DEPT. NAT. RES & ENV
PE903715

APPENDIX 19.

QUESTA REPORT ON DST-3 & 4.

PINE LODGE-1

W1034

REPORT ON TESTING OF PINE LODGE 1 DST 3 AND DST 4

Prepared for

GAS AND FUEL EXPLORATION N.L.

Report No. 90027
WP: 0116wp
September, 1990

Questa Australia Pty Ltd

DST 3 (2043-2070m)

A complete report on this test can be prepared as required by Gas and Fuel Exploration. At the moment, suffice to say that without knowing the production rate from the tested zone (surface pressure too small to measure) no precise values of many of the standard parameters will ever be known. It is also doubtful if any degree of depletion can be calculated since extremely small quantities of all fluids were produced. Nonetheless, the following remarks, based on experience of hydrocarbon gas and CO_2 zones elsewhere in the Otway Basin may be of some use:

> The test was valid. No plugging was observed and the characteristics of both the flow (memory) and the blanked off gauge (BT) are entirely normal.
>
> The flowing pressure, although gradually rising (due to low rate of liquid entry) was very low, ending up at 180 psia after two hours.
>
> The permeability is extremely low and is "a handful of micro-darcies" (thousandths of a milli-darcy).
>
> The gas production most probably came from solution in the formation water.

Figures 1 and 2 show the pressure characteristics of this test.

DST 4 (1940-1967m)

Figures 1 and 2 also show the pressure characteristics of this test. These are very similar to those observed in DST 1 over the same interval. The results of this test are described in preliminary form in Questa's report of 22nd August.

Two matters required resolution following DST 1. These were whether a permanent pressure drop had occurred as a result of production during the test (no initial pressure was taken) and the extent to which the drop in FBHP during the last 20 minutes of the flow period was valid.

In DST 4, these two points were addressed and the results are discussed here. Additionally, the very important and quite technical matter of what the well's flow rate during the test actually was is discussed briefly. More detailed discussion of this is merited as required, since a clear understanding of the technical details and their implications is important. This matter will be addressed first.

FLOW RATE

The flow rate during both DST's 1 and 4 were estimated using the conventional choke flow formula which for a 1/2" choke (that used during both tests) is:

$$Q = \frac{113 \times P}{\sqrt{G \times T}} \text{ MCFPD}$$

where P is upstream pressure
G is gas gravity (air=1.00)
T is flowing temperature (^{o}R)

Thus for DST 1 where

P = 880 + 14.7 = 894.7 psia
G = 1.50 (97% pure CO_2)
T = 80 + 460 = 540^{o}R

Q = 3.55 MMCFPD ---------- DST 1

and for DST 4 where

P = 810 + 14.7 = 824.7 psia
G = 1.50
T = 65 + 460 = 525^{o}R

Q = 3.32 MMCFPD ---------- DST 4

Unfortunately, this formula does not take into account the deviation of CO_2 from the perfect gas law and so is subject to some inaccuracy.

Although not completely correct, the following formula does account for the major inaccuracy of the conventional choke flow formula:

$$Q = \frac{113 \times P}{\sqrt{G \times T \times Z}}$$

where Z is the supercompressibility of CO_2 at P and T.

At the surface conditions that pertained during these two DSTs, the value of Z varies very considerably with temperature as the following table shows:

P(psia)	T(^{o}F)	Z
895	60	.135
895	65	.139
895	70	.144
895	75	.153
895	80	.553
825	60	.126
825	65	.130
825	70	.136
825	75	.589
825	80	.616

Thus, it can be seen that the flowing tubing head temperature becomes a very critical factor.

During DST 1, this value was estimated to be about 80°F. During DST 4 very careful attempts were made to measure it accurately and a mean value of 65°F (with variation over a range of about 64° to 66°F) was recorded (Attachment 2).

Thus, assuming that this is correct, a better estimate of the flow rate during the test (DST 4)

$$Q_{65} = \frac{113 \times 825}{\sqrt{1.50 \times 525 \times 0.13}}$$

$$= 9.2 \text{ MMCFPD} \quad \text{---------- DST 4}$$

which is about 2.8 times that estimated.

If, however, the flowing tubing head temperature were, in fact, 75°F, the rate would be estimated to be:

$$Q_{75} = \frac{113 \times 825}{\sqrt{1.50 \times 535 \times 0.59}}$$

$$= 4.3 \text{ MMCFPD} \quad \text{---------- DST 4}$$

which is much closer to that estimated.

Another complexity enters this matter and that is whether the fluid passing through the choke was gas (assumed up until now) or liquid.

The reason for the extreme variations in supercompressibility mentioned above is that the fluid is very close to the critical locus (between gas and liquid). If in fact, the fluid was liquid and not gas then, in theory, everything that has been said up to now goes out of the window and other methods must be used.

The critical locus of CO_2 passes extremely close to 825 psia and 65°F. Thus it is entirely possible that the fluid passing through the choke during this test was liquid (at 75°F it is definitely gas).

In this case we can calculate the rate using the formula for a liquid phase critical flow prover which is:

$$W = K \times \sqrt{P_1 \times RHO}$$

where W is lbs/day of liquid
P_1 is upstream pressure (psia)
RHO is liquid density (gms/cc)
K is constant which is $\pm$ 37,400 for 1/2" choke

From the specific volume graph provided with Questa's first report, it can be seen that the variation of SV (and thus densities of CO_2) varies little with pressure at 65°F and is about 0.02 cu ft/lb or 50 lbs/cu ft or 0.80 gm/cc.

Therefore,

$$W = 37{,}400 \times \sqrt{825 \times 0.80}$$

$$= 961{,}000 \text{ lbs/day of liquid } CO_2$$

$$\equiv 8.3 \text{ MMCFPD in vapour form at atmospheric conditions}$$

This latter rate is in fair agreement with that calculated assuming a vapour and so we can be confident that the maximum rate from the well during DST was about 9 MMCFPD. The minimum rate is about 4 MMCFPD.

It is remarked, parenthetically, that the only way to determine the true flow rate of CO_2 is by using a mass meter and not a volume device (of whatever sort).

BUILDUP ANALYSIS

Figures 3 and 4 are HRS's plotted Horner plots for the initial and final buildups of DST 4. Note that these are plotted as P^2 rather than pseudo pressure (as in the case of DST 1) which is a step in the right direction. Attachment 1 gives the test details.

Figures 5 and 6 are Questa's extrapolations of these buildups. Note that when comparing these pressures with those of DST 1, there is a 67 ft depth difference between the two gauges. Thus, adding about 20 psi to DST 4 readings will put them on the same basis as those from DST 1.

