

NOMENCLATURE

B	Formation Volume Factor (Res Vol / Std Vol)	—
C ₁	System Total Compressibility	(Vol / Vol) / psi
DR	Damage Ratio	—
h	Estimated Net Pay Thickness	ft
k	Permeability	md
m	(Liquid) Slope Extrapolated Pressure Plot (Gas) Slope Extrapolated m(P) Plot	psi cycle MM psi cp cycle
m(P*)	Real Gas Potential at P*	MM psi / cp
m(P _i)	Real Gas Potential at P _i	MM psi / cp
AOF ₁	Maximum Indicated Absolute Open Flow at Test Conditions	MCF D
AOF ₂	Minimum Indicated Absolute Open Flow at Test Conditions	MCF D
P*	Extrapolated Static Pressure	Psig
P _f	Final Flow Pressure	Psig
Q	Liquid Production Rate During Test	BPD
Q ₁	Theoretical Liquid Production w/ Damage Removed	BPD
Q _g	Measured Gas Production Rate	MCFD
r _i	Approximate Radius of Investigation	ft
r _w	Radius of Well Bore	ft
S	Skin Factor	—
t	Total Flow Time Previous to Closed-in	Minutes
Δt	Closed-in Time at Data Point	Minutes
T	Temperature Rankine	R
φ	Porosity	—
μ	Viscosity of Gas or Liquid	cp
Log	Common Log	



EQUATIONS FOR DST LIQUID WELL ANALYSIS

Transmissibility	$\frac{kh}{\mu}$	$\frac{162.6 QB}{m}$	$\frac{\text{md-ft}}{\text{cp}}$
Indicated Flow Capacity	q	$\frac{kh}{\mu}$	md-ft
Average Effective Permeability	k	$\frac{kh}{h}$	md
Skin Factor	S	$1.51 \left[\frac{P^* - P_i}{m} \right]$	$\frac{\text{LOG} \left(\frac{\kappa(t) 60}{\phi \mu c h^2} \right) + 3.23}{—}$
Damage Ratio	DR	$\frac{P^* - P_i}{P^* - P_i - 0.87 \text{ mS}}$	—
Theoretical Potential w/ Damage Removed	Q ₁	Q DR	BPD
Approx. Radius of Investigation	r_i	$0.032 \sqrt{\frac{\kappa(t) 60}{\phi \mu c}}$	ft

EQUATIONS FOR DST GAS WELL ANALYSIS

Indicated Flow Capacity	q	$\frac{1637 Q_1 T}{m}$	md-ft
Average Effective Permeability	k	$\frac{kh}{h}$	md
Skin Factor	S	$1.51 \left[\frac{m(P^*) - m(P_i)}{m} \right]$	$\frac{\text{LOG} \left(\frac{\kappa(t) 60}{\phi \mu c h^2} \right) + 3.23}{—}$
Damage Ratio	DR	$\frac{m(P^*) - m(P_i)}{m(P^*) - m(P_i) - 0.87 \text{ mS}}$	—
Indicated Flow Rate (Maximum)	AOF ₁	$\frac{Q_1 m(P^*)}{m(P^*) - m(P_i)}$	MCFD
Indicated Flow Rate (Minimum)	AOF ₂	$Q_1 \sqrt{\frac{m(P^*)}{m(P^*) - m(P_i)}}$	MCFD
Approx. Radius of Investigation	r_i	$0.032 \sqrt{\frac{\kappa(t) 60}{\phi \mu c}}$	ft

