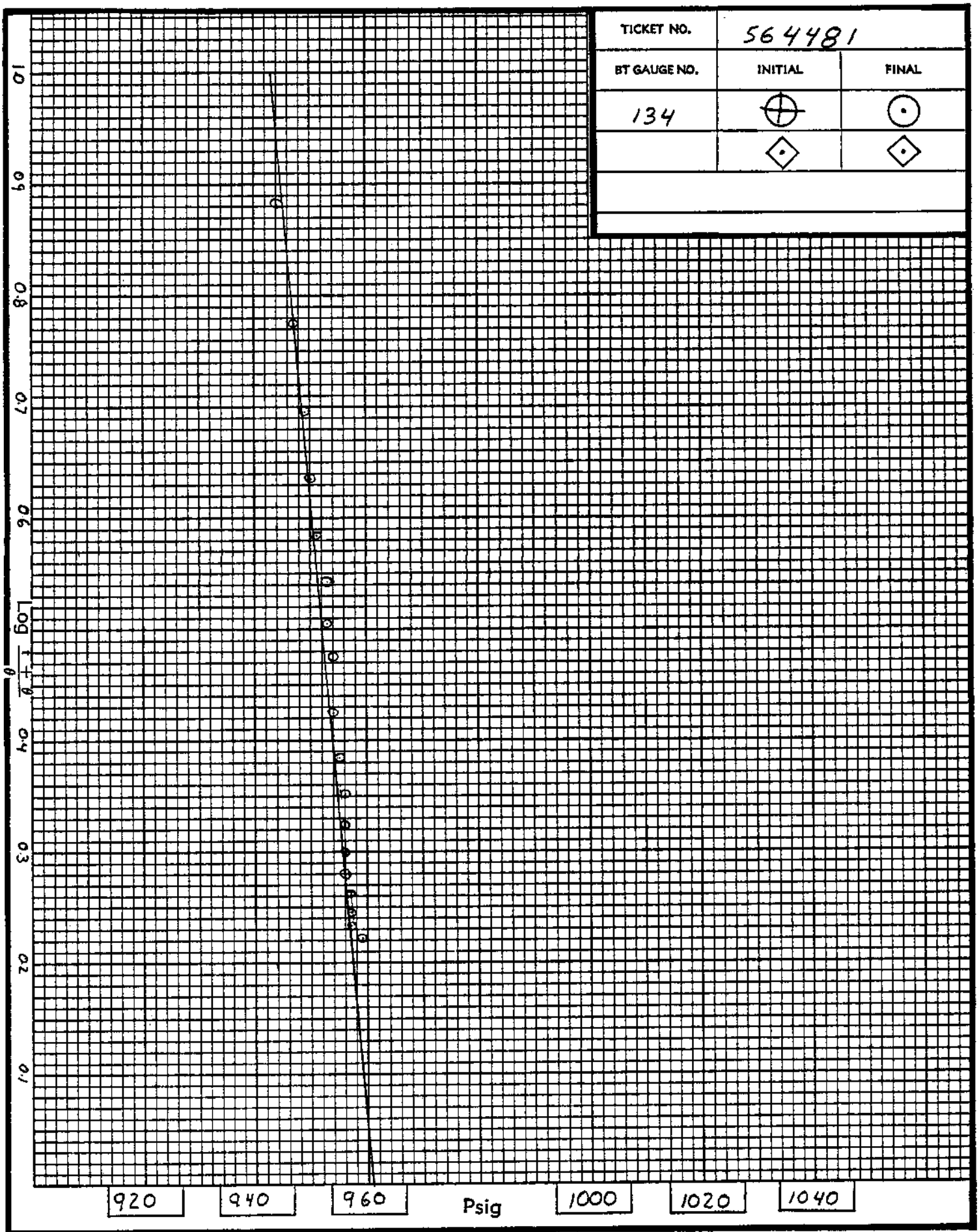
TICKET NO.	564481	
BT GAUGE NO.	INITIAL	FINAL
7702	⊕	⊙
	◇	◇



