JOHNSTON TESTERS
A WORLD OF EXPERIENCE

DRILL STEM TEST SPECIAL DATA ANALYSIS

FIELD REPORT #63674 L

APRIL 25, 1962

THIS APPEARS TO BE A GOOD FORMATION AND A GOOD MECHANICAL TEST. THE TEST WAS CONDUCTED IN SUCH A MANNER THAT THE DATA OBTAINED SHOULD BE ADEQUATE FOR RELIABLE ANALYSIS.

1. WELL BORE DAMAGE: THE CALCULATED ESTIMATED DAMAGE RATIO OF 2.18 INDICATES THAT WELL BORE DAMAGE IS PRESENT AT THE TIME AND CONDITIONS OF THIS TEST. THIS VALUE INFERS THAT THE RATE OF PRODUCTION OBSERVED DURING THIS TEST SHOULD BE INCREASED 2.18 TIMES IF THE WELL BORE DAMAGE WERE REMOVED. THIS DOES NOT INFER THAT THIS WELL SHOULD FLOW OIL AT THE SURFACE IF THE WELL BORE DAMAGE WERE REMOVED. THE VALUE CALCULATED FOR THE POTENTIOMETRIC SURFACE OF -353 FEET OF FRESH WATER INFERS THAT THE AVAILABLE RESERVOIR PRESSURE WOULD LIFT A COLUMN OF FRESH WATER TO THIS ELEVATION. IT DOES NOT APPEAR LIKELY THAT THE RESERVOIR PRESSURE WOULD LIFT A COLUMN OF RELATIVELY DEAD OIL THE ADDITIONAL 3172 FEET TO THE SURFACE.

2. PERMEABILITY: THE CALCULATED TRANSMISSIBILITY FACTOR OF 300.66 MD.-FT./CP. INDICATES AN AVERAGE EFFECTIVE PERMEABILITY TO OIL OF 57.1 MD. FOR THE 6 FOOT OF NET EFFECTIVE POROSITY WITHIN THE 162 FOOT TEST INTERVAL. THIS VALUE WAS CALCULATED ASSUMING 35° API OIL, WITH 767 CU. FT. OF DISSOLVED GAS AT RESERVOIR CONDITIONS. APPROPRIATE VALUES FOR OIL VISCOSITY AND FORMATION VOLUME FACTOR WERE SELECTED FROM THE LITERATURE FOR THIS OIL.

3. RESERVOIR PRESSURE: EXTRAPOLATION OF THE INITIAL SHUT-IN PRESSURE BUILD-UP PLOT INDICATES A RESERVOIR PRESSURE OF 1271 P.S.I.G. AT RECORDER DEPTH.

4. GENERAL COMMENTS: THIS APPEARS TO BE A TEST OF A GOOD PERMEABLE OIL ZONE. THE RESERVOIR PRESSURE SEEMS TO BE LESS THAN SHOULD BE ENCOUNTERED AT THE DEPTH OF THIS TEST. REMOVAL OF THE WELL BORE DAMAGE WOULD RESULT IN CONSERVATION OF RESERVOIR ENERGY; HOWEVER, IT WOULD APPEAR FROM THIS TEST THAT A PUMPING WELL SHOULD RESULT FROM COMPLETION WHICH SHOULD BE CAPABLE OF PRODUCING THE PERMITTED ALLOWABLE.

