



DRILL STEM TEST REPORT

HALLIBURTON RESERVOIR SERVICES



A Halliburton Company

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	$\left\{ \begin{array}{l} \text{(Liquid) Slope Extrapolated Pressure Plot} \\ \text{(Gas) Slope Extrapolated } m(P) \text{ Plot} \end{array} \right.$	$\begin{array}{l} \text{psi/cycle} \\ \text{MM psi}^2/\text{cp/cycle} \end{array}$
$m(P^*)$	= Real Gas Potential at P^*	MM psi ² /cp
$m(P_i)$	= Real Gas Potential at P_i	MM psi ² /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 (fraction)	
μ	= Viscosity of Gas or Liquid	cp
Log	= Common Log	

COLLINS
LEASE NAMEA-1
WELL NO.2
TEST NO.5494.9 - 5600.0
TESTED INTERVALANADARKO PETROLEUM CORPORATION
LEASE OWNER/COMPANY NAMELEGAL LOCATION
SEC. - TWP. - RANG.

6 - 28 - 41

FIELD
AREA

WEST OF JOHNSON

COUNTY

BACA

STATE

COLORADO SM

ANADARKO PETROLEUM CORPORATION

LEASE : COLLINS

WELL NO. : A-1

TEST NO. : 2

TICKET NO. 00896200

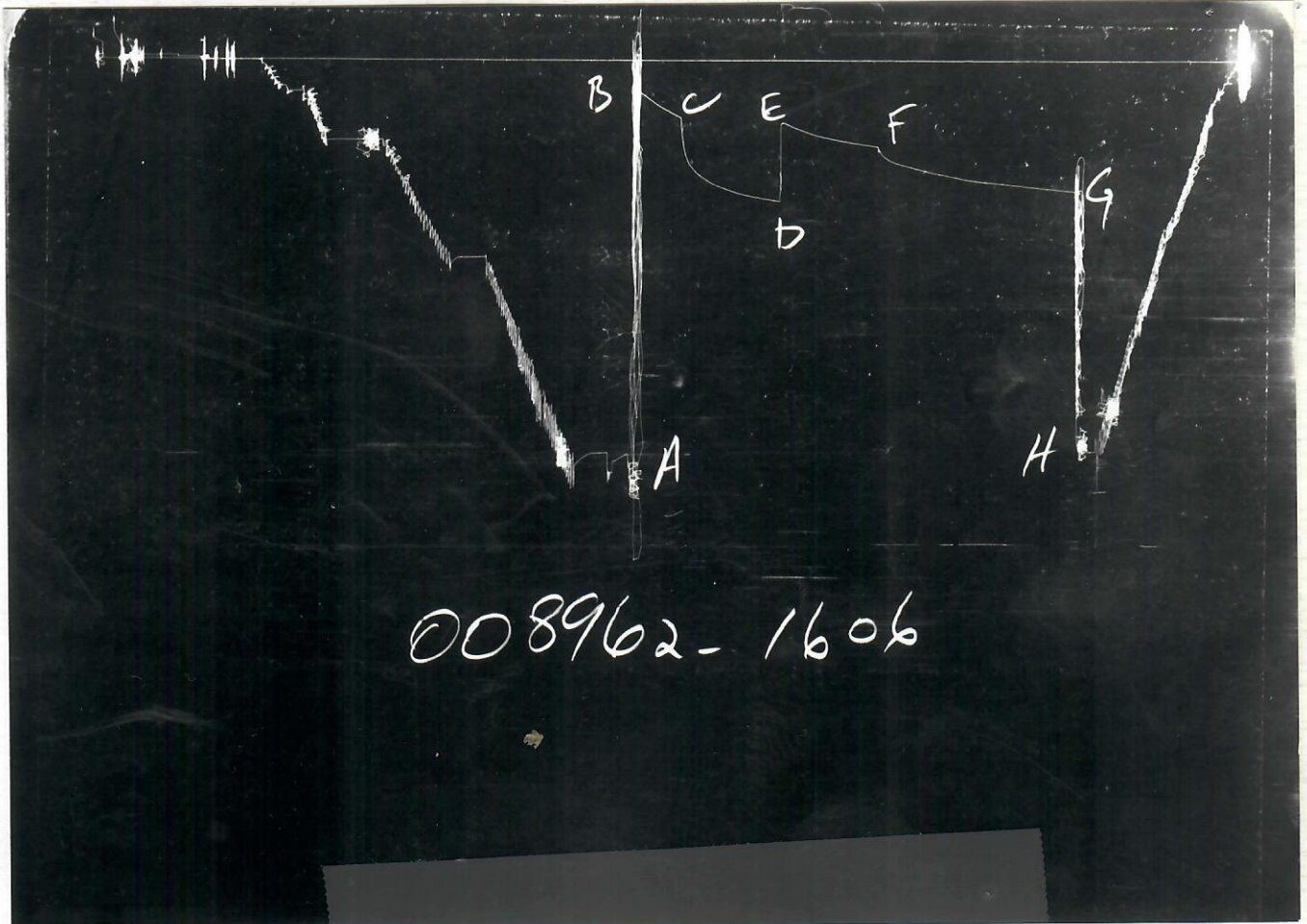
11-FEB-93

LIBERAL

RECEIVED

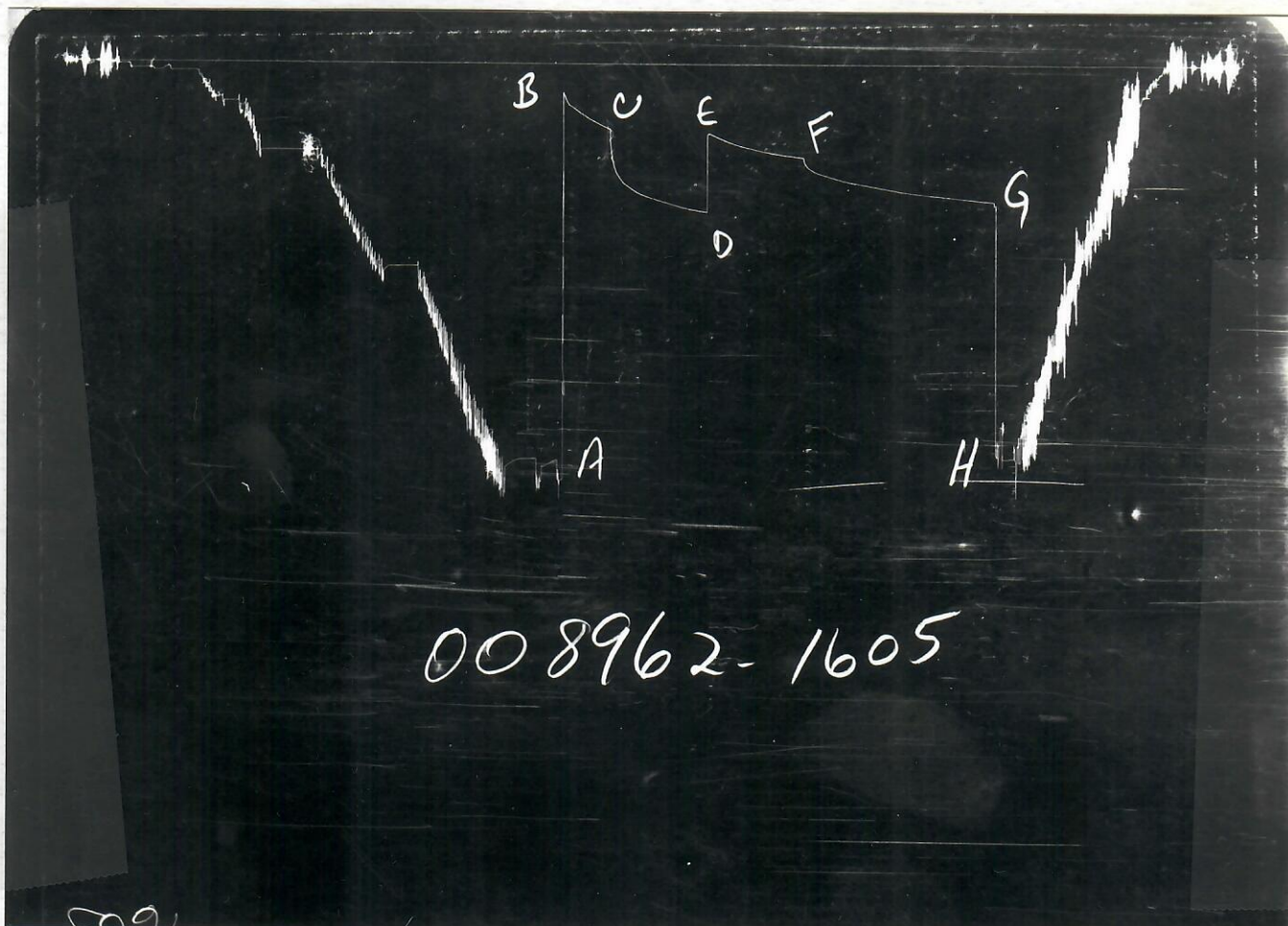
MAR 8 1993

COLO. OIL & GAS CONS. COMM.