NOMENCLATURE

B	Formation Volume Factor (Res Vol - Std Vol)	—
C _t	System Total Compressibility	(Vol Vol) psi
DR	Damage Ratio	—
h	Estimated Net Pay Thickness	ft
k	Permeability	md
m	$\left\{ \begin{array}{l} \text{(Liquid) Slope Extrapolated Pressure Plot} \\ \text{(Gas) Slope Extrapolated } m(P_i) \text{ Plot} \end{array} \right.$	psi cycle MM psi' cp cycle
m(P*)	Real Gas Potential at P*	MM psi' cp
m(P _f)	Real Gas Potential at P _f	MM psi' cp
AOF ₁	Maximum Indicated Absolute Open Flow at Test Conditions	MCFD
AOF ₂	Minimum Indicated Absolute Open Flow at Test Conditions	MCFD
P*	Extrapolated Static Pressure	Psig
P _f	Final Flow Pressure	Psig
Q	Liquid Production Rate During Test	BPD
Q ₁	Theoretical Liquid Production w/ Damage Removed	BPD
Q _g	Measured Gas Production Rate	MCFD
r _i	Approximate Radius of Investigation	ft
r _w	Radius of Well Bore	ft
S	Skin Factor	—
t	Total Flow Time Previous to Closed-in	Minutes
Δt	Closed-in Time at Data Point	Minutes
T	Temperature Rankine	R
ϕ	Porosity	—
μ	Viscosity of Gas or Liquid	cp
Log	Common Log	

EQUATIONS FOR DST LIQUID WELL ANALYSIS

Transmissibility	$\frac{kh}{\mu}$	$\frac{162.6 QB}{m}$	$\frac{\text{md-ft}}{\text{cp}}$
Indicated Flow Capacity	$kh \frac{m}{\mu}$		md-ft
Average Effective Permeability	$k \frac{h}{h}$		md
Skin Factor	$S = 1.151 \left[\frac{P^* - P_i}{m} - \text{LOG} \left(\frac{k(t/60)}{0.1 \mu c r_w^2} \right) - 3.23 \right]$		—
Damage Ratio	$DR = \frac{P^* - P_i}{P^* - P_i - 0.87 \text{ mS}}$		—
Theoretical Potential w/ Damage Removed	$Q_1 = Q DR$		BPD
Approx. Radius of Investigation	$r_i = 0.032 \sqrt{\frac{k(t/60)}{0.1 \mu c}}$		ft

EQUATIONS FOR DST GAS WELL ANALYSIS

Indicated Flow Capacity	kh	$\frac{1637 Q_1 T}{m}$	md-ft
Average Effective Permeability	$k \frac{h}{h}$		md
Skin Factor	$S = 1.151 \left[\frac{m(P^*) - m(P_i)}{m} - \text{LOG} \left(\frac{k(t/60)}{0.1 \mu c r_w^2} \right) - 3.23 \right]$		—
Damage Ratio	$DR = \frac{m(P^*) - m(P_i)}{m(P^*) - m(P_i) - 0.87 \text{ mS}}$		—
Indicated Flow Rate (Maximum)	$AOF_1 = \frac{Q_1 m(P^*)}{m(P^*) - m(P_i)}$		MCFD
Indicated Flow Rate (Minimum)	$AOF_2 = Q_1 \sqrt{\frac{m(P^*)}{m(P^*) - m(P_i)}}$		MCFD
Approx. Radius of Investigation	$r_i = 0.032 \sqrt{\frac{k(t/60)}{0.1 \mu c_1}}$		ft

NOMENCLATURE

V	Formation Volume Factor (Res Vol / Std Vol)	—	(Vol / Vol) psi
C	System Total Compressibility	—	
DR	Damage Ratio	—	
t	Estimated Net Pay Thickness	Ft	
k	Permeability	md	
m	(Liquid) Slope Extrapolated Pressure Plot (Gas) Slope Extrapolated $m(P_i)$ Plot	psi cycle MM psi cp cycle	
$\pi(P^*)$	Real Gas Potential at P^*	MM psi ² cp	
$\pi(P_i)$	Real Gas Potential at P_i	MM psi ² cp	
iOF_1	Maximum Indicated Absolute Open Flow at Test Conditions	MCFD	
iOF_2	Minimum Indicated Absolute Open Flow at Test Conditions	MCFD	
P^*	Extrapolated Static Pressure	Psig	
P_f	Final Flow Pressure	Psig	
Q	Liquid Production Rate During Test	BPD	
Q_l	Theoretical Liquid Production w/ Damage Removed	BPD	
Q_g	Measured Gas Production Rate	MCFD	
r	Approximate Radius of Investigation	Ft	
r_w	Radius of Well Bore	Ft	
S	Skin Factor		
t	Total Flow Time Previous to Closed-in	Minutes	
t_c	Closed-in Time at Data Point	Minutes	
T	Temperature Rankine	R	
ϕ	Porosity	—	
μ	Viscosity of Gas or Liquid	cp	
$\log$	Common Log		