James D. Hillhouse

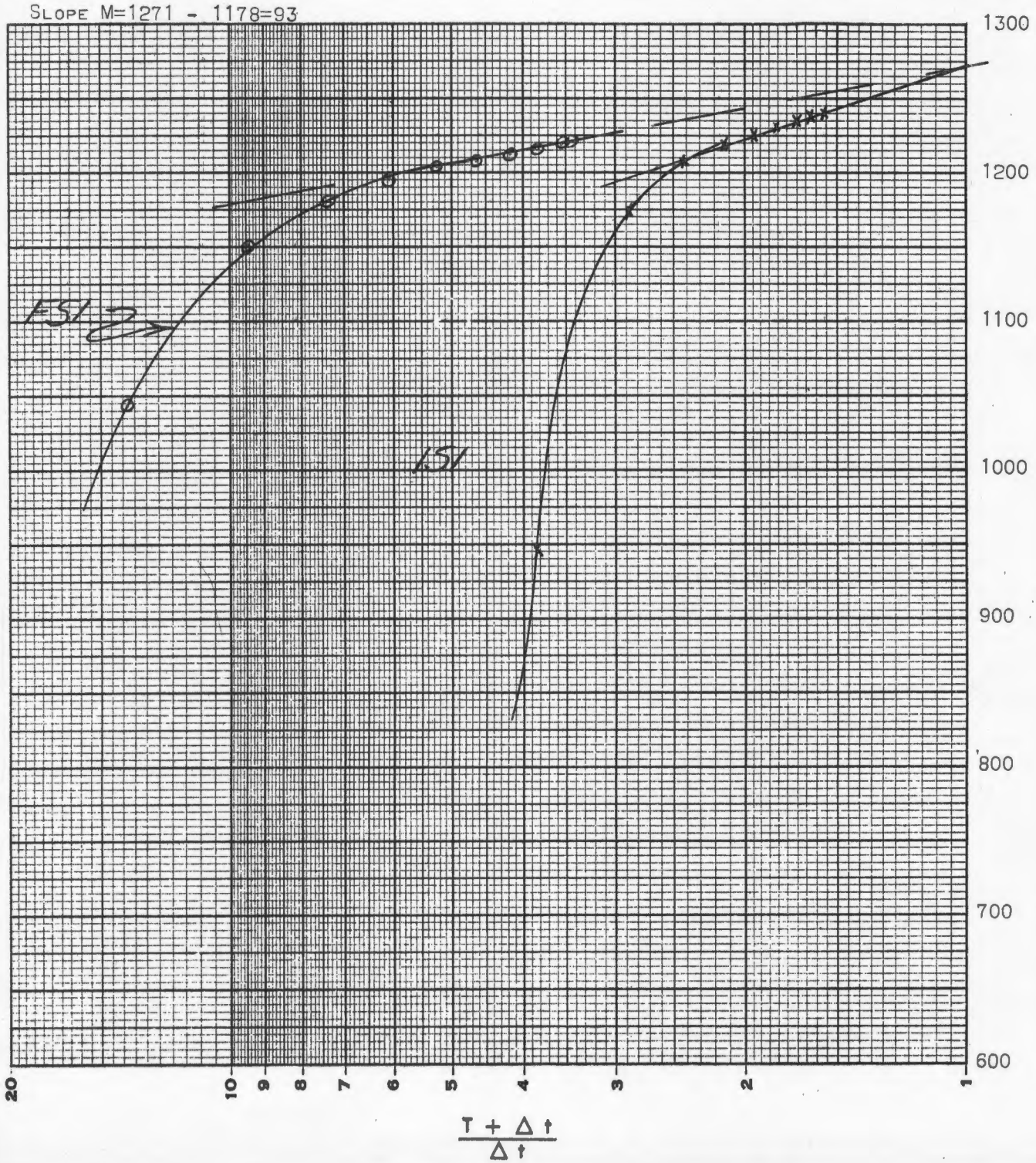
JAMES D. HILLHOUSE,
CHART ANALYST

ANADARKO PRODUCTION CO.
WINCHELL #A-1, SEWARD CO., KANSAS
TEST #1, 5950' TO 6112'

JOHNSTON TESTERS, INC.

Recorder No. T-247 **Reservoir Engineering Data** Field Report No. 63674 L

Estimated Damage Ratio	EDR	2.18		Effective Transmissibility	$\frac{Kh}{\mu B}$	300.66	$\frac{Md\text{-}ft.}{Cp.}$
Maximum Reservoir Pressure	P_o	1271	P.S.I.G.	Effective Transmissibility	$\frac{Kh}{\mu B}$		$\frac{Md\text{-}ft.}{Cp.}$
Slope of Shut-in Curve	M	93	PSI /log cycle	Flow Rate	Q	172	Bbl./day
Potentiometric Surface (Datum Plane, Sea Level)	PS	-353	ft.	Flow Rate	Q		Bbl./day
Productivity Index	PI	.19	Bbl./day/PSI	Gas Oil Ratio	GOR	767	CF/Bbl.
				K(EFFECTIVE TO OIL)		57.1 MD.	