The initial buildup extrapolates to 2754 psia. There is essentially no doubt about this extrapolation (apart from HRS's choice of scale).

The final buildup is slightly more open to interpretation. Questa prefer an extrapolated P* of 2708 psia while admitting that a value of 2723 psia is possible.

Figure 7 gives a more conventional Horner Plot. This shows the initial pressure to be 2750 psia and the final 2708 psia (both extrapolated).

Figure 8 gives the conversion from values of P to P/Z for CO_2 at 155°F. This is necessary for the simplified material balance calculations from the following formula:

$$G = \frac{P_1 / Z_1}{(P_1/Z_1 - P_2/Z_2)} \times Gp$$

where G = GIIP (MMCF)
P_1 = Initial Pressure (psia)
Z_1 = Initial supercompressibility
P_2 = Final Pressure (psia)
Z_2 = Final supercompressibility
Gp = Production during test (3hr) (MMCF)

There are various possibilities for Gp and P_2. Some of these are given in the following table with the resulting values of G (P_1/Z_1 = 6075).

Q(MMCFPD)	Gp(MMCF)	P_2(psia)	P_2/Z_2(psia)	G(MMCF)
4	0.5	2708	6010	47
4	0.5	2723	6035	76
8	1.0	2708	6010	94
8	1.0	2723	6035	152

Thus, a probable range of the GIIP of 50-150 MMCF is established. Questa is of the opinion that a range of 50-100 MMCF of GIIP producible at commercial rates is possible with the rest being present in tight rock not allowing such rates to be achieved.

Calculations of Kh and Skin

The buildup curve is very similar to that of DST 1 which exhibited the characteristics of fractures.

Kh

Assumptions

μ = 0.041 cp (Fig 9)
Bg = 0.0036
m = 490 psi/cycle
} @ $\frac{P^* + Pwf}{2}$

Q(MCFPD)	Kh (md ft)	Kh/q	Kh/qμ
4000	35		
5000	44		
6000	53	0.0087	0.212
7000	61		
8000	70		

Skin

Assumptions

P1hr = 2420 psia
Pwf = 1600 psia
m = 490 psi/cycle
ϕ = 0.2
Ct = CgSg + CwSw - Cf
= (370 x 0.5 + 3.5 x 0.5 + 5) x 10^{-6} = 0.0002 vol/vol/psi
r_w = 0.35 ft
h = 10 ft

Kh (md ft)	K min (md)	Skin	Δp Skin (psi)
35	3.5	-2.7	-1140
44	4.4	-2.8	-1190
53	5.3	-2.9	-1230
61	6.1	-3.0	-1260
70	7.0	-3.0	-1290

K max (md)	Skin	Δp Skin (psi)
10	-3.2	-1370
15	-3.4	-1452
25	-3.7	-1561

Thus, the possible range of permeabilities is 4 to 25 md.

Thus, assuming different values of r_w eff

r_w eff (ft)	K (md)	Skin	Δp Skin (psi)
2	5	-1.1	-470
2	10	-1.5	-620
2	25	-1.9	-820
5	5	-0.2	-80
5	10	-0.5	-23
5	25	-1.0	-430
10	5	0.5	210
10	10	0.1	60
10	25	-0.3	-130
15	5	0.9	384
15	10	0.6	236
15	25	0.1	40

It is seen that an r_w eff range of 5-15 ft is possible and this results in a permeability range of 5-25 md for the formation away from the fractured zone.

Since

R frac = 4 x r_w eff (under certain assumptions)

Fracture half lengths of 20-60 ft are implied.

However, the constraint of Kh being in the range 35-70 also exists. Thus, taking Kh = 70 (say), a K of 7 md and an r_w eff of 8 ft (R frac = 24 ft) results.

Steady State Analysis

Pseudo steady state had not been reached at the end of the drawdown test.

Assume that the pressure would have had to drop to 1500 psi for pseudo steady state to be reached (radius of investigation after three hours was about 120 ft).

Then,

$$\ln\left(\frac{re}{r_w\ eff}\right) = \frac{0.000703\ (Pe^2 - Pwf^2)}{Tz}\left(\frac{Kh}{q}\right)$$

$$= \frac{0.000703\ (2750^2 - 1500^2)}{615 \times 0.45} \times 0.212$$

$$= 2.86$$

therefore,

$$\frac{re}{r_w\ eff} = 17.5$$

$$re = 140\ ft$$

therefore,

$$GIIP = \frac{\pi re^2 \times 0.2 \times 0.5 \times 10}{0.00284}$$

$$= 22\ MMCF$$

(with Pwf = 1400 psia this would rise to 30 MMCF)

Thus, steady state analysis confirms the same order of magnitude reservoir size.

DRAWDOWN TEST

Figures 1 and 2 show the pressure performance of this test (period K to L). Figure 10 shows these same data in an expanded scale.

It appears that many of the same characteristics that were observed during DST 1 are being seen here. It seems, however, that any formation damage had mostly been removed during the first test since buildup to a fairly constant (1600 - 1650 psia) pressure was almost immediate in this test whereas it took much longer to reach these pressures during DST 1 (the fact that the pipe was full of gas also helped). This is also backed-up by the field observations that the amount of flowline plugging appeared less and the amount of silt found in the tool was also less.

Had this test continued for only two hours instead of three, an entirely predictable slope would have been interpreted. This would have given a reservoir size similar to that given in Questa's report on DST 1. However, just after the first two hours, a hiccup (SPE technical term) occurred. This may have been due to some unplugging back in the formation or plugging at the tool itself (not at the perforated nipple because the blanked-off gauge also sees this event). Once this plug cleared or unplugging ceased, however, the pressure continued down at much the same general rate as before.

If an average pressure drop of 0.3 psi per minute is used and a production rate of 8 MMCFPD is assumed, an approximate GIIP of 50 MMCF is calculated. This is somewhat lower than that calculated from the buildup but this may be due to the probability that this drawdown slope may well have settled down to a somewhat lower value in a few more hours time as tighter parts of the reservoir start to contribute.

The downward tendencies of this drawdown are, nonetheless unusual and disturbing. One possible explanation is the closing of fractures as the formation pressure drops. If this is the case, one can expect the flowing pressure to continue an ever increasing rate of fall-off as production continues.

In spite of the above, these data confirm a reservoir size of 50-150 (max) MMCF calculated from buildup data.

What else could cause this pressure behaviour? As was discussed in Questa's report on DST 1, a specific set of circumstances could be responsible.