EQUATIONS FOR DST LIQUID WELL ANALYSIS

Transmissibility	$\frac{kh}{\mu}$	$\frac{162.6 QB}{m}$	$\frac{\text{md-ft}}{\text{cp}}$
Indicated Flow Capacity	$kh \frac{\mu}{\mu}$		md-ft
Average Effective Permeability	$k \frac{kh}{h}$		md
Skin Factor	$S = 1.151 \left[\frac{P^* - P_i}{m} - \text{LOG} \left(\frac{k(t/60)}{0.000263 \mu C V_w} \right) - 3.23 \right]$		—
Damage Ratio	$DR = \frac{P^* - P_i}{P^* - P_i - 0.87 mS}$		—
Theoretical Potential w/ Damage Removed	$Q_i = Q DR$		BPD
Approx. Radius of Investigation	$r = 0.032 \sqrt{\frac{k(t/60)}{\phi \mu C_i}}$		ft

EQUATIONS FOR DST GAS WELL ANALYSIS

Indicated Flow Capacity	kh	$\frac{1637 Q_i T}{m}$	md-ft
Average Effective Permeability	$k \frac{kh}{h}$		md
Skin Factor	$S = 1.151 \left[\frac{m(P^*) - m(P_i)}{m} - \text{LOG} \left(\frac{k(t/60)}{0.000263 \mu C V_w} \right) - 3.23 \right]$		—
Damage Ratio	$DR = \frac{m(P^*) - m(P_i)}{m(P^*) - m(P_i) - 0.87 mS}$		—
Indicated Flow Rate (Maximum)	$AOF_1 = \frac{Q_i m(P^*)}{m(P^*) - m(P_i)}$		MCFD
Indicated Flow Rate (Minimum)	$AOF_2 = Q_o \sqrt{\frac{m(P^*)}{m(P^*) - m(P_i)}}$		MCFD
Approx. Radius of Investigation	$r = 0.032 \sqrt{\frac{k(t/60)}{\phi \mu C_i}}$		ft