GAUGE NO: 1606 DEPTH: 5474.0 BLANKED OFF: NO HOUR OF CLOCK: 12

ID	DESCRIPTION	PRESSURE		TIME		TYPE
		REPORTED	CALCULATED	REPORTED	CALCULATED	
A	INITIAL HYDROSTATIC	2580	2608.4			
B	INITIAL FIRST FLOW	214	141.6	30.0	29.1	F
C	FINAL FIRST FLOW	378	380.9			
C	INITIAL FIRST CLOSED-IN	378	380.9	60.0	60.6	C
D	FINAL FIRST CLOSED-IN	944	945.3			
E	INITIAL SECOND FLOW	395	428.7	60.0	60.2	F
F	FINAL SECOND FLOW	558	574.8			
F	INITIAL SECOND CLOSED-IN	558	574.8	120.0	120.1	C
G	FINAL SECOND CLOSED-IN	847	870.2			
H	FINAL HYDROSTATIC	2580	2584.1			



GAUGE NO: 1605 DEPTH: 5597.0 BLANKED OFF: YES HOUR OF CLOCK: 12

ID	DESCRIPTION	PRESSURE		TIME		TYPE
		REPORTED	CALCULATED	REPORTED	CALCULATED	
A	INITIAL HYDROSTATIC	2636	2667.8			
B	INITIAL FIRST FLOW	166	199.0			
C	FINAL FIRST FLOW	399	442.2	30.0	29.1	F
C	INITIAL FIRST CLOSED-IN	399	442.2			
D	FINAL FIRST CLOSED-IN	989	999.8	60.0	60.6	C
E	INITIAL SECOND FLOW	465	475.7			
F	FINAL SECOND FLOW	613	630.6	60.0	60.2	F
F	INITIAL SECOND CLOSED-IN	613	630.6			
G	FINAL SECOND CLOSED-IN	923	927.6	120.0	120.1	C
H	FINAL HYDROSTATIC	2619	2645.6			