Suppose that at about 17:30 the flowing temperature was about 75-80°F. The flow through the surface choke would then have been gas at a rate of about 4.5 MMCFPD would have been occuring (both at the surface and from the formation). Suppose further that during the next two hours or so the surface temperature dropped to about 65°F. This would increase the flow rate (with no noticeable change in flowing THP towards some 8 MMCFPD). If such an increase in flow rate were occurring, the bottomhole flowing pressure would be expected to drop and this could then have no bearing on the size of the reservoir.

The facts (Attachment 2), however, do not support this temperature behaviour. A fairly constant 64°-66°F was reported from 13 minutes into the flow period (about 16:50 hours) through to about 19:30 hrs. Moreover, the FTHP did drop by 40 psi during the test.

SUMMARY

The vast majority of the evidence collected during this test points to a limited CO_2 reservoir with about 50 to 150 MMCF of GIIP.

If one could accept the very special set of circumstances (not confirmed by the facts) involving the drawdown test and if one could extrapolate the final buildup curve up to a P* of 2750 psia then the limited reservoir concept would disappear. One would then have a reservoir of unknown size with the potential to deliver up to 9 MMCFPD for an unknown period of time.

Based on the work done to date, Questa does not believe this to be the case while admitting that there is a small possibility (5-10%) of it, in fact being so.

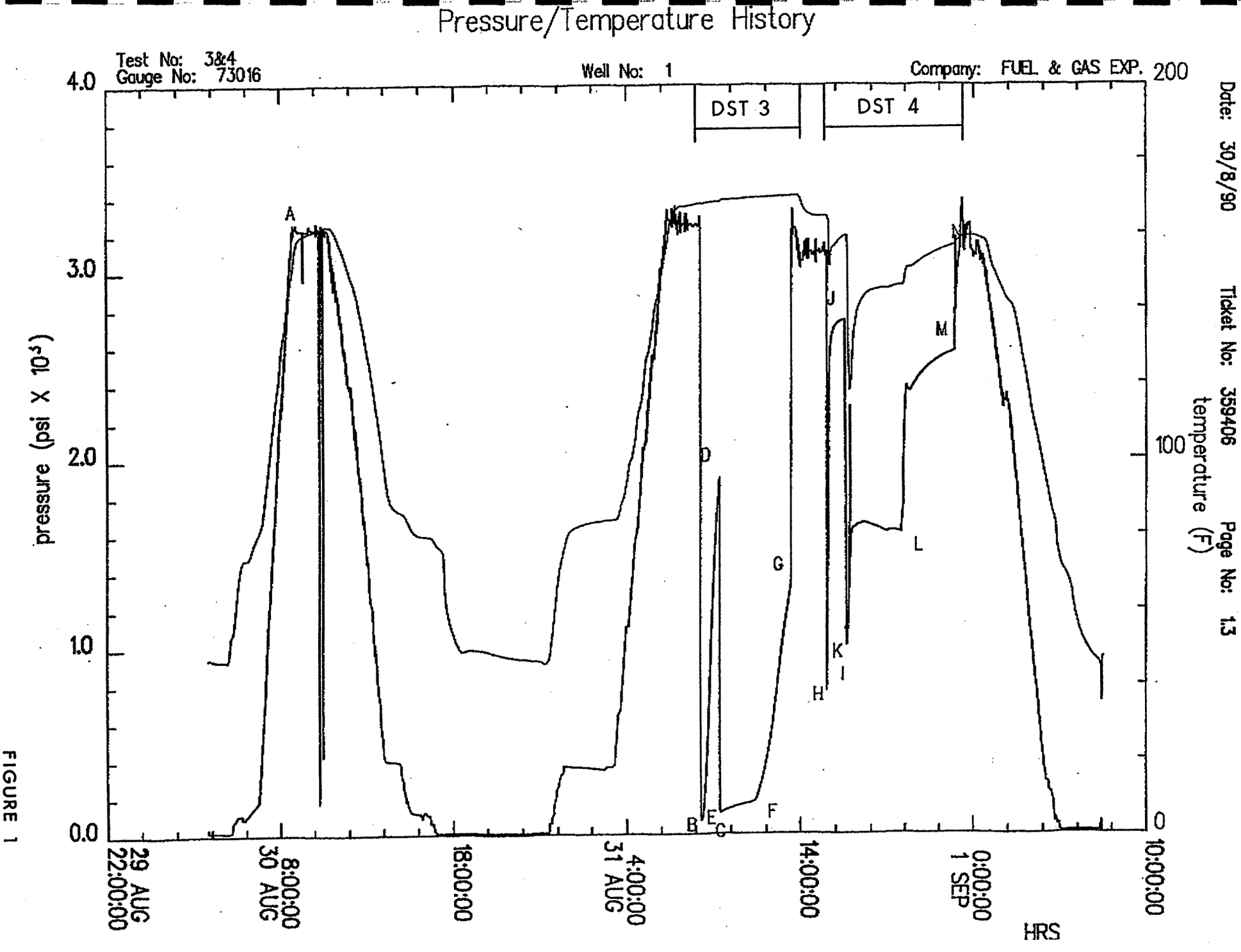

Pressure/Temperature History
Test No: 3&4
Gauge No: 73016
Well No: 1
Company: FUEL & GAS EXP.
DST 3
DST 4
Date: 30/8/90
Ticket No: 359406
Page No: 1.3
pressure (psi X 10³)
temperature (F)
4.0
3.0
2.0
1.0
0.0
200
100
0
A
B
C
D
E
F
G
H
I
J
K
L
M
29 AUG 22:00:00
30 AUG 8:00:00
18:00:00
31 AUG 4:00:00
14:00:00
1 SEP 0:00:00
10:00:00
HRS