EXTRAPOLATED PRESSURE GRAPH

FORM 134—PRINTED IN U.S.A.
LITTLE'S

TICKET NO.	564481	
BT GAUGE NO.	INITIAL	FINAL
134	⊕	⊙
	◇	◇



EXTRAPOLATED PRESSURE GRAPH

Gas Production

B.T. Gauge Numbers			7702	134	Ticket Number		564481	
			PRESSURE	PRESSURE				
Initial Hydrostatic			1147	1172	Elevation		30	ft.
Final Hydrostatic			1136	1165	Production Rate	1st Flow		MCF
1st Flow	Initial	Time	69	91		2nd Flow	11.9	MCF
	Final	119	168	188		3rd Flow		MCF
	Closed In Pressure	242	901	914	Hole Size	assumed	8.75	in.
2nd Flow	Initial	Time	199	212	Footage Tested		68	ft.
	Final	478	272	287	Mud Weight		10.1	lbs./gal.
	Closed In Pressure	901	959	959	Gas Viscosity		.013	cp
3rd Flow	Initial	Time			Gas Gravity	assumed	.60	—
	Final				Gas Compressibility		.85	—
	Closed In Pressure				Temperature		65	°F
Extrapolated Static Pressure		1st						
		2nd	961	961				
		3rd						
Slope P/10		1st						
		2nd	942	943				
		3rd						

Remarks: Initial period not calculated due to insufficient closure during closed in period.

SUMMARY

B.T. Gauge No. 7702, Depth 2098' | B.T. Gauge No. 134, Depth 2139'

PRODUCT	EQUATION	FIRST	SECOND	THIRD	FIRST	SECOND	THIRD	UNITS
Transmissibility	$\frac{Kh}{\mu} = \frac{1637\ Q_g\ ZT}{m}$		240.43			253.65		$\frac{md.\ ft.}{cp}$
Theoretical Flow Capacity	$Kh = \frac{Kh}{\mu}\ \mu$		3.13			3.30		md. ft.
Average Effective	$K = \frac{Kh}{h}$		.046			.049		md.
Permeability	$K_1 = \frac{Kh}{h_1}$		-			-		md.
Indicated Flow Capacity	$(Kh)_a = \frac{3200\ Q_g\ \mu\ ZT\ \log(0.472\ b/r_w)}{P_s^2 - P_f^2}$		.229			.234		md. ft.
Damage Ratio	$DR = \frac{\text{Theo. Flow Cap}}{\text{Indicated Flow Cap}} \quad \frac{Kh}{(Kh)_a}$		13.68			14.10		—
Indicated Flow Rate	$OF_1 = \frac{Q_g \quad P_s^2}{P_s^2 - P_f^2}$ Max.		12.94			13.08		MCFD
	$OF_2 = \frac{Q_g \quad P_s}{\sqrt{P_s^2 - P_f^2}}$ Min.		12.41			12.47		MCFD
Theoretical Potential Rate	$OF_3 = OF_1\ DR$ Max.		176.96			184.36		MCFD
	$OF_4 = OF_2\ DR$ Min.		169.72			175.89		MCFD
Approx. Radius of Investigation	$b \cong \sqrt{Kt}$ or $\sqrt{Kt_0}$		5.60			5.75		ft.
	$b_1 \cong \sqrt{K_1 t}$ or $\sqrt{K_1 t_0}$		-			-		ft.
Potentiometric Surface *	$Pot. = (El - GD) + (2.319\ Ps)$		160.56			119.56		ft.

TICKET NO. 564481

	D. D.	I. D.	LENGTH	DEPTH
Drill Pipe or Tubing				
Drill Collars				
Reversing Sub	4.75"	2.75"	1'	
Water Cushion Valve				
Drill Pipe	3.50"	2.764"	1750'	
Drill Collars	4.75"	2.25"	322'	
Handling Sub & Choke Assembly			4.50'	
Dual CIP Valve	3.88"	.87"	6.85'	2081'
~~Dual CIP Sampler~~ Tight -hole sub assy.	4.75"	.50"	6.66'	
Hydro-Spring Tester	3.90"	.62"	6.30'	2095'
Multiple CIP Sampler				
Extension Joint				
AP Running Case	3.87"	3.00"	4.93'	2098'
"	3.87"	3.00"	4.93'	2102'
Hydraulic Jar	3.90"	1.25"	5.00'	
VR Safety Joint	3.88"	75"	3.30'	
Pressure Equalizing Crossover				
Packer Assembly	5.43"	1.90"	4.50'	2117'
Distributor				
Packer Assembly				
Flush Joint Anchor	2 7/8"	2.44"	15.85'	
Pressure Equalizing Tube				
Blanked-Off B.T. Running Case				
Drill Collars				
Anchor Pipe Safety Joint				
Packer Assembly				
Distributor				
Packer Assembly				
Anchor Pipe Safety Joint				
Side Wall Anchor				
Drill Collars				
Flush Joint Anchor				
Blanked-Off B.T. Running Case	3.03"	2.31"	4'	2135'
"	3.03"	2.31"	4.75'	2139'
Total Depth				2313'

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EQUIPMENT DATA

LITTLE'S