EQUIPMENT & HOLE DATA

FORMATION TESTED: ST. LOUIS
 NET PAY (ft): _____
 GROSS TESTED FOOTAGE: 105.1
 ALL DEPTHS MEASURED FROM: GROUND LEVEL
 CASING PERFS. (ft): _____
 HOLE OR CASING SIZE (in): 7.875
 ELEVATION (ft): 3680.0 GROUND LEVEL
 TOTAL DEPTH (ft): 5600.0
 PACKER DEPTH(S) (ft): 5489, 5495
 FINAL SURFACE CHOKE (in): _____
 BOTTOM HOLE CHOKE (in): 0.750
 MUD WEIGHT (lb/gal): 9.00
 MUD VISCOSITY (sec): 57
 ESTIMATED HOLE TEMP. (°F): _____
 ACTUAL HOLE TEMP. (°F): 127 @ 5595.0 ft

TICKET NUMBER: 00896200DATE: 02-08-93 TEST NO: 2TYPE DST: OPEN HOLEFIELD CAMP:
LIBERALTESTER: ABLAWITNESS: JOHN SHILLINGDRILLING CONTRACTOR:
GABBERT AND JONES DRILLING COMPANY**FLUID PROPERTIES FOR
RECOVERED MUD & WATER**

SOURCE	RESISTIVITY	CHLORIDES
PIT	<u>9.000 @ 62 °F</u>	<u>1970 ppm</u>
TOP	<u>0.320 @ 60 °F</u>	<u>14778 ppm</u>
MIDDLE	<u>0.160 @ 59 °F</u>	<u>27093 ppm</u>
BOTTOM	<u>0.150 @ 59 °F</u>	<u>28571 ppm</u>
SAMPLER	<u>0.150 @ 60 °F</u>	<u>28571 ppm</u>
	<u> @ °F</u>	<u> ppm</u>

SAMPLER DATA

Psig AT SURFACE: 550.0
 cu.ft. OF GAS: _____
 cc OF OIL: _____
 cc OF WATER: 2240.0
 cc OF MUD: _____
 TOTAL LIQUID cc: 2240.0

HYDROCARBON PROPERTIES

OIL GRAVITY (°API): _____ @ _____ °F
 GAS/OIL RATIO (cu.ft. per bbl): _____
 GAS GRAVITY: _____

CUSHION DATA

TYPE	AMOUNT	WEIGHT
_____	_____	_____
_____	_____	_____

RECOVERED :

1280 FEET OF RECOVERY CONSISTING OF :
 120 FEET OF DRILLING MUD
 488 FEET OF MUDDY SALT WATER
 672 FEET OF SALT WATER

MEASURED FROM
TESTER VALVE**REMARKS :**

TICKET NO: 00896200

CLOCK NO: 13668 HOUR: 12

GAUGE NO: 1606

DEPTH: 5474.0

REF	MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta P}{t + \Delta P}$	$\log \frac{t + \Delta P}{\Delta P}$
FIRST FLOW					
B 1	0.0	141.6			
2	3.0	205.3	63.7		
3	6.0	231.8	26.5		
4	9.0	254.7	22.9		
5	12.0	278.3	23.5		
6	15.0	301.0	22.7		
7	18.0	321.1	20.1		
8	21.0	338.2	17.0		
9	24.0	356.2	18.0		
10	27.0	371.0	14.8		
C 11	29.1	380.9	9.9		
FIRST CLOSED-IN					
C 1	0.0	380.9			
2	1.0	521.0	140.1	1.0	1.465
3	2.0	592.1	211.2	1.9	1.191
4	3.0	637.6	256.8	2.7	1.027
5	4.0	666.4	285.6	3.5	0.923
6	5.0	689.4	308.6	4.3	0.832
7	6.0	705.6	324.8	5.0	0.769
8	7.0	720.0	339.2	5.6	0.714
9	8.0	733.8	352.9	6.3	0.665
10	9.0	744.5	363.6	6.9	0.626
11	10.0	754.8	374.0	7.5	0.591
12	12.0	773.4	392.6	8.5	0.535
13	14.0	788.8	407.9	9.4	0.489
14	16.0	802.7	421.8	10.3	0.450
15	18.0	814.8	434.0	11.1	0.418
16	20.0	826.6	445.8	11.9	0.390
17	22.0	836.2	455.3	12.5	0.366
18	24.0	844.7	463.9	13.2	0.344
19	26.0	853.6	472.8	13.7	0.326
20	28.0	861.4	480.5	14.3	0.310
21	30.0	868.8	488.0	14.8	0.295
22	35.0	884.2	503.3	15.9	0.263
23	40.0	898.3	517.4	16.9	0.237
24	45.0	911.5	530.7	17.7	0.217
25	50.0	923.8	542.9	18.4	0.199
26	55.0	934.3	553.4	19.0	0.184
D 27	60.6	945.3	564.4	19.7	0.170
SECOND FLOW					
E 1	0.0	428.7			
2	3.0	422.0	-6.6		
3	6.0	437.1	15.1		
4	9.0	451.2	14.1		
5	12.0	464.4	13.2		
6	15.0	475.8	11.4		

