



## DRILL STEM TEST REPORT

# HALLIBURTON RESERVOIR SERVICES



A Halliburton Company



# NOMENCLATURE

B	= Formation Volume Factor	(Res Vol/Std Vol)
$c_i$	= 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 <sup>2</sup> /cp
$m(P_i)$	= Real Gas Potential at $P_i$	MM psi <sup>2</sup> /cp
AOF <sub>1</sub>	= Maximum Indicated Absolute Open Flow at Test Conditions	MCFD
AOF <sub>2</sub>	= 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 <sub>1</sub>	= Theoretical Liquid Production w/Damage Removed	BPD
Q <sub>g</sub>	= 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
$\Delta t$	= Closed-in Time at Data Point	Minutes
T	= Temperature Rankine	°R
$\phi$	= Porosity (fraction)	
$\mu$	= Viscosity of Gas or Liquid	cp
Log	= Common Log	



**ANADARKO PETROLEUM CORPORATION**

**LEASE : COLLINS**

**WELL NO. : A-1**

**TEST NO. : 1**

**TICKET NO. 00896100**  
**10-FEB-93**  
**LIBERAL**

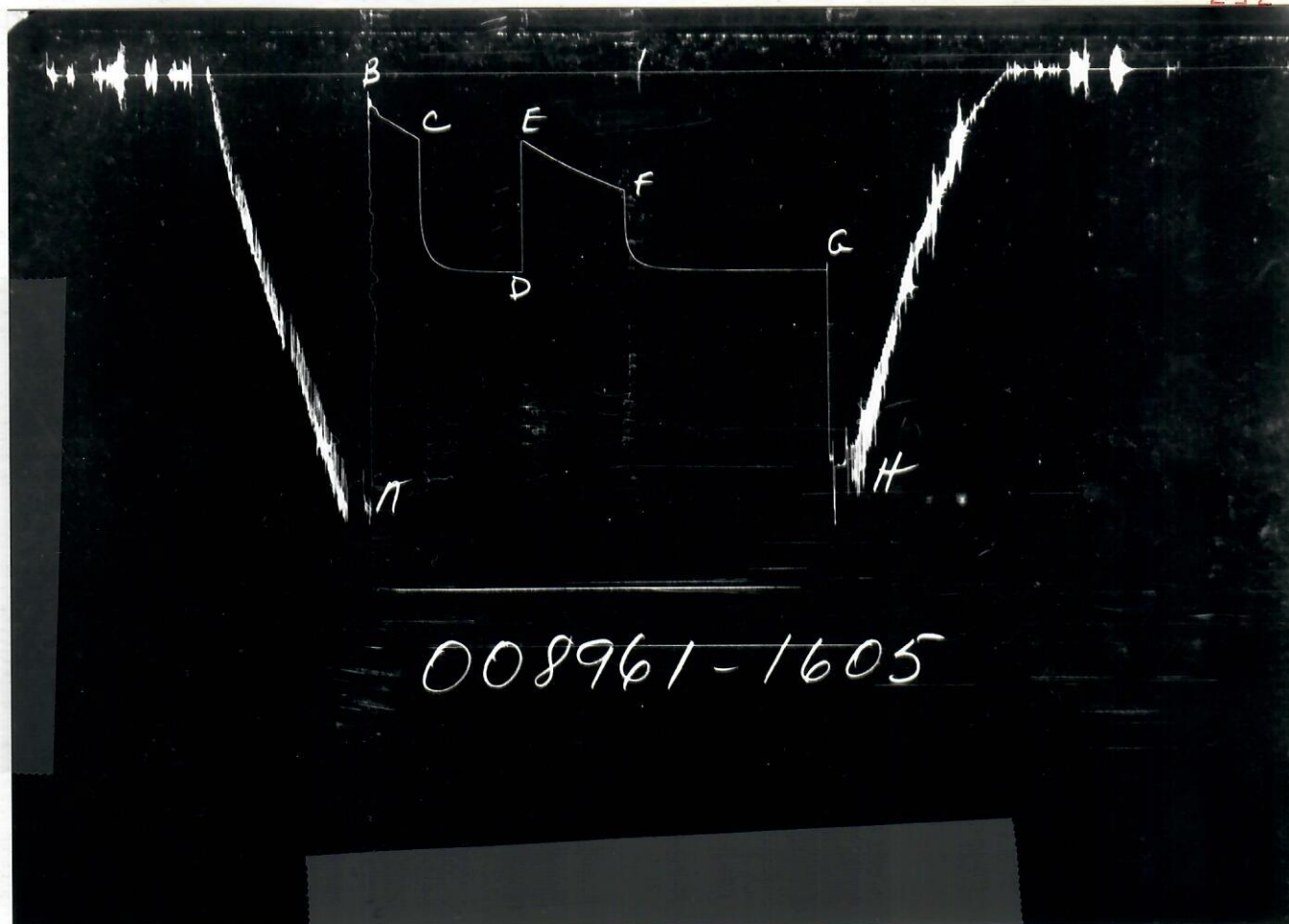
LEGAL LOCATION SEC. - TWP. - RANG.	6 - 28 - 41	FIELD AREA	WEST OF JOHNSON	COUNTY	BACA	STATE	COLORADO
LEASE NAME	COLLINS	WELL NO.	A-1	TEST NO.	1	TESTED INTERVAL	5290.0 - 5360.0
LEASE OWNER/COMPANY NAME						ANADARKO PETROLEUM CORPORATION	