FIGURE 1

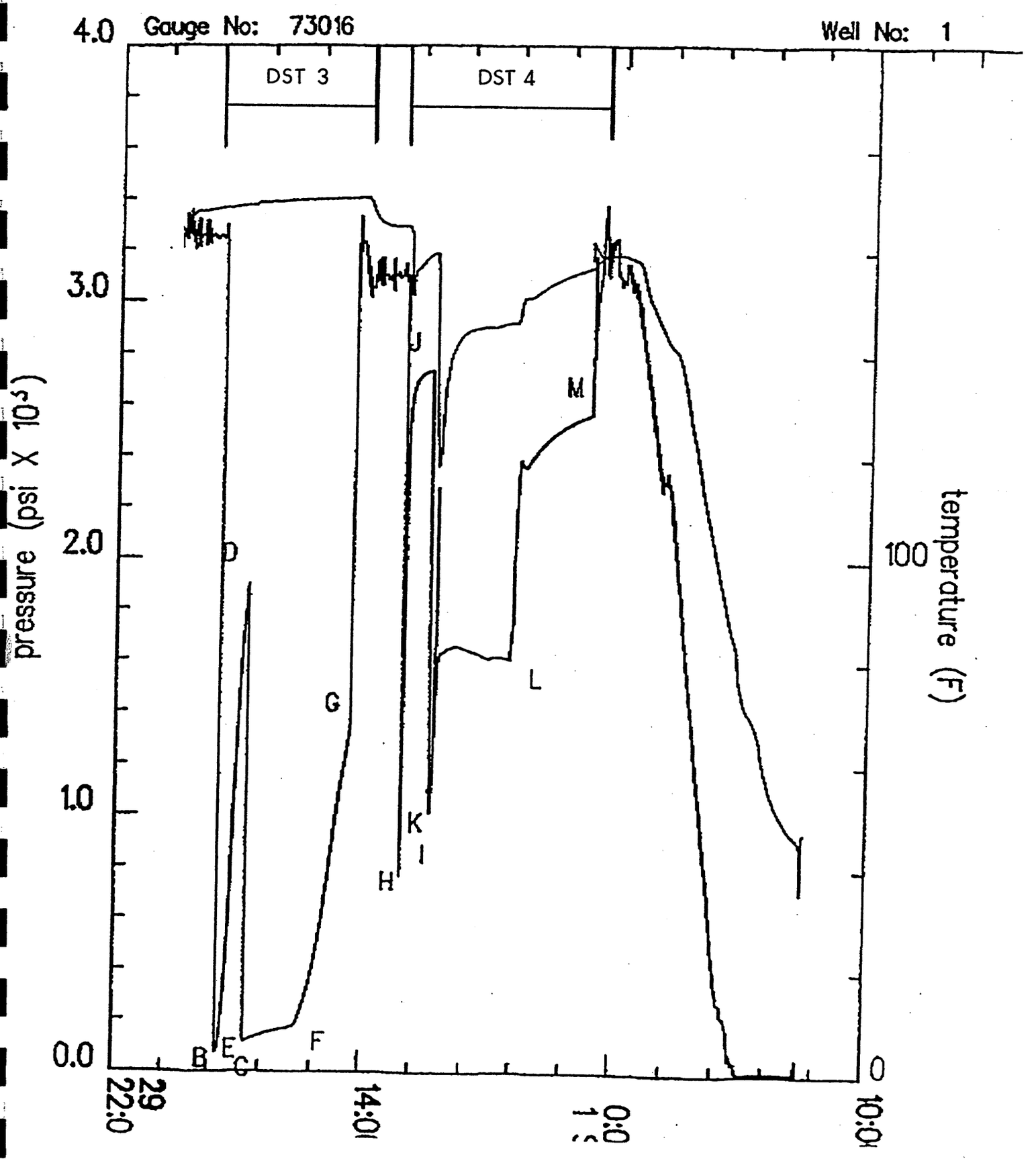

4.0
Gauge No: 73016
Well No: 1
DST 3
DST 4
3.0
2.0
1.0
0.0
pressure (psi X 10³)
temperature (F)
100
0
A
B
C
D
E
F
G
H
I
J
K
L
M
N
29
22:0
14:01
0:0
10:0

FIGURE 2

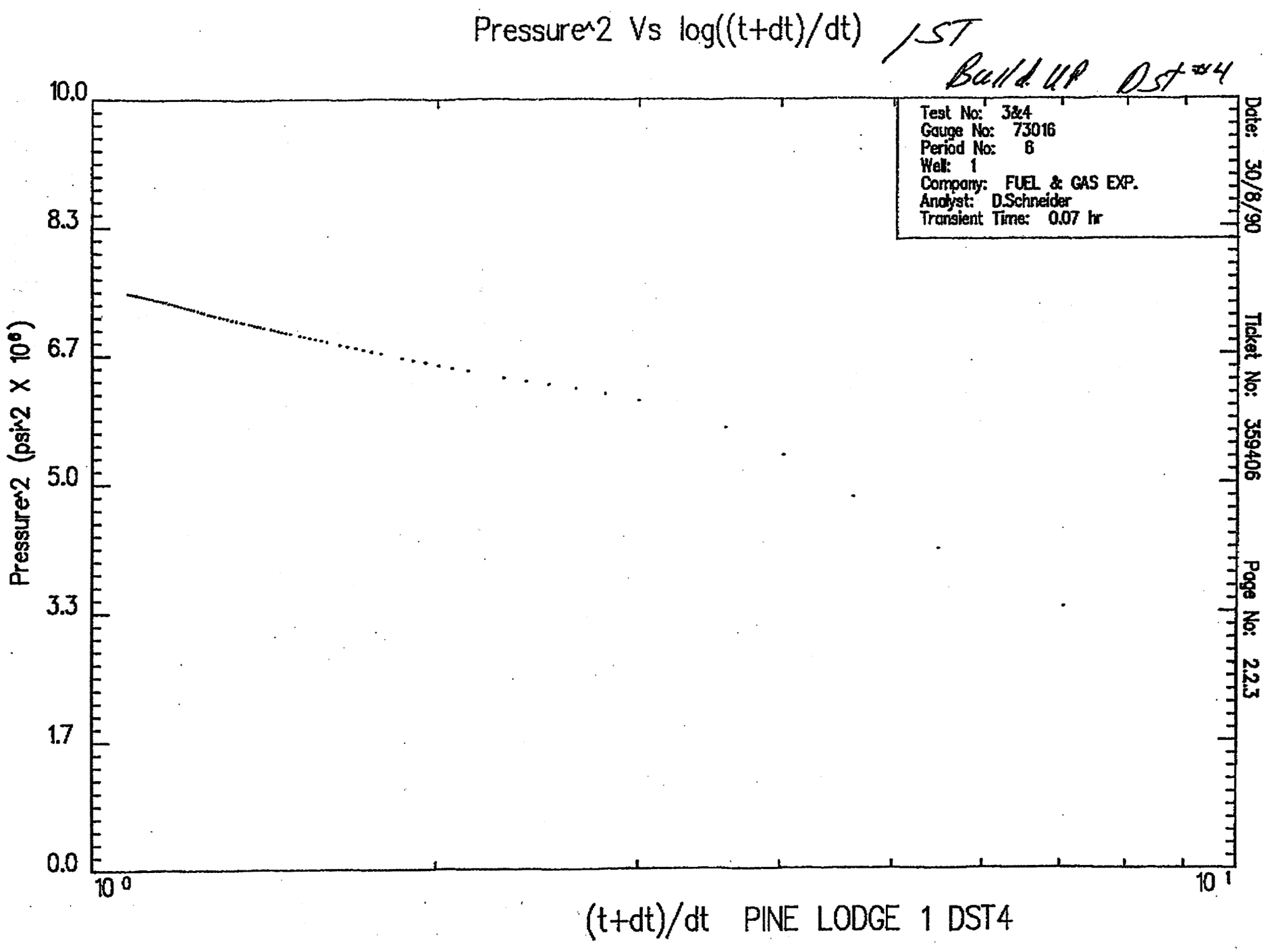

Pressure^2 Vs log((t+dt)/dt) 1ST Build UP DST #4
Test No: 3&4
Gauge No: 73016
Period No: 6
Well: 1
Company: FUEL & GAS EXP.
Analyst: D.Schneider
Transient Time: 0.07 hr
Date: 30/8/90
Ticket No: 359406
Page No: 2.2.3
Pressure^2 (psi^2 X 10^6)
10.0
8.3
6.7
5.0
3.3
1.7
0.0
10^0
10^1
(t+dt)/dt PINE LODGE 1 DST4