REF	MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta P}{t + \Delta P}$	$\log \frac{t + \Delta P}{\Delta P}$
SECOND FLOW - CONTINUED					
7	18.0	486.5	10.7		
8	21.0	496.5	10.1		
9	24.0	504.8	8.3		
10	27.0	512.6	7.8		
11	30.0	520.2	7.6		
12	33.0	526.7	6.5		
13	36.0	533.4	6.7		
14	39.0	538.9	5.5		
15	42.0	544.3	5.4		
16	45.0	549.8	5.5		
17	48.0	555.1	5.4		
18	51.0	559.5	4.4		
19	54.0	563.6	4.1		
20	57.0	569.6	6.0		
F 21	60.2	574.8	5.2		
SECOND CLOSED-IN					
F 1	0.0	574.8			
2	1.0	599.7	25.0	1.0	1.958
3	2.0	620.0	45.3	1.9	1.661
4	3.0	634.3	59.5	2.9	1.488
5	4.0	644.3	69.6	3.8	1.371
6	5.0	652.9	78.2	4.7	1.276
7	6.0	659.7	85.0	5.6	1.201
8	7.0	665.7	91.0	6.5	1.137
9	8.0	670.9	96.2	7.4	1.084
10	9.0	675.1	100.4	8.2	1.037
11	10.0	679.2	104.4	9.0	0.998
12	12.0	687.1	112.4	10.6	0.926
13	14.0	693.5	118.7	12.1	0.868
14	16.0	700.4	125.7	13.6	0.818
15	18.0	706.4	131.7	15.0	0.775
16	20.0	711.6	136.9	16.3	0.738
17	22.0	717.3	142.5	17.6	0.705
18	24.0	723.0	148.2	18.9	0.674
19	26.0	728.6	153.9	20.1	0.647
20	28.0	734.3	159.5	21.3	0.622
21	30.0	739.2	164.4	22.5	0.599
22	35.0	751.5	176.7	25.2	0.550
23	40.0	762.7	187.9	27.6	0.510
24	45.0	775.6	200.9	29.9	0.475
25	50.0	787.8	213.0	32.1	0.445
26	55.0	796.7	221.9	34.0	0.419
27	60.0	802.0	227.3	35.9	0.396
28	70.0	813.8	239.1	39.3	0.357
29	80.0	826.5	251.7	42.2	0.326
30	90.0	838.5	263.7	44.8	0.299
31	100.0	850.4	275.7	47.2	0.277
32	110.0	860.8	286.0	49.3	0.258
G 33	120.1	870.2	295.4	51.2	0.241

REMARKS:

TICKET NO: 00896200

CLOCK NO: 2596 HOUR: 12

GAUGE NO: 1605




















DEPTH: 5597.0

REF	MINUTES	PRESSURE	AP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
FIRST FLOW					
B 1	0.0	199.0			
2	3.0	272.1	73.1		
3	6.0	297.3	25.1		
4	9.0	320.4	23.2		
5	12.0	342.9	22.5		
6	15.0	365.6	22.7		
7	18.0	384.3	18.7		
8	21.0	401.4	17.1		
9	24.0	417.6	16.3		
10	27.0	433.1	15.4		
C 11	29.1	442.2	9.2		
FIRST CLOSED-IN					
C 1	0.0	442.2			
2	1.0	622.1	179.8	1.0	1.459
3	2.0	674.6	232.3	1.8	1.197
4	3.0	712.0	269.7	2.7	1.029
5	4.0	738.9	296.6	3.5	0.916
6	5.0	757.9	315.6	4.3	0.835
7	6.0	773.1	330.9	4.9	0.770
8	7.0	787.4	345.1	5.6	0.713
9	8.0	799.4	357.1	6.2	0.668
10	9.0	809.5	367.3	6.9	0.628
11	10.0	819.2	376.9	7.5	0.592
12	12.0	835.9	393.7	8.5	0.534
13	14.0	850.0	407.8	9.4	0.489
14	16.0	862.5	420.2	10.3	0.450
15	18.0	873.9	431.7	11.1	0.418
16	20.0	883.8	441.5	11.8	0.391
17	22.0	893.6	451.3	12.5	0.366
18	24.0	902.4	460.2	13.2	0.345
19	26.0	910.0	467.7	13.7	0.326
20	28.0	917.8	475.6	14.3	0.310
21	30.0	925.4	483.1	14.8	0.294
22	35.0	941.0	498.7	15.9	0.263
23	40.0	955.2	513.0	16.8	0.237
24	45.0	969.0	526.7	17.7	0.217
25	50.0	980.4	538.2	18.4	0.199
26	55.0	990.3	548.0	19.0	0.184
D 27	60.6	999.8	557.5	19.7	0.170
SECOND FLOW					
E 1	0.0	475.7			
2	3.0	476.5	0.8		
3	6.0	492.3	15.8		
4	9.0	507.7	15.4		
5	12.0	521.2	13.5		
6	15.0	532.5	11.3		