GAUGE NO: 1606 DEPTH: 5269.0 BLANKED OFF: NO HOUR OF CLOCK: 12

ID	DESCRIPTION	PRESSURE		TIME		TYPE
		REPORTED	CALCULATED	REPORTED	CALCULATED	
A	INITIAL HYDROSTATIC	2532	2529.3			
B	INITIAL FIRST FLOW	132	128.4			
C	FINAL FIRST FLOW	362	369.4	30.0	29.7	F
C	INITIAL FIRST CLOSED-IN	362	369.4			
D	FINAL FIRST CLOSED-IN	1233	1226.3	60.0	60.1	C
E	INITIAL SECOND FLOW	395	406.6			
F	FINAL SECOND FLOW	703	708.7	60.0	60.9	F
F	INITIAL SECOND CLOSED-IN	703	708.7			
G	FINAL SECOND CLOSED-IN	1233	1229.2	120.0	119.4	C
H	FINAL HYDROSTATIC	2452	2473.4			





GAUGE NO: 1605 DEPTH: 5357.0 BLANKED OFF: YES HOUR OF CLOCK: 12

ID	DESCRIPTION	PRESSURE		TIME		TYPE
		REPORTED	CALCULATED	REPORTED	CALCULATED	
A	INITIAL HYDROSTATIC	2554	2570.4			
B	INITIAL FIRST FLOW	133	159.9	30.0	29.7	F
C	FINAL FIRST FLOW	399	414.8			
C	INITIAL FIRST CLOSED-IN	399	414.8	60.0	60.1	C
D	FINAL FIRST CLOSED-IN	1266	1267.8			
E	INITIAL SECOND FLOW	432	436.8	60.0	60.9	F
F	FINAL SECOND FLOW	727	750.5			
F	INITIAL SECOND CLOSED-IN	727	750.5	120.0	119.4	C
G	FINAL SECOND CLOSED-IN	1266	1267.0			
H	FINAL HYDROSTATIC	2489	2514.1			

**EQUIPMENT & HOLE DATA**FORMATION TESTED: MORROW

NET PAY (ft): \_\_\_\_\_

GROSS TESTED FOOTAGE: 70.0ALL DEPTHS MEASURED FROM: GROUND LEVEL

CASING PERFS. (ft): \_\_\_\_\_

HOLE OR CASING SIZE (in): 7.875ELEVATION (ft): 3680.0 GROUND LEVELTOTAL DEPTH (ft): 5360.0PACKER DEPTH(S) (ft): 5284, 5290

FINAL SURFACE CHOKE (in): \_\_\_\_\_

BOTTOM HOLE CHOKE (in): 0.750MUD WEIGHT (lb/gal): 9.10MUD VISCOSITY (sec): 51

ESTIMATED HOLE TEMP. (°F): \_\_\_\_\_

ACTUAL HOLE TEMP. (°F): 138 @ 5355.0 ftTICKET NUMBER: 00896100DATE: 02-05-93 TEST NO: 1TYPE DST: OPEN HOLE

FIELD CAMP:

LIBERALTESTER: ABLA

WITNESS: \_\_\_\_\_

DRILLING CONTRACTOR:

GABBERT AND JONES DRILLING COMPANY**FLUID PROPERTIES FOR  
RECOVERED MUD & WATER**

SOURCE

RESISTIVITY

CHLORIDES

PIT 0.460 @ 72 °F 9359 ppmTOP 0.170 @ 65 °F 26600 ppmMIDDLE 0.120 @ 65 °F 44827 ppmBOTTOM 0.110 @ 65 °F 49260 ppmSAMPLER 0.110 @ 50 °F 49260 ppm