Assumptions made for Calculations for Liquid Recoveries

1. Q is taken as steady state flow.

2. P_f is formation flowing pressure at steady state flow.

3. Formation flow is taken as single phase flow.
   If gas is produced at surface, phase separation is assumed to have occurred in drill pipe.

4. Radial flow is assumed.

5. Where PVT data is not available then it is assumed that:

Effective permeability, K, will fall between	1 to 200 md
Formation porosity, f, will fall between	0.1 to 0.3
Fluid compressibility, c, will fall between	10^{-6} to 10^{-4}
Fluid viscosity, μ, will fall between	0.05 to 50 cp.
Well bore radius, r_w, will fall between	3⅞" to 4⅜"
Which gives an average value for the function $\log \frac{K}{f\mu c r_w^2}$ of	5.5

6. Other standard radial flow, steady state assumptions.

Empirical Equations:

1. $EDR = \frac{1}{\log T + 2.65} \left[\frac{P_o - P_f}{M}\right]$

2. Transmissibility $\frac{Kh}{\mu B} = \frac{162.6Q}{M}$

3. $P.I. = \frac{Q}{P_o - P_f}$

4. $P.S. = \left[P_o \times 2.309 \text{ ft./PSI}\right] - \left[\text{Recorder depth to sea level.}\right]$

Symbols		Dimensions
B	Formation volume factor	vol./vol.
c	Fluid compressibility	vol./vol./psi.
EDR	Estimated damage ratio	
f	Formation porosity	fractional
h	Producing interval	feet
J	Productivity index	Bbls./day/PSI
K	Permeability	Millidarcies
M	Slope of shut-in build up	PSI/log cycle
P_f	Finol flowing pressure	PSI
P_{fsi}	Final shut-in pressure at time t	PSI
P_{isi}	Initial shut-in pressure	PSI
P_o	Maximum reservoir pressure	PSI
P. S.	Potentiometric surface	ft.

Symbols		Dimensions
Q	Rate of flow during test	Bbls./day
Q_o	Rote of oil flow during test	Bbls./day
Q_w	Rate of water flow during test	Bbls./day
Q_g	Rate of gas flow during test	MCF/day
r_w	Well bore radius	inches
t	Final shut-in time period	minutes
Δt	Increment time of final shut-in time period	minutes
T	Open flow time period	minutes
$°T_f$	Formation temperature	°Rankin
μ	Fluid viscosity	Centipoise
Z	Gas deviation factor (Compressibility factor)	
$\frac{Kh}{\mu B}$ or $\frac{Kh}{\mu}$	Transmissibility factor	$\frac{\text{Md.} - \text{ft.}}{\text{Cp.}}$

JOHNSTON TESTERS, INC.

Pressure Breakdown Data

Date 4-21-62 Field Report No. 63674 L

Recorder No. T-247 Capacity 5000# Recorder Depth 6107' -2919 -3288

Clock No. 1314 Clock travel 0.02085 inches per min. Well Temperature 133 °F.

Point		Pressure
A	Initial Hydrostatic Mud	3041
B	Initial Shut-in	1240
C	Initial Flow	325
D	Final Flow	354
E	Final Shut-in	1221
F	Final Hydrostatic Mud	2906

	Time Given	Time Computed
Opened Tool	0950	
Initial Shut-in	30 Mins.	30 Mins.
Flow	78 Mins.	76 Mins.
Final Shut-in	30 Mins.	32 Mins.

c-1	195
c-2	186

Remarks: FROM POINT "C" TO POINT "c-1"=17 MINUTES.