FIGURE 3

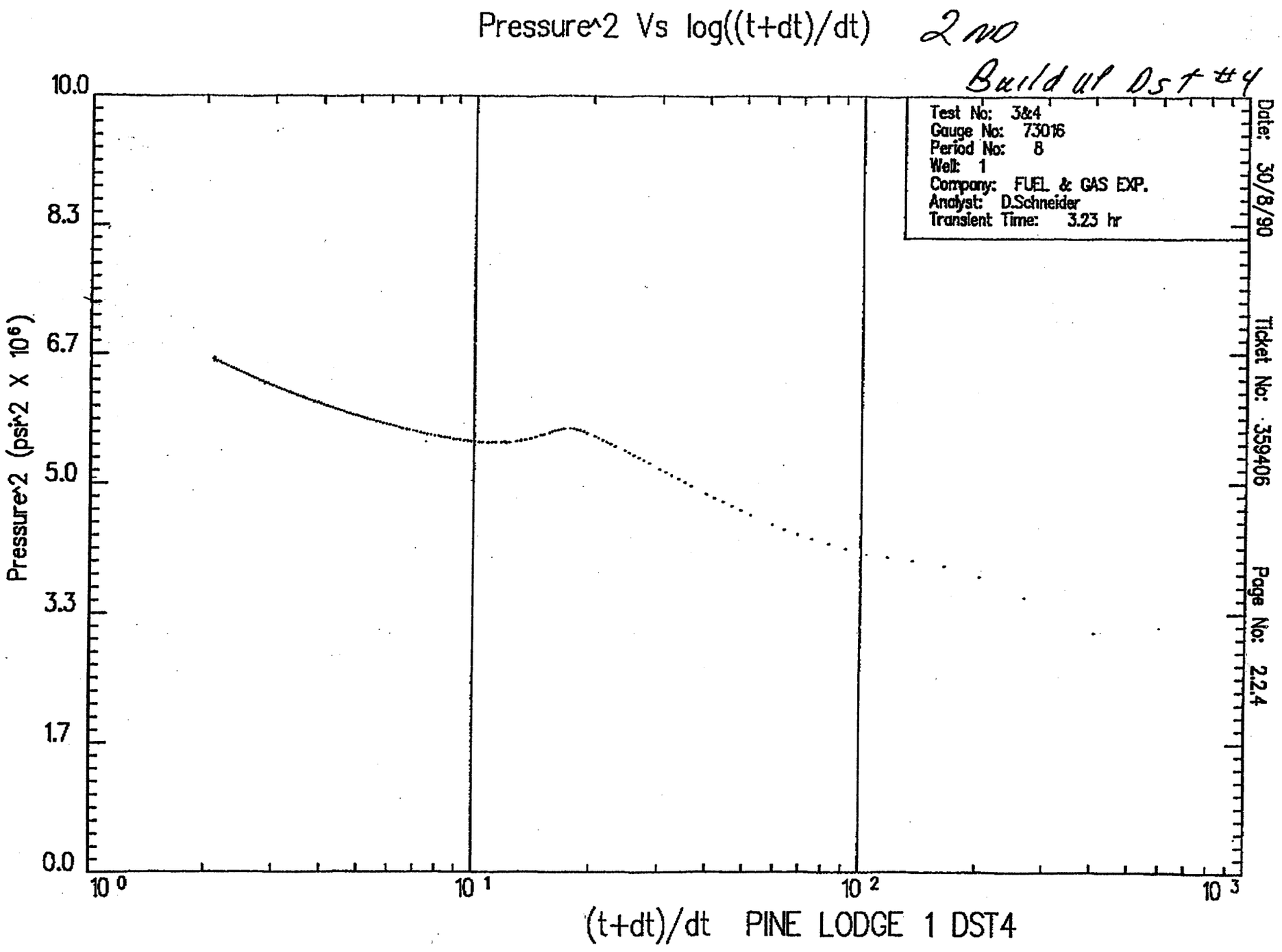

Pressure^2 Vs log((t+dt)/dt) 2nd
Build up Dst #4
Test No: 3&4
Gauge No: 73016
Period No: 8
Well: 1
Company: FUEL & GAS EXP.
Analyst: D.Schneider
Transient Time: 3.23 hr
Date: 30/8/90
Ticket No: 359406
Page No: 2.2.4
Pressure^2 (psi^2 X 10^6)
10.0
8.3
6.7
5.0
3.3
1.7
0.0
10^0
10^1
10^2
10^3
(t+dt)/dt PINE LODGE 1 DST4