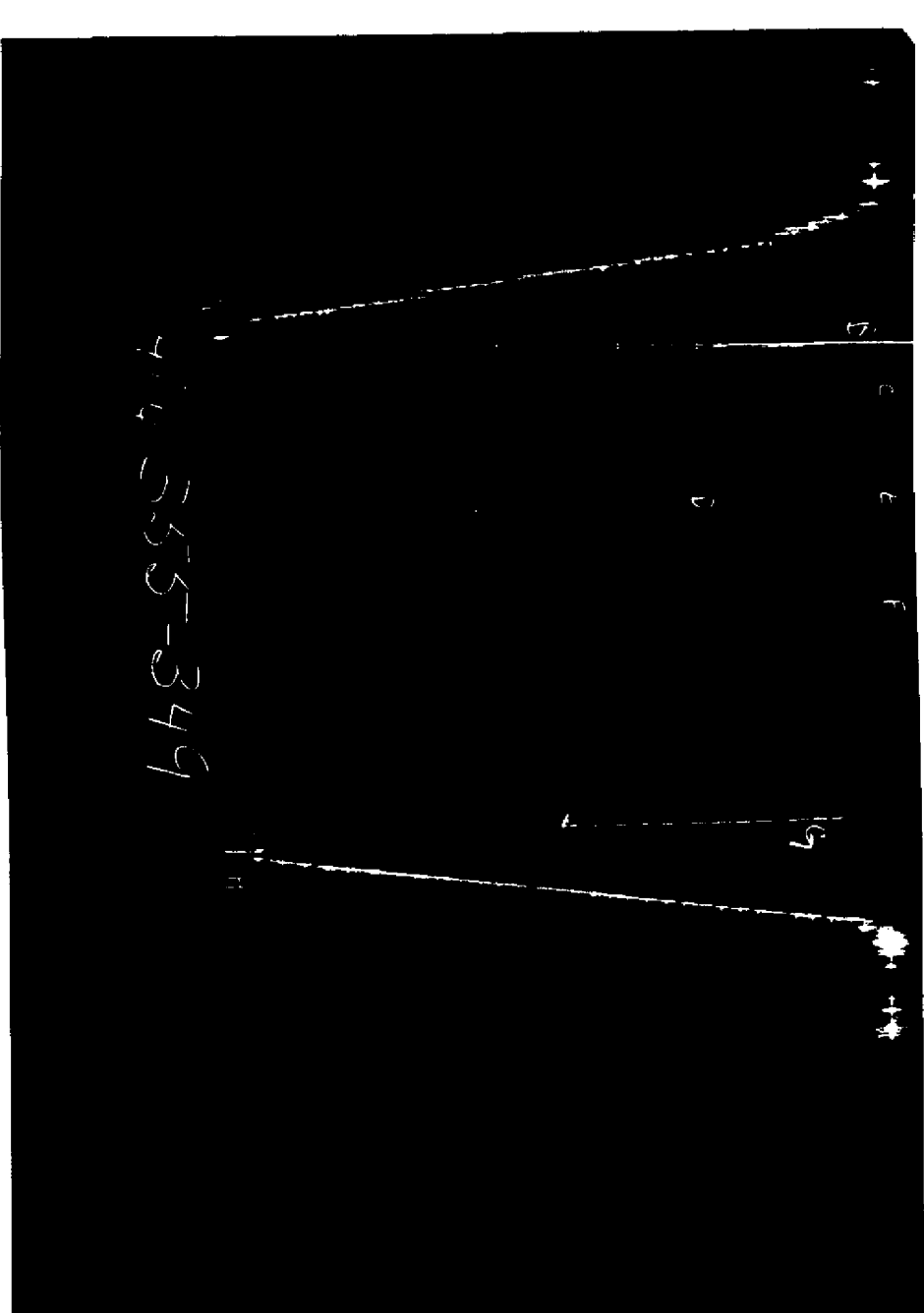


TICKET NO. 40635500
30-JUN-85
FARMINGTON

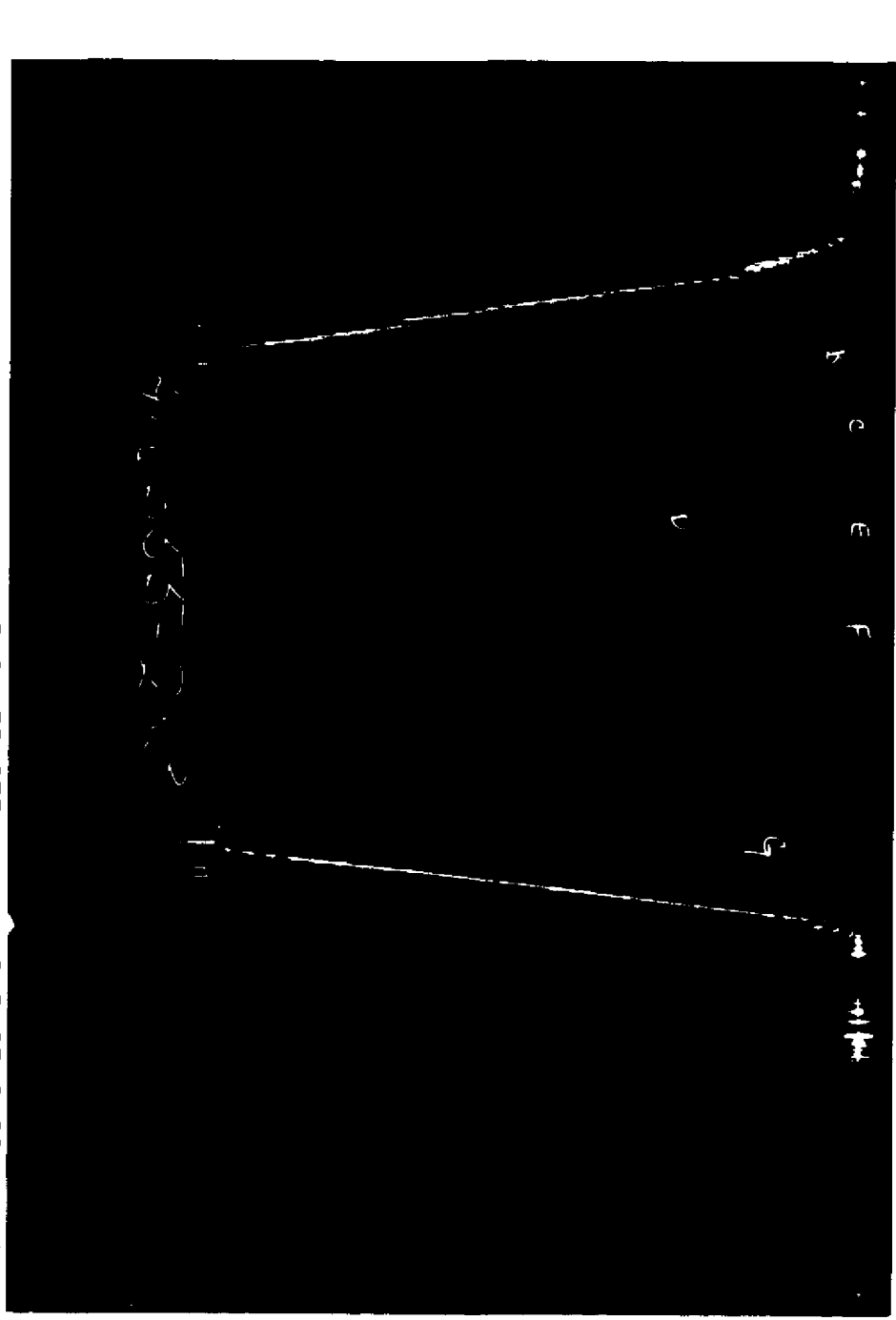
FORMATION TESTING SERVICE REPORT

RECEIVED
FEB 06 1986
OIL FIELD UNIT
UNIT 3

LEGAL LOCATION: 4-23N-12	TEST NO. 4	3592.0	3645.0	WILDCAT	COUNTRY	SAN JUAN	STATE: NEW MEXICO	CO
LEASE NAME: E. T. LBRD	TEST NO. 4	3592.0	3645.0	WILDCAT	COUNTRY	SAN JUAN	STATE: NEW MEXICO	CO
LESSOR: CLEVELAND ENERGY COMPANY	TEST NO. 4	3592.0	3645.0	WILDCAT	COUNTRY	SAN JUAN	STATE: NEW MEXICO	CO



ID	DESCRIPTION	PRESSURE		TIME		TYPE
		REPORTED	CALCULATED	REPORTED	CALCULATED	
A	INITIAL HYDROSTATIC	1741	1722.6			
B	INITIAL FIRST FLOW	7	7.7	30.0	30.0	F
C	FINL FIRST FLOW	7	9.0			
D	INITIAL FIRST CLOSED-IN	7	9.0	60.0	60.0	C
E	INITIAL SECOND FLOW	13	13.5	60.0	60.0	F
F	FINL SECOND FLOW	13	14.5			
G	INITIAL SECOND CLOSED-IN	13	14.5	125.0	125.0	C
H	FINL SECOND CLOSED-IN	192	192.0			
I	FINL HYDROSTATIC	1717	1709.2			