PRESSURE INCREMENTS

Breakdown: ____ increments of ____ mins. and a final increment of ____ mins.			INITIAL SHUT-IN Breakdown: 10 increments of 3 mins. and a final increment of - mins.			FINAL SHUT-IN Breakdown: 10 increments of 3 mins. and a final increment of 2 mins.		
Point Minutes	Pressure	$\frac{T+\Delta t}{\Delta t}$	Point Minutes	Pressure	$\frac{T+\Delta t}{\Delta t}$	Point Minutes	Pressure	$\frac{T+\Delta t}{\Delta t}$
			c-1 0	195		D 0	354	
			3	560	6.667	3	793	26.33
			6	946	3.835	6	1043	13.67
			9	1174	2.889	9	1151	9.44
			12	1208	2.417	12	1181	7.33
			15	1219	2.133	15	1195	6.07
			18	1226	1.945	18	1204	5.22
			21	1232	1.811	21	1208	4.62
			24	1235	1.709	24	1213	4.17
			27	1238	1.630	27	1216	3.82
			B 30	1240	1.567	30	1219	3.53
						E 32	1221	3.45

JOHNSTON TESTERS, INC.

SURFACE INFORMATION

Well Flowed	Amount
GAS	

Reversed Out	Amount
NO	

Recovered	Amount
FREE OIL	230'
MUDDY GAS CUT OIL	180'
HEAVY OIL AND GAS CUT MUD	230'
OIL AND GAS CUT MUD	170'

Blow: STRONG, DECREASING

Maximum Surface Pressure:

Description (Rate of Flow)	Time	Pressure (P.S.I.G.)	Surface Choke
Opened Tool	0950	-	1"
GAS TO SURFACE	0957	0	"
CLOSED FOR INITIAL SHUT-IN	1008	-	"
RE-OPENED TOOL	1038	-	"
139,000 CF GAS/DAY	1043	-	"
139,000 CF GAS/DAY	1048	-	"
164,000 CF GAS/DAY	1118	-	"
132,000 CF GAS/DAY	1130	-	"
132,000 CF GAS/DAY	1138	-	"

Remarks:

TOOL, HOLE & MUD DATA

Type Test: CONVENTIONAL
Formation Tested: CHESTER
Elevation: 2819 Ft.
All Depths Measured From: GROUND LEVEL

TOOL SEQUENCE

Tool	Size/Type	Depth/Length/I.D.
DRILL PIPE	4½" FH	5555'
		3.80"
DRILL COLLARS	4" H-90	270'
		2 3/8"
CIRCULATING SUB	4½" B	
DRILL COLLARS	4" H-90	90'
		2.25"
4-STAGE SHUT-IN	3½"	
HYDRAULIC TOOL	3½" SI	
JARS	3½" HS-1	
PACKER-BOB TAIL	6 5/8"	5950'
PERF. ANCHOR	4½" HVY.	7'
DRILL COLLARS	4" H-90	58'
		2 3/8"
PERF. ANCHOR	4½" HVY.	23'
DRILL COLLARS	4" H-90	58'
		2.25"
PERF. ANCHOR	4½" HVY.	6'
RECORDER CARRIER	4 7/8" T	6'
RECORDER CARRIER	4 7/8" L	4'