FIGURE 4

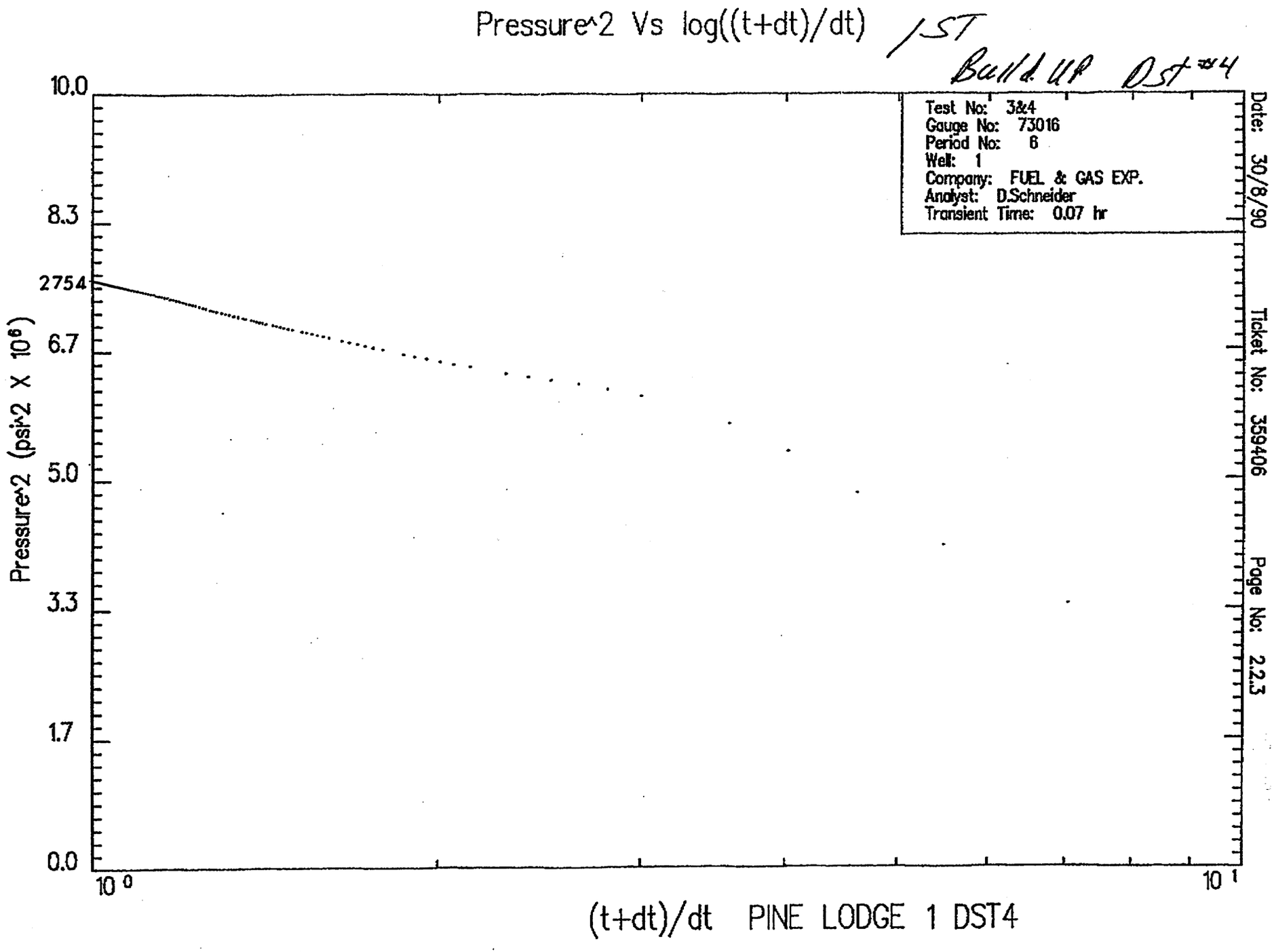

Pressure^2 Vs log((t+dt)/dt) 1ST Build UP DST #4
Test No: 3&4
Gauge No: 73016
Period No: 6
Well: 1
Company: FUEL & GAS EXP.
Analyst: D.Schneider
Transient Time: 0.07 hr
Date: 30/8/90
Ticket No: 359406
Page No: 2.2.3
10.0
8.3
2754
6.7
5.0
3.3
1.7
0.0
Pressure^2 (psi^2 X 10^6)
10^0
10^1
(t+dt)/dt PINE LODGE 1 DST4