ID	DESCRIPTION	PRESSURE		TIME		TYPE
		REPORTED	CALCULATED	REPORTED	CALCULATED	
A	INITIAL HYDROSTATIC	1778	1769.9			
B	INITIAL FIRST FLOW	54	45.9	30.0	30.0	F
C	FINL FIRST FLOW	54	49.0			
D	INITIAL FIRST CLOSED-IN	54	49.0	60.0	60.0	C
E	INITIAL SECOND FLOW	61	52.8	60.0	60.0	F
F	FINL SECOND FLOW	61	54.7			
G	INITIAL SECOND CLOSED-IN	61	54.7	125.0	125.0	C
H	FINL SECOND CLOSED-IN	235	235.0			
I	FINL HYDROSTATIC	1785	1782.4			

EQUIPMENT & HOLE DATA		TICKET NUMBER: 40635500	
FORMATION TESTED: GALLUP		DATE: 1-25-86 TEST NO: 4	
NET PAY (ft): 10.0		TYPE DST: OPEN HOLE	
GROSS TESTED FOOTAGE: 63.0		HALLIBURTON CAMP: FARMINGTON	
ALL DEPTHS MEASURED FROM: KB		TESTER: DAN RUIZ	
CASING PERFS. (ft):		WITNESS: MR. CHRISTOPHERSON	
HOLE OR CASING SIZE (in): 7.875		DRILLING CONTRACTOR: BEDFORD #7	
ELEVATION (ft): 5974.0 GROUND LEVEL			
TOTAL DEPTH (ft): 3645.0			
PACKER DEPTH(S) (ft): 3576, 3550			
FINL SURFACE CHOKER (in):			
BOTTOM HOLE CHOKER (in): 0.750			
MUD WEIGHT (lb/gal): 2.30			
MUD VISCOSITY (sec): 43			
ESTIMATED HOLE TEMP. (°F):			
ACTUAL HOLE TEMP. (°F): 122 @ 3645.0 ft			
FLUID PROPERTIES FOR RECOVERED MUD & WATER SOURCE		SAMPLER DATA	
RESISTIVITY		PSIG AT SURFACE: 0.0	
CHLORIDES		cc OF OIL: 50.0	
PIT		cc OF WATER: 1500.0	
BOTTOM		TOTAL LIQUID cc: 1350.0	
SAMPLED			
OIL GRAVITY (api):		CUSHION DATA	
GAS/OIL RATIO (cu.ft. per bbl):		TYPE AMOUNT WEIGHT	
GAS GRAVITY:		MEASURED FROM TESTER VALVE	
RECOVERED: 5' OF OIL CUT MUD 60' OF MUD			
REMARKS:			

TYPE & SIZE MEASURING DEVICE				TICKET NO. 40635500
TIME	CHOKER SIZE	SURFACE PRESSURE PSI	GAS RATE MCF	LIQUID BPD
1-25-86				
1400				
1640				
1728				
1857	1/8 BH	1.02		
1907		.5.02		
1917		0		
1927				
2027	1/8 BH			
2127				
2332				
1-26-86				
0330				

EQUIPMENT DATA				TICKET NO. 40635500
ITEM	DESCRIPTION	Q.D.	I.D.	DEPTH
1	DRILL PIPE	4.500	3.666	3009.0
2	DRILL COLLARS	6.125	2.500	447.0
3	IMPACT REVERSING SUB	6.000	3.000	1.0
4	DRILL COLLARS	6.125	2.500	90.0
5	CROSSOVER	6.000	3.000	1.0
6	DUAL CIP SHAFT-LEVER	5.000	0.750	7.0
7	HYDRAULIC TESTER	5.000	0.750	5.0
8	CLOSED TOOL WITH NO BLOW	5.000	2.353	4.0
9	OPENED BY PRESS. TRIP OUT	5.000	1.750	5.0
10	W. SAFETY JOINT	5.000	1.000	3.0
11	OPEN HOLE PROCKER	6.750	1.550	6.0
12	OPEN HOLE PROCKER	6.750	1.550	3576.0
13	CROSSOVER	6.000	3.000	1.0
14	DRILL COLLARS	6.125	2.500	28.0
15	CROSSOVER	6.000	3.000	1.0
16	FLUSH JOINT ANCHOR	5.750	2.500	27.0
17	BLANKET-OUT RUNNING CHOKER	5.750		4.0
18	TOTAL DEPTH			3645.0