\_\_\_\_\_ @ \_\_\_\_\_ °F \_\_\_\_\_ ppm

**SAMPLER DATA**P<sub>sig</sub> AT SURFACE: 700.0

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 :**

244 FEET OF DRILLING MUD  
 244 FEET OF MUDDY SALT WATER  
 1018 FEET OF SALT WATER

MEASURED FROM  
TESTER VALVE**REMARKS :**





TICKET NO: 00896100

CLOCK NO: 13668 HOUR: 12

GAUGE NO: 1606

DEPTH: 5269.0

REF	MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
FIRST FLOW					
B 1	0.0	128.4			
2	5.0	196.0	67.6		
3	10.0	248.3	52.3		
4	15.0	278.2	29.9		
5	20.0	311.1	33.0		
6	25.0	341.2	30.0		
C 7	29.7	369.4	28.2		
FIRST CLOSED-IN					
C 1	0.0	369.4			
2	1.0	890.8	521.4	1.0	1.478
3	2.0	968.8	619.4	1.8	1.209
4	3.0	1040.4	671.0	2.7	1.036
5	4.0	1069.5	700.1	3.5	0.927
6	5.0	1092.9	723.5	4.3	0.843
7	6.0	1112.1	742.7	5.0	0.774
8	7.0	1128.1	758.7	5.7	0.720
9	8.0	1141.2	771.8	6.3	0.674
10	9.0	1151.3	781.9	6.9	0.633
11	10.0	1159.2	789.8	7.5	0.600
12	12.0	1174.7	805.3	8.6	0.540
13	14.0	1185.9	816.5	9.5	0.494
14	16.0	1194.1	824.7	10.4	0.456
15	18.0	1199.7	830.3	11.2	0.423
16	20.0	1205.1	835.7	12.0	0.395
17	22.0	1208.8	839.4	12.6	0.372
18	24.0	1211.7	842.3	13.3	0.350
19	26.0	1214.2	844.8	13.9	0.331
20	28.0	1216.3	846.9	14.4	0.314
21	30.0	1217.3	847.9	14.9	0.299
22	35.0	1220.7	851.3	16.1	0.267
23	40.0	1223.0	853.6	17.1	0.241
24	45.0	1224.4	855.0	17.9	0.220
25	50.0	1225.1	855.6	18.6	0.203
26	55.0	1225.9	856.5	19.3	0.188
D 27	60.1	1226.3	856.9	19.9	0.175
SECOND FLOW					
E 1	0.0	406.6			
2	5.0	415.6	8.9		
3	10.0	447.9	32.3		
4	15.0	478.1	30.2		
5	20.0	506.7	28.6		
6	25.0	535.1	28.4		
7	30.0	563.3	28.2		
8	35.0	589.2	25.9		
9	40.0	615.2	25.9		
10	45.0	639.2	24.0		

REF	MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
SECOND FLOW - CONTINUED					
11	50.0	661.9	22.7		
12	55.0	683.6	21.7		
F 13	60.9	708.7	25.1		
SECOND CLOSED-IN					
F 1	0.0	708.7			
2	1.0	1019.5	310.8	1.0	1.947
3	2.0	1063.0	354.3	2.0	1.661
4	3.0	1089.3	380.6	2.9	1.497
5	4.0	1109.2	400.5	3.8	1.375
6	5.0	1127.2	418.4	4.8	1.280
7	6.0	1138.6	429.9	5.6	1.210
8	7.0	1149.5	440.7	6.5	1.147
9	8.0	1159.0	450.3	7.3	1.091
10	9.0	1167.2	458.5	8.2	1.044
11	10.0	1173.5	464.8	9.0	1.002
12	12.0	1184.4	475.6	10.6	0.932
13	14.0	1192.3	483.5	12.2	0.872
14	16.0	1197.9	489.2	13.6	0.824
15	18.0	1202.3	493.6	15.0	0.781
16	20.0	1206.0	497.3	16.4	0.743
17	22.0	1208.9	500.2	17.7	0.709
18	24.0	1210.7	502.0	19.0	0.678
19	26.0	1213.1	504.4	20.2	0.651
20	28.0	1214.6	505.8	21.4	0.627
21	30.0	1215.5	506.8	22.6	0.604
22	35.0	1217.9	509.2	25.3	0.555
23	40.0	1219.4	510.7	27.7	0.514
24	45.0	1220.7	512.0	30.1	0.479
25	50.0	1222.0	513.3	32.2	0.449
26	55.0	1223.1	514.4	34.2	0.423
27	60.0	1224.4	515.7	36.1	0.400
28	70.1	1225.2	516.5	39.5	0.360
29	80.0	1227.5	518.8	42.5	0.329
30	90.0	1228.3	519.6	45.1	0.303
31	100.0	1228.8	520.0	47.5	0.280
32	110.0	1229.2	520.5	49.7	0.261
G 33	119.4	1229.2	520.5	51.5	0.245