REF	MINUTES	PRESSURE	AP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
SECOND FLOW - CONTINUED					
7	18.0	543.0	10.5		
8	21.0	552.7	9.7		
9	24.0	561.1	8.4		
10	27.0	569.3	8.2		
11	30.0	577.4	8.0		
12	33.0	584.3	6.9		
13	36.0	590.2	5.9		
14	39.0	596.6	6.4		
15	42.0	602.0	5.4		
16	45.0	607.6	5.6		
17	48.0	612.7	5.1		
18	51.0	617.9	5.3		
19	54.0	621.9	3.9		
20	57.0	626.6	4.8		
F 21	60.2	630.6	3.9		
SECOND CLOSED-IN					
F 1	0.0	630.6			
2	1.0	676.4	45.8	1.0	1.936
3	2.0	692.3	61.7	2.0	1.659
4	3.0	700.7	70.1	2.9	1.494
5	4.0	708.1	77.5	3.9	1.365
6	5.0	713.8	83.2	4.7	1.276
7	6.0	718.9	88.3	5.6	1.201
8	7.0	724.8	94.2	6.5	1.139
9	8.0	730.5	100.0	7.3	1.086
10	9.0	734.6	104.1	8.1	1.040
11	10.0	738.9	108.4	9.0	0.997
12	12.0	746.1	115.6	10.6	0.927
13	14.0	753.2	122.6	12.1	0.868
14	16.0	759.4	128.9	13.6	0.819
15	18.0	765.3	134.8	15.0	0.776
16	20.0	770.8	140.2	16.4	0.737
17	22.0	776.3	145.8	17.7	0.704
18	24.0	782.7	152.2	18.9	0.674
19	26.0	787.5	156.9	20.2	0.647
20	28.0	792.6	162.0	21.3	0.622
21	30.0	796.7	166.1	22.5	0.599
22	35.0	807.5	177.0	25.1	0.551
23	40.0	818.0	187.5	27.6	0.509
24	45.0	828.7	198.1	29.9	0.475
25	50.0	837.0	206.5	32.1	0.445
26	55.0	846.2	215.7	34.0	0.419
27	60.0	855.6	225.0	35.9	0.396
28	70.0	869.2	238.6	39.3	0.357
29	80.0	883.0	252.4	42.2	0.326
30	90.0	894.8	264.2	44.8	0.299
31	100.0	907.3	276.7	47.2	0.277
32	110.0	918.4	287.9	49.3	0.258
G 33	120.1	927.6	297.0	51.2	0.241

REMARKS:

TICKET NO. 00896200

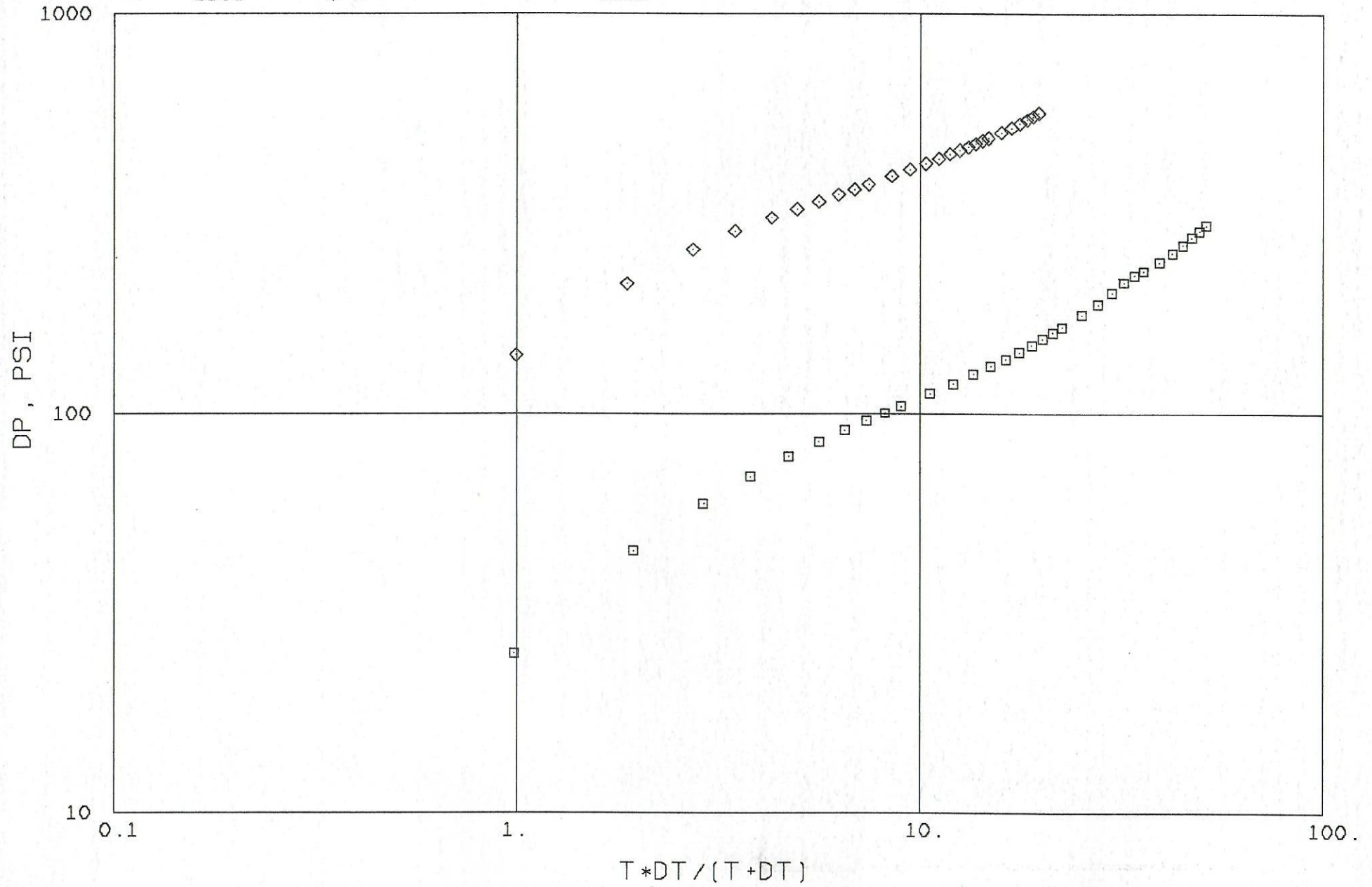
		O.D.	I.D.	LENGTH	DEPTH	
1		DRILL PIPE.....	4.500	3.826	5064.3	
3		DRILL COLLARS.....	6.250	2.250	330.0	
50		IMPACT REVERSING SUB.....	6.250	3.000	1.0	5394.8
3		DRILL COLLARS.....	6.250	2.250	60.0	
5		CROSSOVER.....	6.250	2.250	1.0	
11		HANDLING SUB & CHOKE ASSEMBLY...	4.500	3.826	5.0	
13		DUAL CIP SAMPLER.....	5.000	0.750	7.0	
60		HYDROSPRING TESTER.....	5.000	0.750	5.0	5472.1
80		AP RUNNING CASE.....	5.000	2.250	4.1	5474.2
15		JAR.....	5.000	1.750	5.0	
16		VR SAFETY JOINT.....	5.000	1.000	2.7	
70		OPEN HOLE PACKER.....	6.750	1.530	5.8	5489.1
70		OPEN HOLE PACKER.....	6.750	1.530	5.8	5494.9
5		CROSSOVER.....	6.250	2.250	1.0	
3		DRILL COLLARS.....	6.250	2.250	60.0	
5		CROSSOVER.....	6.250	2.250	2.0	
20		FLUSH JOINT ANCHOR.....	5.000	2.370	35.0	
82		TEMPERATURE RUNNING CASE.....	5.000		1.0	5595.0
81		BLANKED-OFF RUNNING CASE.....	5.000		4.3	5597.0
TOTAL DEPTH					5600.0	