FIGURE 5

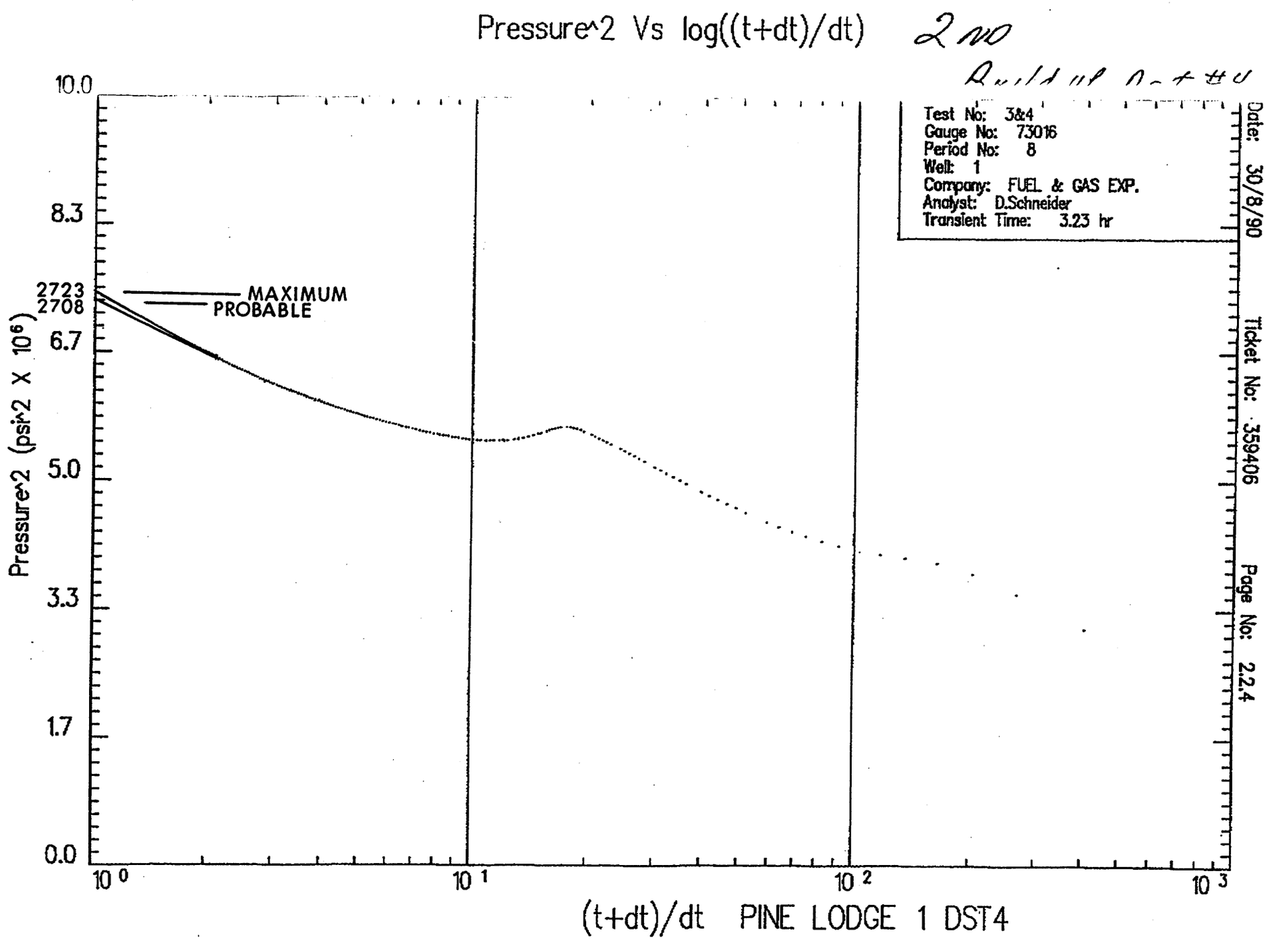
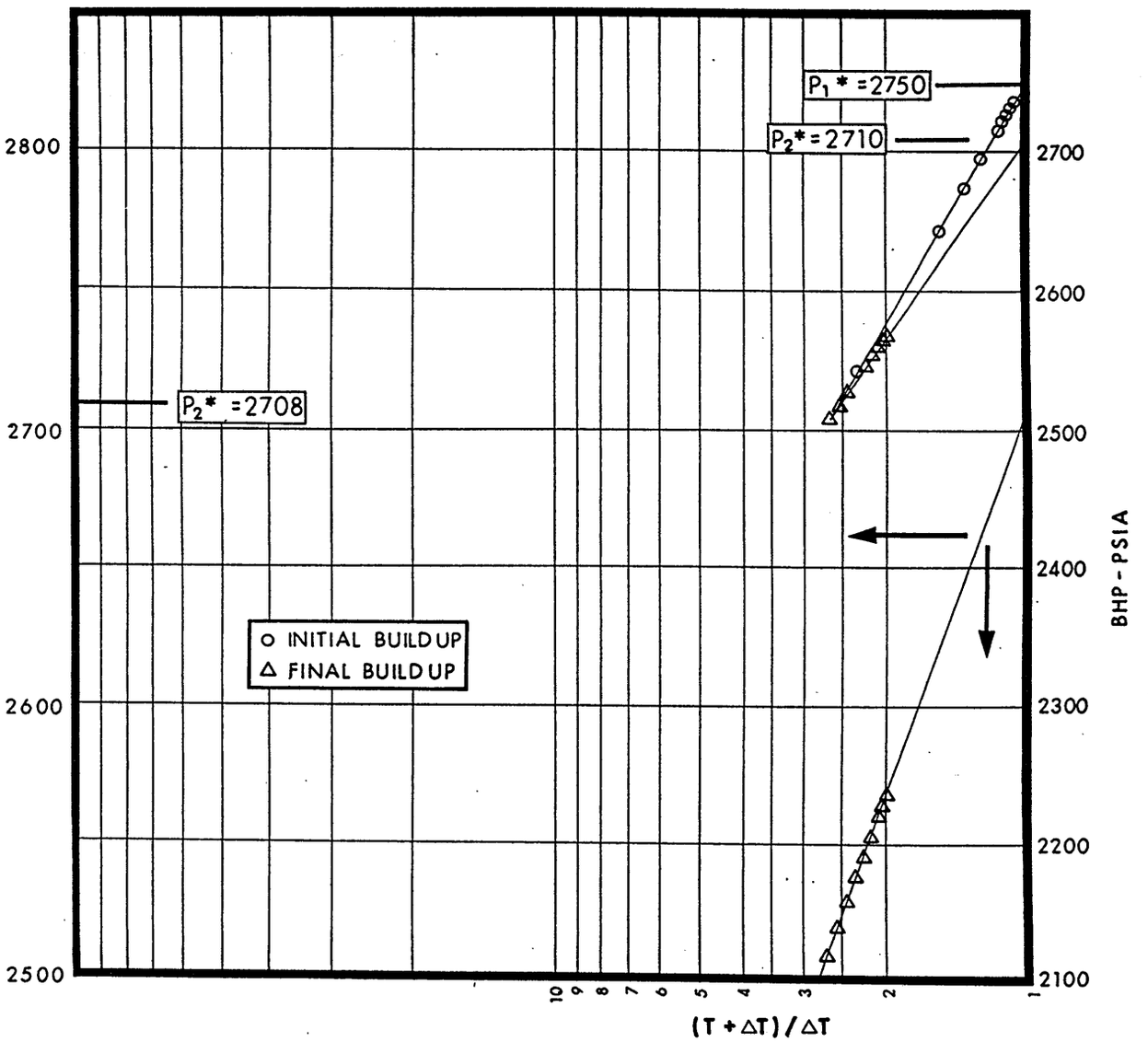

Pressure^2 Vs log((t+dt)/dt) 2nd
Build up 3+4
Test No: 3&4
Gauge No: 73016
Period No: 8
Well: 1
Company: FUEL & GAS EXP.
Analyst: D.Schneider
Transient Time: 3.23 hr
Date: 30/8/90
Ticket No: 359406
Page No: 2.2.4
MAXIMUM
PROBABLE
2723
2708
Pressure^2 (psi^2 X 10^6)
10.0
8.3
6.7
5.0
3.3
1.7
0.0
10^0
10^1
10^2
10^3
(t+dt)/dt PINE LODGE 1 DST4

FIGURE 6



PINE LODGE 1 (DST 4)