REMARKS:



TICKET NO: 00896100

GAUGE NO: 1605

CLOCK NO: 2596 HOUR: 12

DEPTH: 5357.0



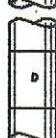

















REF	MINUTES	PRESSURE	AP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
FIRST FLOW					
B 1	0.0	159.9			
2	5.0	233.8	73.9		
3	10.0	290.0	56.2		
4	15.0	320.6	30.5		
5	20.0	354.9	34.3		
6	25.0	386.4	31.5		
C 7	29.7	414.8	28.4		
FIRST CLOSED-IN					
C 1	0.0	414.8			
2	1.0	997.7	582.9	1.0	1.478
3	2.0	1056.1	641.3	1.8	1.207
4	3.0	1093.6	678.8	2.7	1.041
5	4.0	1123.1	708.3	3.5	0.925
6	5.0	1145.4	730.6	4.3	0.843
7	6.0	1163.2	748.4	5.0	0.773
8	7.0	1176.5	761.7	5.6	0.722
9	8.0	1189.6	774.8	6.3	0.673
10	9.0	1199.1	784.3	6.9	0.634
11	10.0	1207.7	792.9	7.5	0.599
12	12.0	1222.1	807.4	8.5	0.541
13	14.0	1231.8	817.0	9.5	0.495
14	16.0	1239.0	824.2	10.4	0.456
15	18.0	1244.2	829.4	11.2	0.424
16	20.0	1248.3	833.5	12.0	0.395
17	22.0	1251.6	836.8	12.6	0.372
18	24.0	1254.7	839.9	13.3	0.350
19	26.0	1256.0	841.2	13.9	0.331
20	28.0	1257.7	842.9	14.4	0.314
21	30.0	1259.5	844.7	14.9	0.299
22	35.0	1261.3	846.5	16.1	0.267
23	40.0	1264.0	849.3	17.1	0.241
24	45.0	1265.4	850.6	17.9	0.220
25	50.0	1266.2	851.4	18.6	0.202
26	55.0	1267.0	852.2	19.3	0.188
D 27	60.1	1267.8	853.0	19.9	0.175
SECOND FLOW					
E 1	0.0	436.8			
2	5.0	454.3	17.6		
3	10.0	486.4	32.0		
4	15.0	518.2	31.9		
5	20.0	549.4	31.2		
6	25.0	578.8	29.4		
7	30.0	604.8	25.9		
8	35.0	631.5	26.8		
9	40.0	656.8	25.3		
10	45.0	680.3	23.5		

REF	MINUTES	PRESSURE	AP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
SECOND FLOW - CONTINUED					
11	50.0	703.9	23.6		
12	55.0	725.9	22.0		
F 13	60.9	750.5	24.6		
SECOND CLOSED-IN					
F 1	0.0	750.5			
2	1.0	1067.9	317.4	1.0	1.953
3	2.0	1109.0	358.5	2.0	1.666
4	3.0	1136.9	386.4	2.9	1.496
5	4.0	1156.5	406.0	3.8	1.378
6	5.0	1173.9	423.4	4.7	1.284
7	6.0	1187.5	437.0	5.6	1.207
8	7.0	1197.4	446.8	6.5	1.147
9	8.0	1205.5	455.0	7.3	1.093
10	9.0	1212.3	461.7	8.2	1.044
11	10.0	1218.5	468.0	9.0	1.003
12	12.0	1227.3	476.8	10.6	0.932
13	14.0	1233.7	483.2	12.1	0.874
14	16.0	1239.6	489.1	13.6	0.824
15	18.0	1243.7	493.2	15.0	0.780
16	20.0	1245.5	495.0	16.4	0.742
17	22.0	1248.3	497.8	17.7	0.709
18	24.0	1250.6	500.1	19.0	0.678
19	26.0	1252.7	502.2	20.2	0.652
20	28.0	1253.6	503.0	21.4	0.627
21	30.0	1254.7	504.2	22.6	0.604
22	35.0	1256.8	506.3	25.2	0.555
23	40.0	1258.6	508.1	27.8	0.514
24	45.0	1259.5	508.9	30.1	0.479
25	50.0	1260.8	510.2	32.2	0.449
26	55.0	1261.9	511.4	34.2	0.423
27	60.0	1262.9	512.4	36.1	0.400
28	70.0	1263.7	513.2	39.5	0.360
29	80.0	1264.5	514.0	42.5	0.329
30	90.0	1265.3	514.8	45.1	0.302
31	100.0	1265.5	515.0	47.5	0.280
32	110.0	1266.7	516.1	49.7	0.261
G 33	119.4	1267.0	516.5	51.5	0.245