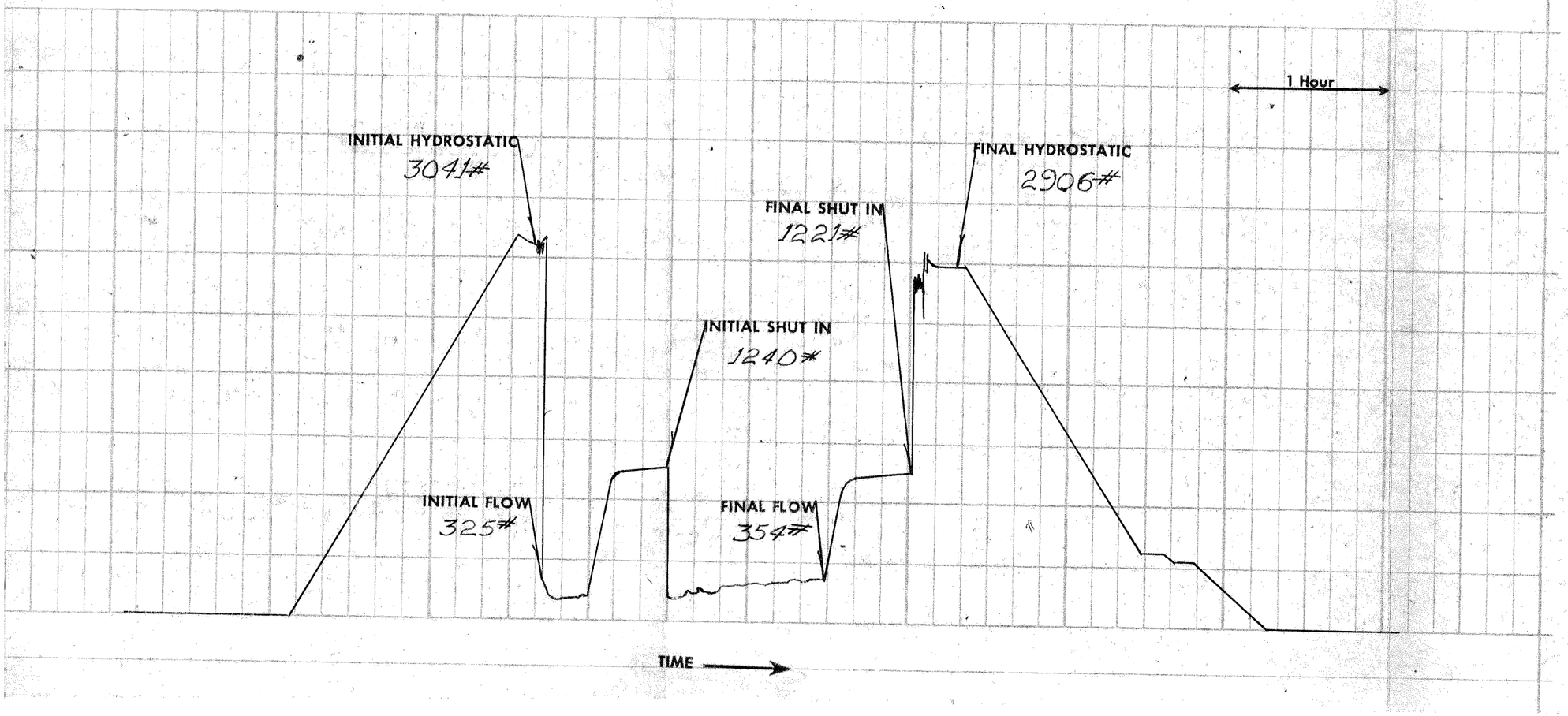
Total Depth: 6112 Ft.
Main Hole Size: 7 7/8" Rat Hole Size: -
Casing Size: - Liner Size: -
Bottom Choke Size: 3/4" Mud Type: CHEM
Mud. Wt.: 9.5 Mud Viscosity: 61
Air Chamber Length: - Ft. - I.D.

Cushion Type	Amount	Pressure
-	-	-

TIME DATA

Initial Shut-in: - Hrs. 30 Mins.
Flow Period: 1 Hrs. 18 Mins.
Final Shut-in: - Hrs. 30 Mins.

Company: ANADARKO PRODUCTION CO. BOX 351 LIBERAL, KANSAS Date: 4-21-62
Well: WINCHELL #A-1 Field: - Location: 9-33-33
Test Interval: 5950' TO 6112' Formation Test #: 1 Casing Test #: -
County: SEWARD State: KANSAS Field Report No.: 63674 L
Tester: RALPH W. RINE Test Approved By: MR. CLARK DAVIS No. DST Reports Requested: 5



A WORLD OF EXPERIENCE

JOHNSTON TESTERS

Pressure Log*

Field Report No. 636741

Recorder No. T-247

Capacity 5000 p.s.i.

Recorder Depth 6107 ft.

*a continuous tracing of the original chart

JOHNSTON TESTERS, INC.

Pressure Data Field Report No. 63674 L

Recorder No.	T-247	(INSIDE)				
Capacity (P.S.I.G.)	5000					
Recorder Depth	6107'					
Pressure Gradient P.S.I./Ft.						
Well Temperature °F.	133					
A Initial Hydrostatic Mud	3041					
B Initial Shut-in	*1240					
C Initial Flow	325					
D Final Flow	354					
E Final Shut-in	* 1221					
F Final Hydrostatic Mud	2906					

Remarks: c-1 195
c-2 186

*Shut in pressure did not reach static reservoir pressure.