EQUIPMENT DATA

TICKET NO 00896200

GAUGE NO CIP 1 2
1606 \diamond \square

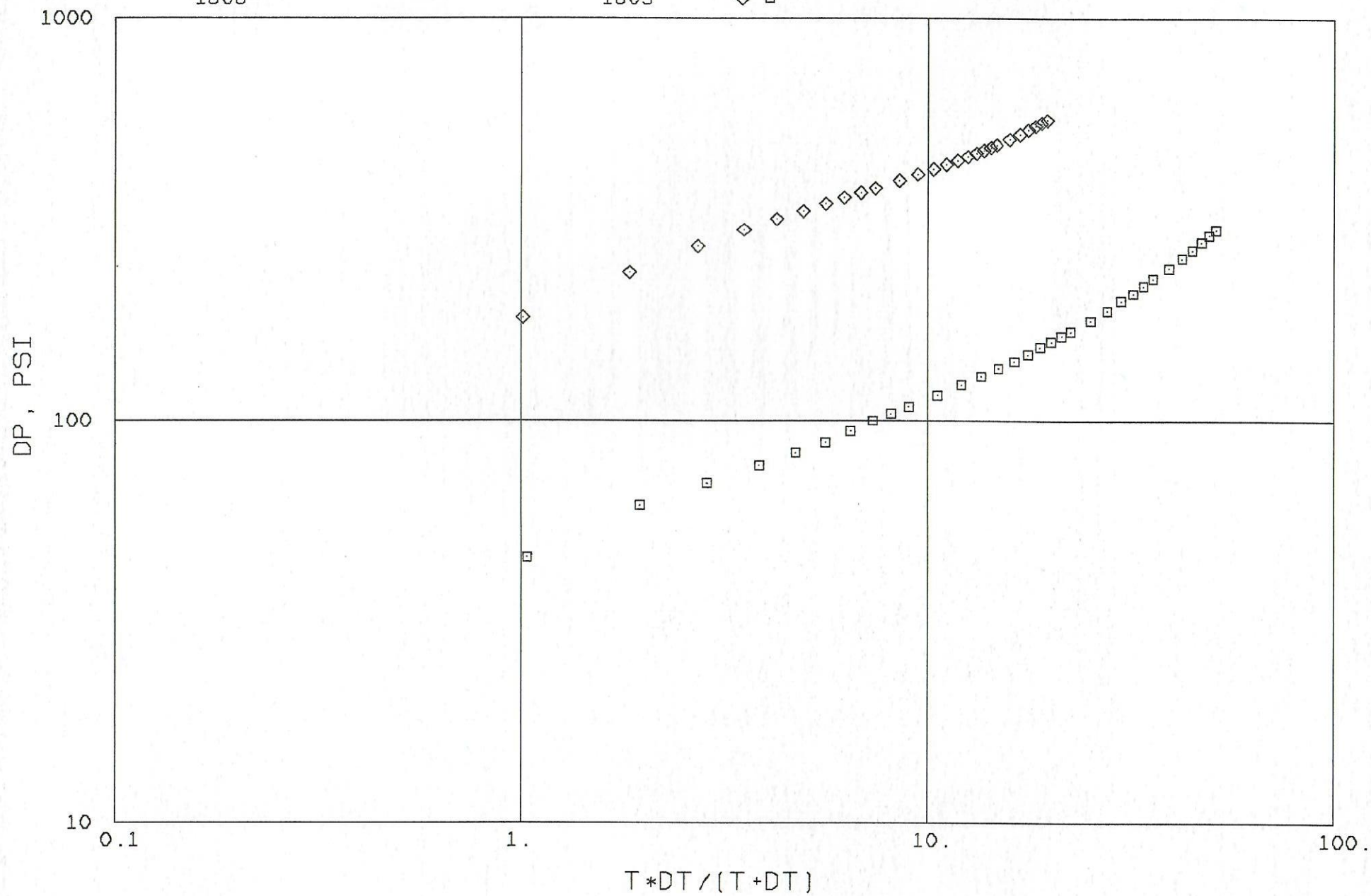
GAUGE NO CIP 1 2
1605 \diamond \square



TICKET NO 00896200

GAUGE NO CIP 1 2
1606

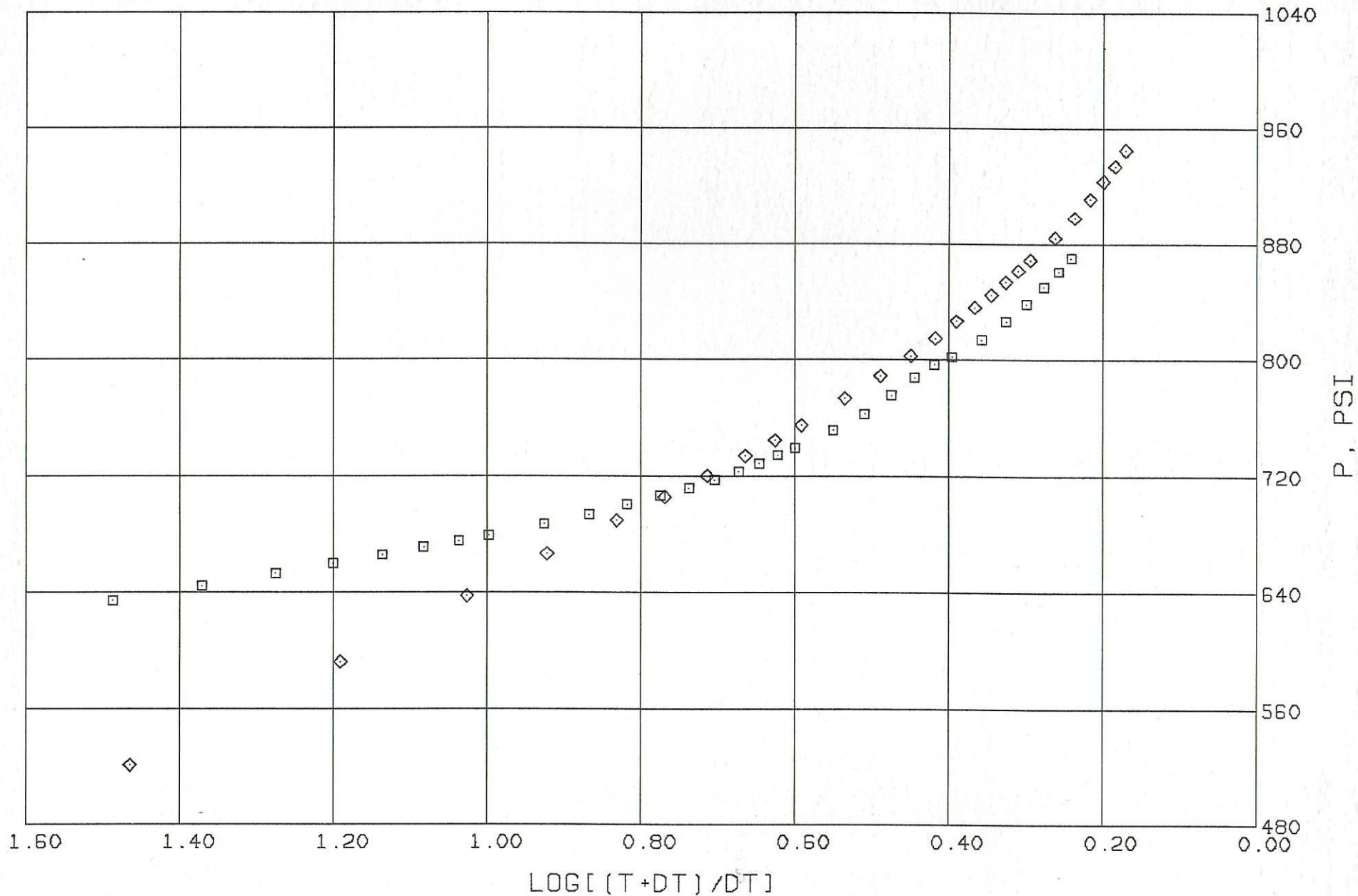
GAUGE NO CIP 1 2
1605 \diamond \square



TICKET NO 00896200

GAUGE NO CIP 1 2
1606 ◇ □

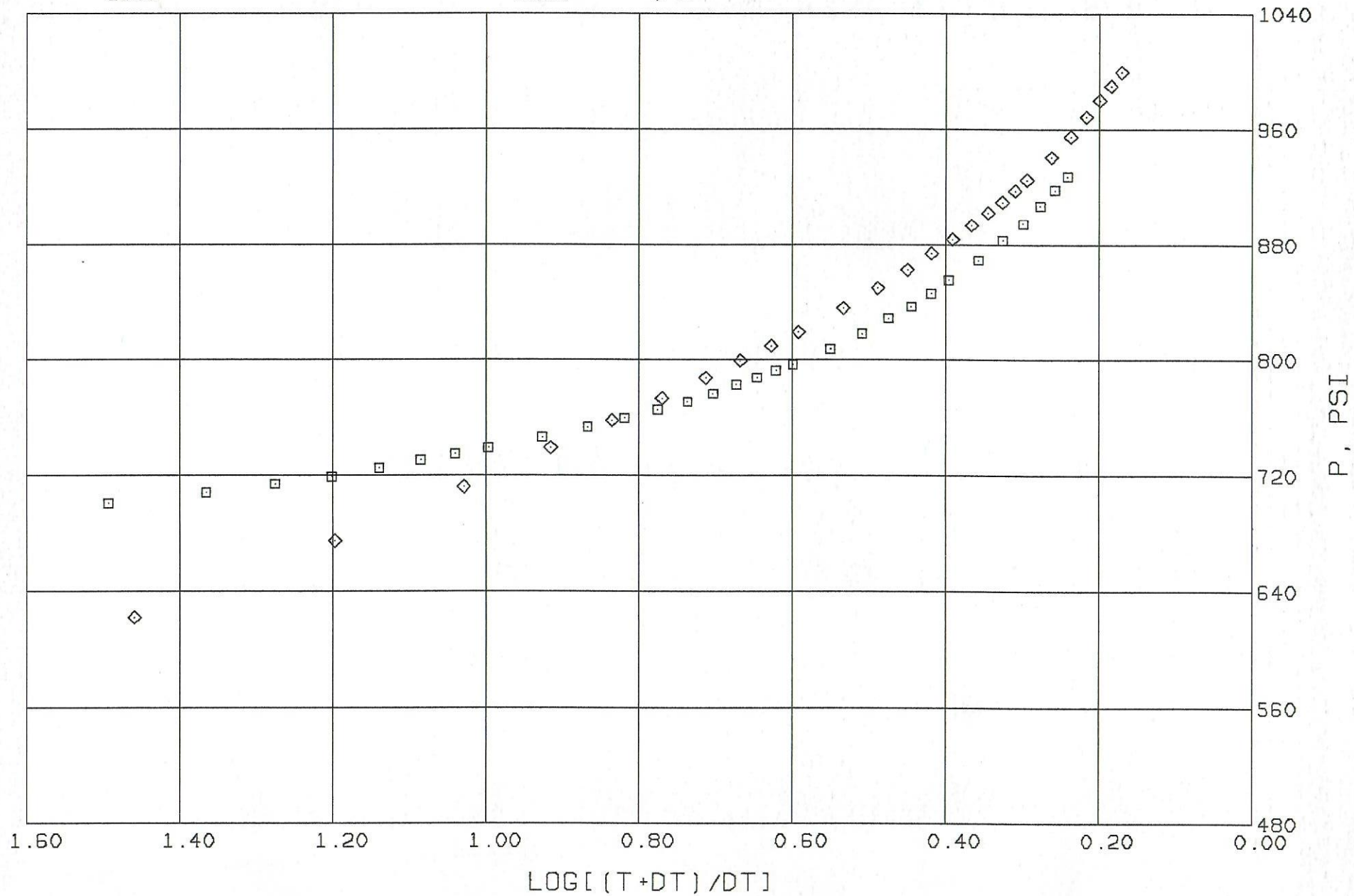
GAUGE NO CIP 1 2
1605 ◇ □



TICKET NO 00896200

GAUGE NO CIP 1 2
1606

GAUGE NO CIP 1 2
1605 \diamond \square



**TEMPERATURE
RECORDER
CHART**



10° each circle

EQUATIONS FOR DST LIQUID WELL ANALYSIS

Transmissibility	$\frac{kh}{\mu} = \frac{162.6 QB}{m}$	$\frac{\text{md-ft}}{\text{cp}}$
Indicated Flow Capacity	$kh = \frac{kh}{\mu} \mu$	md-ft