REMARKS:



TICKET NO. 00896100

		O.D.	I.D.	LENGTH	DEPTH	
1		DRILL PIPE.....	4.500	3.826	4831.0	
3		DRILL COLLARS.....	6.250	2.250	368.0	
50		IMPACT REVERSING SUB.....	6.250	3.000	1.0	5188.0
3		DRILL COLLARS.....	6.250	2.250	61.0	
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	5.0	
13		DUAL CIP SAMPLER.....	5.000	0.750	7.0	
60		HYDROSPRING TESTER.....	5.000	0.750	5.0	5267.0
80		AP RUNNING CASE.....	5.000	2.250	4.1	5269.0
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	5284.0
70		OPEN HOLE PACKER.....	6.750	1.530	5.8	5290.0
5		CROSSOVER.....	6.250	2.250	1.0	
3		DRILL COLLARS.....	6.250	2.250	31.0	
5		CROSSOVER.....	6.250	2.250	2.0	
2		TUBING.....	5.000	2.370	29.0	
82		TEMPERATURE RUNNING CASE.....	5.000		1.0	5355.0
81		BLANKED-OFF RUNNING CASE.....	5.000		4.3	5357.0
TOTAL DEPTH					5360.0	

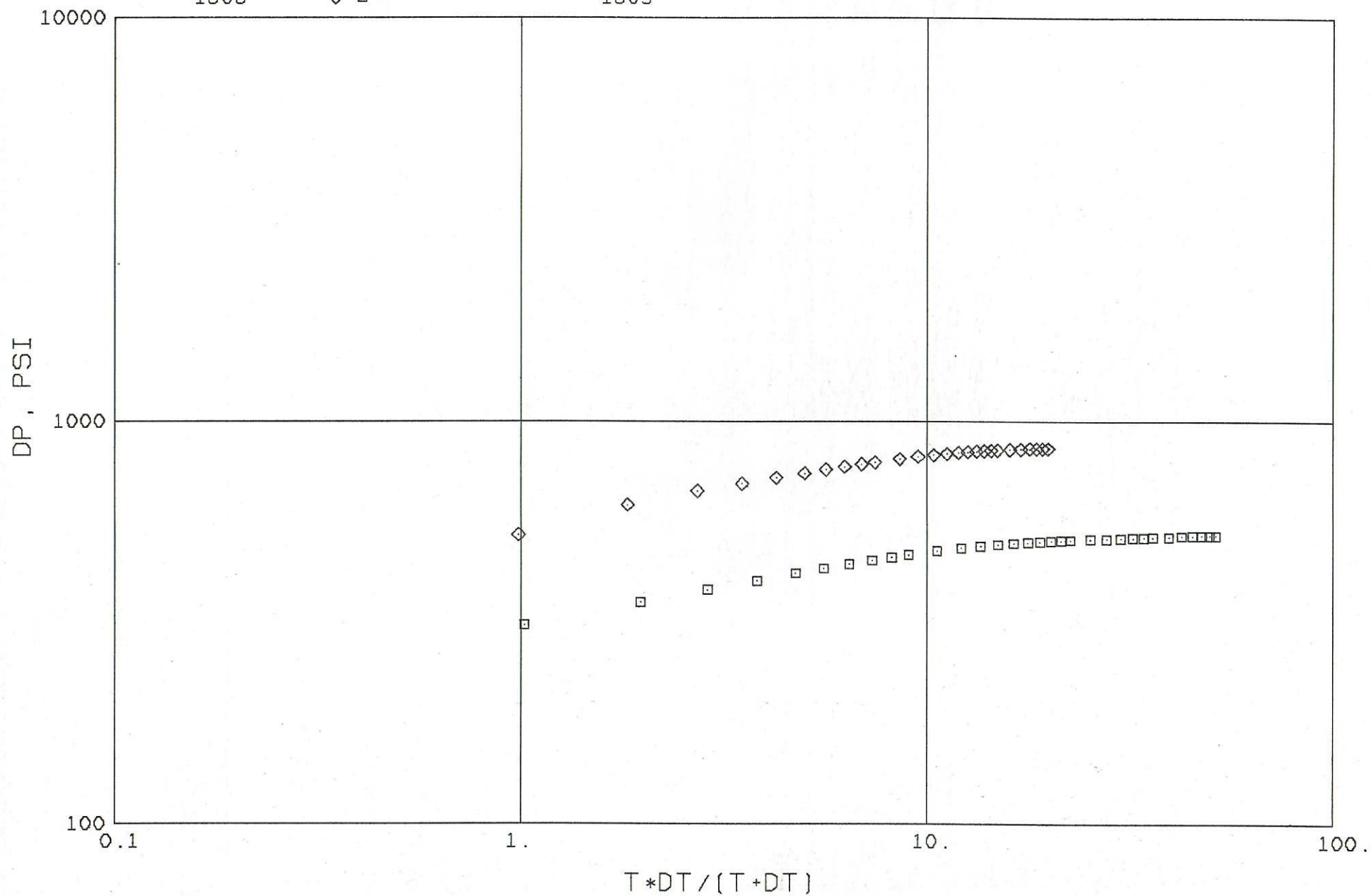
EQUIPMENT DATA



TICKET NO 00896100

GAUGE NO CIP 1 2  
1606      $\diamond$   $\square$

GAUGE NO CIP 1 2  
1605

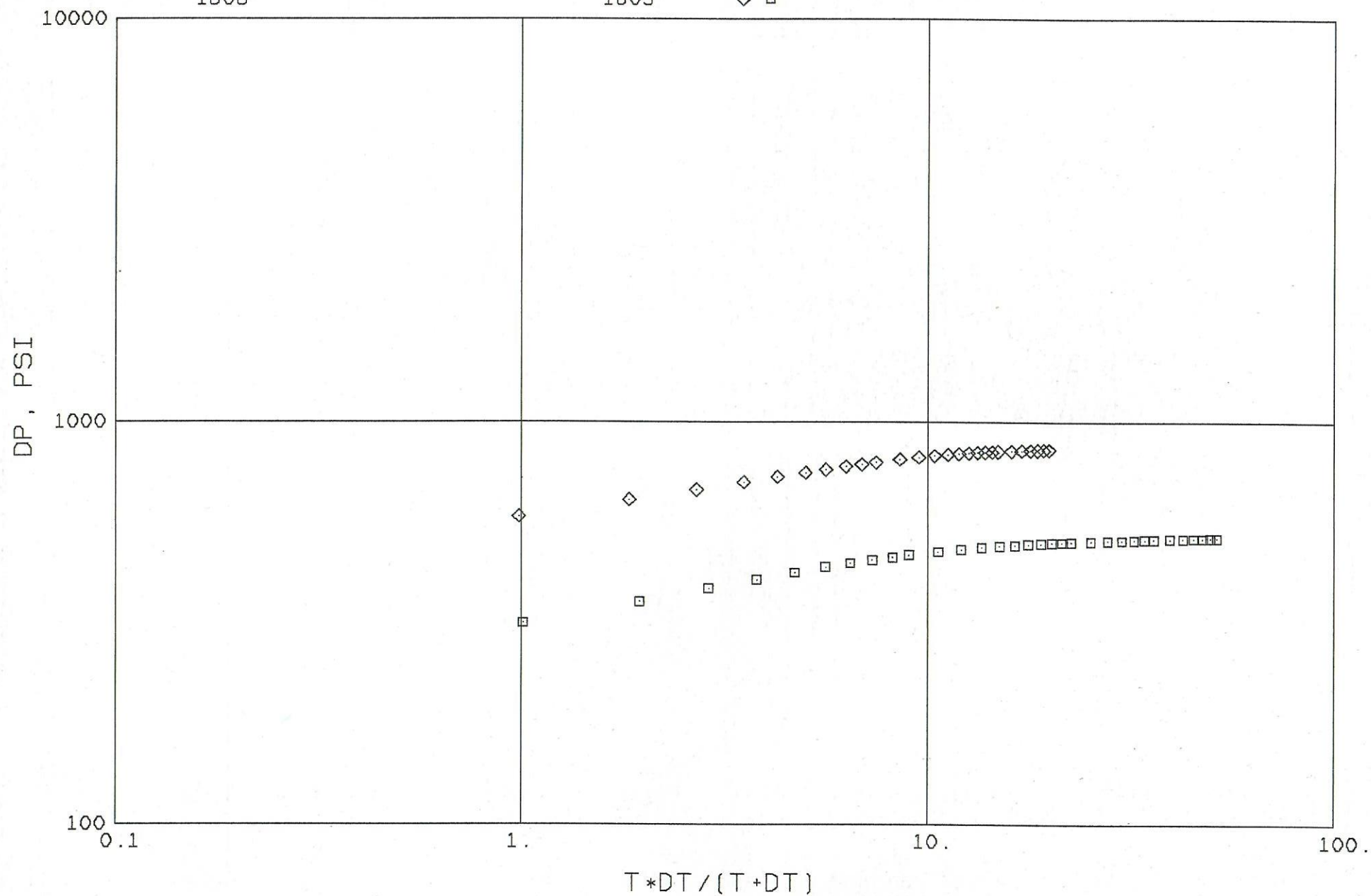