Average Effective Permeability	$k = \frac{kh}{h}$	md
Skin Factor	$S = 1.151 \left[\frac{P^* - P_i}{m} - \text{LOG} \left(\frac{k (t/60)}{\phi \mu c_r r_w^2} \right) + 3.23 \right]$	
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	$r_i = 0.032 \sqrt{\frac{k (t/60)}{\phi \mu c_r}}$	ft

EQUATIONS FOR DST GAS WELL ANALYSIS

Indicated Flow Capacity	$kh = \frac{.001637 Q_g T}{m}$	md-ft
Average Effective Permeability	$k = \frac{kh}{h}$	md
Skin Factor	$S = 1.151 \left[\frac{m(P^*) - m(P_i)}{m} - \text{LOG} \left(\frac{k (t/60)}{\phi \mu c_r r_w^2} \right) + 3.23 \right]$	
Damage Ratio	$DR = \frac{m(P^*) - m(P_i)}{m(P^*) - m(P_i) - 0.87 mS}$	
Indicated Flow Rate (Maximum)	$AOF_1 = \frac{Q_g m(P^*)}{m(P^*) - m(P_i)}$	MCFD
Indicated Flow Rate (Minimum)	$AOF_2 = Q_g \sqrt{\frac{m(P^*)}{m(P^*) - m(P_i)}}$	MCFD
Approx. Radius of Investigation	$r_i = 0.032 \sqrt{\frac{k (t/60)}{\phi \mu c_r}}$	ft

Because of the uncertainty of variable well conditions and the necessity of relying on facts and supporting services furnished by others, HRS is unable to guarantee the accuracy of any chart interpretation, research analysis, job recommendation or other data furnished by HRS. HRS personnel will use their best efforts in gathering such information and their best judgment in interpreting it but customer agrees that HRS shall not be responsible for any damages arising from the use of such information except where due to HRS gross negligence or willful misconduct in the preparation of furnishing of information.