TICKET NO 00896100

GAUGE NO CIP 1 2  
1606

GAUGE NO CIP 1 2  
1605  $\diamond$   $\square$

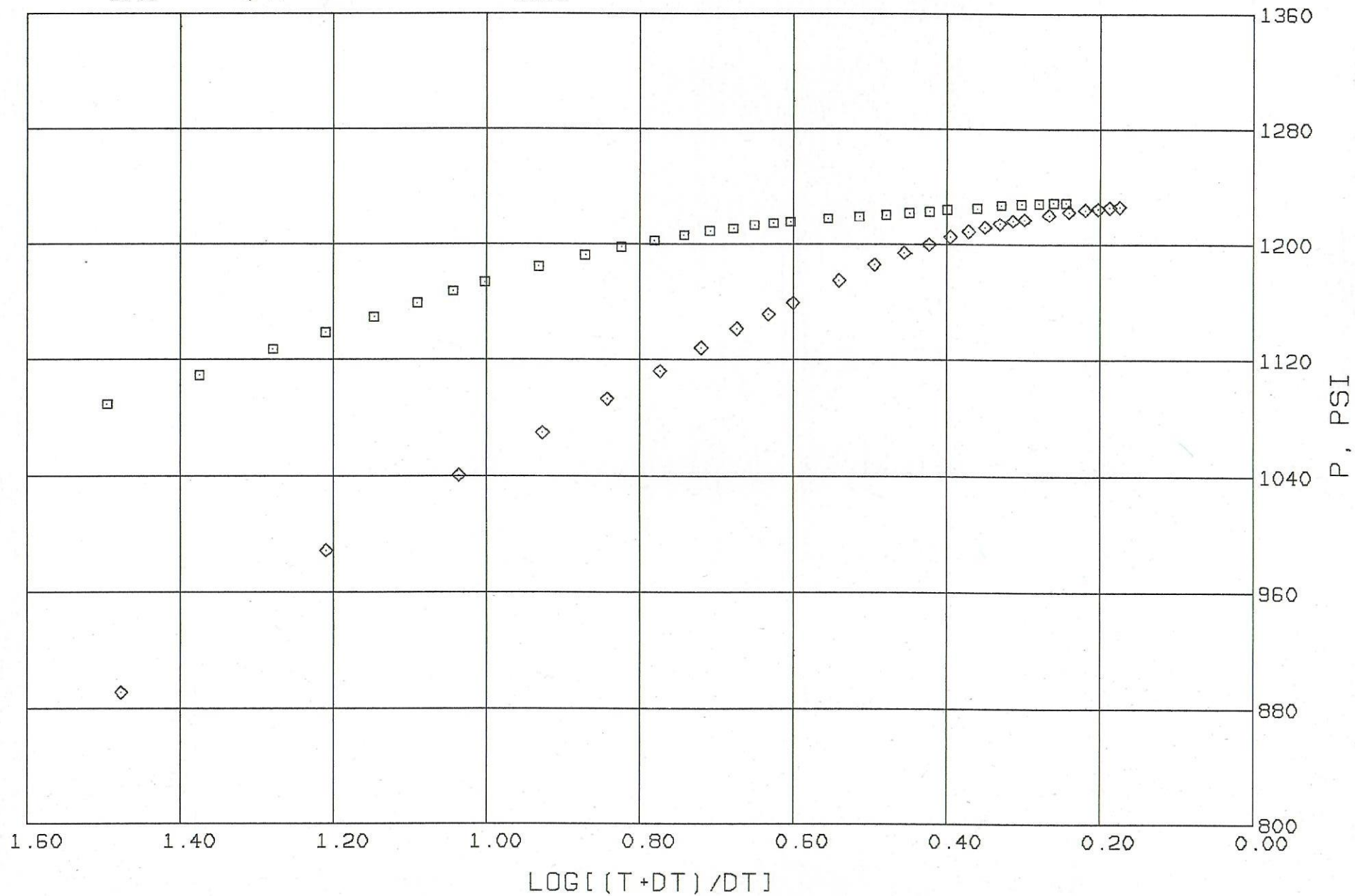




TICKET NO 00896100

GAUGE NO CIP 1 2  
1606     ◇ □

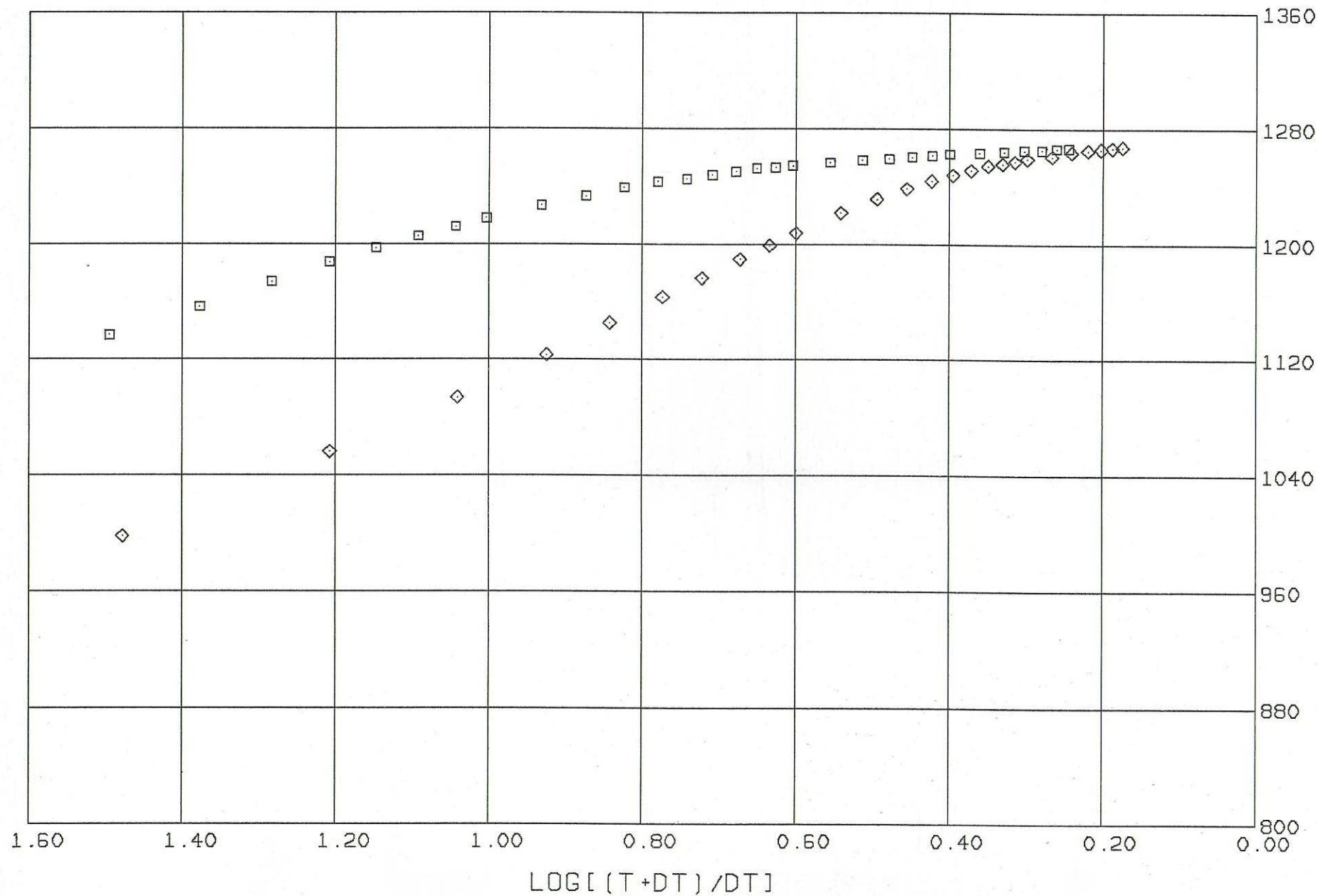
GAUGE NO CIP 1 2  
1605     ◇ □



TICKET NO 00896100

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	$S = 1.151 \left[ \frac{P^* - P_i}{m} - \text{LOG} \left( \frac{k(t/60)}{\phi \mu c_i r_w^2} \right) + 3.23 \right]$	
Damage Ratio	$DR = \frac{P^* - P_i}{P^* - P_i - 0.87 mS}$	
Theoretical Potential w/Damage Removed	$Q_1 = Q DR$	BPD
Approx. Radius of Investigation	$r_i = 0.032 \sqrt{\frac{k(t/60)}{\phi \mu c_i}}$	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	$S = 1.151 \left[ \frac{m(P^*) - m(P_i)}{m} - \text{LOG} \left( \frac{k(t/60)}{\phi \mu c_i r_w^2} \right) + 3.23 \right]$	
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	$r_i = 0.032 \sqrt{\frac{k(t/60)}{\phi \mu c_i}}$	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.