HORNER BUILDUPS

Questa Australia Pty Ltd

AUTHOR:	C.I.:
DRAFTED: C.R.	REPORT NO.:
DATE:	FIGURE NO.: 7

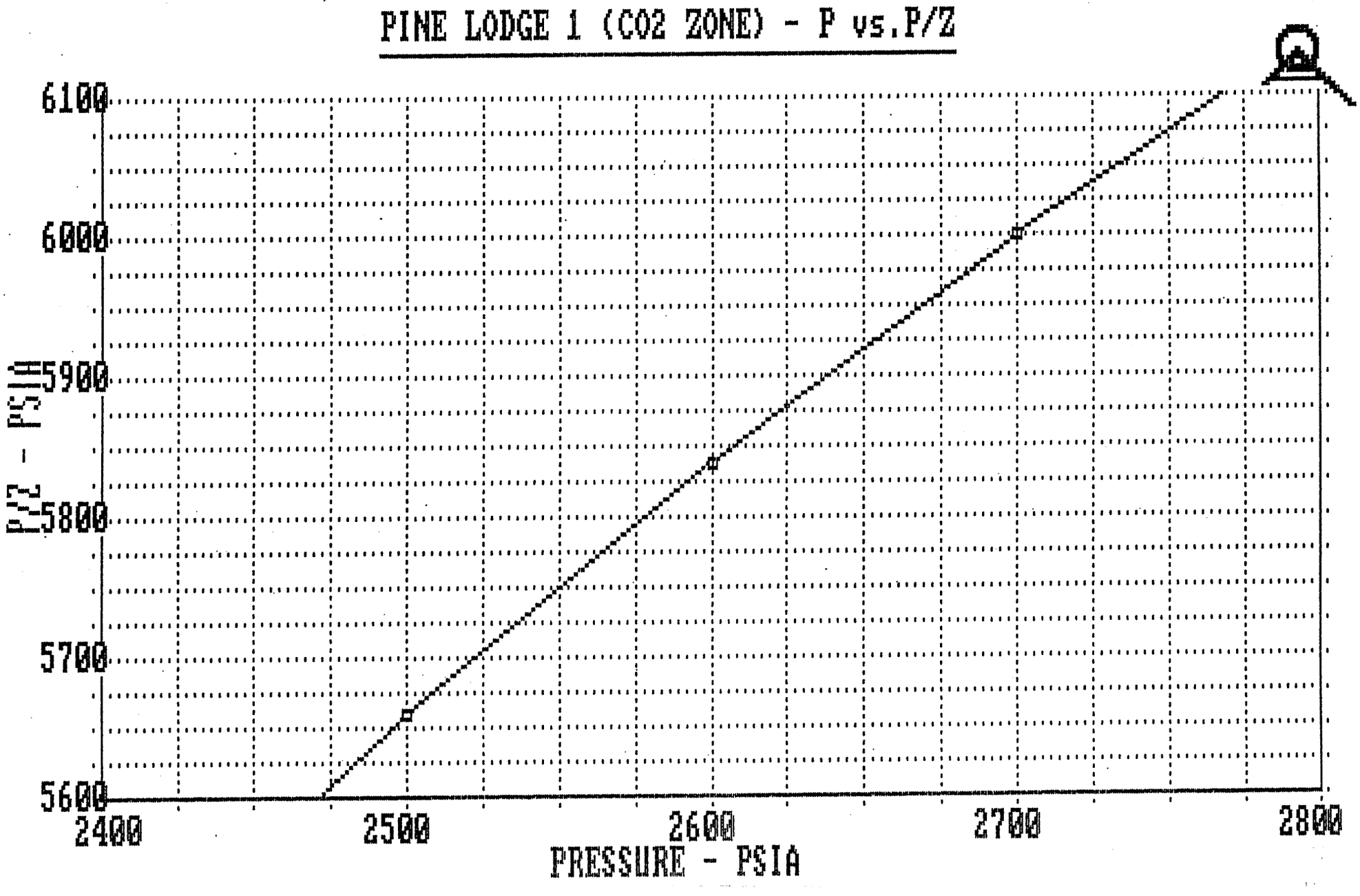

PINE LODGE 1 (CO2 ZONE) - P vs.P/Z
6100
6000
5900
5800
5700
5600
P/Z - PSIA
2400
2500
2600
2700
2800
PRESSURE - PSIA

FIGURE 8

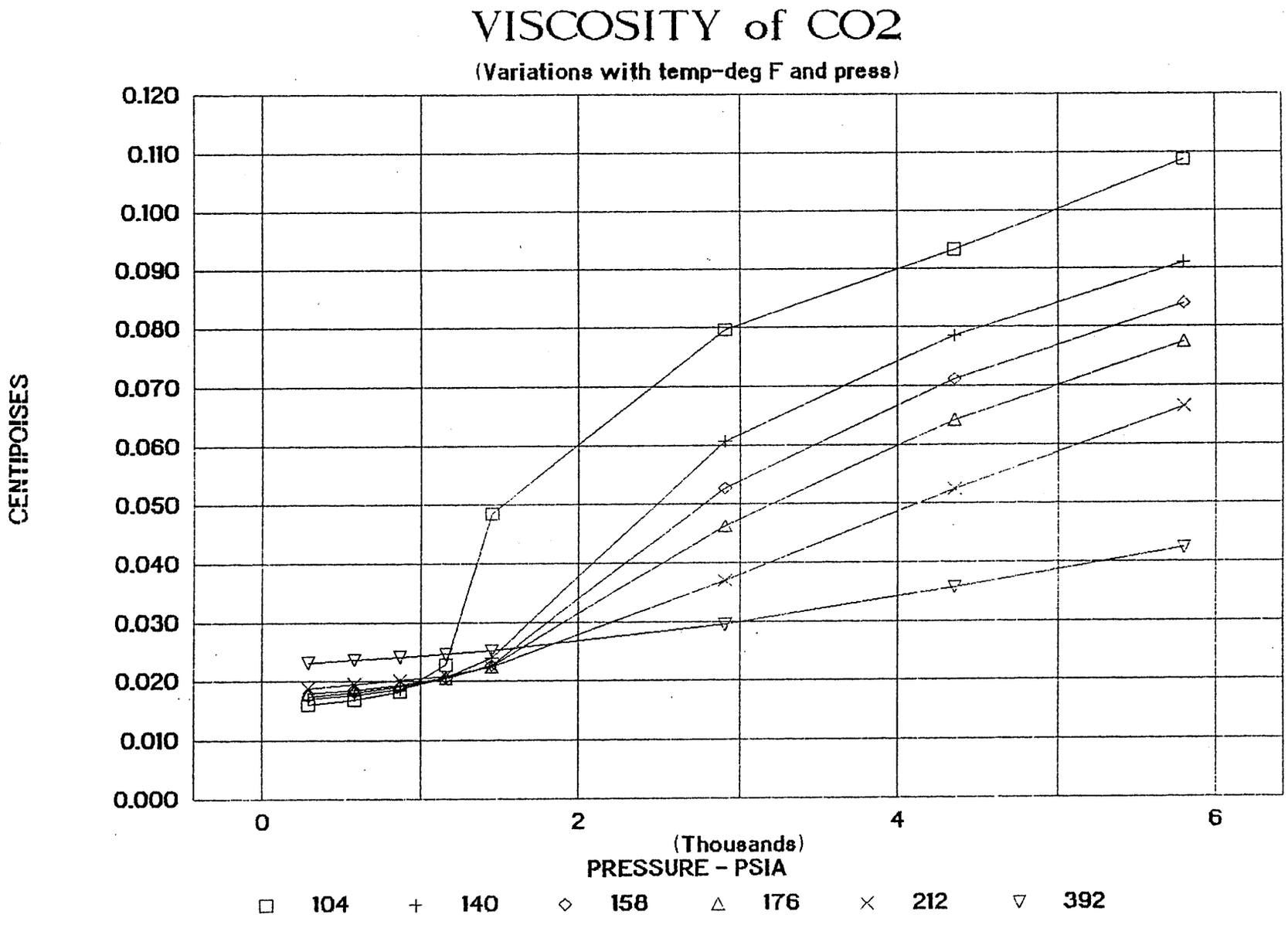
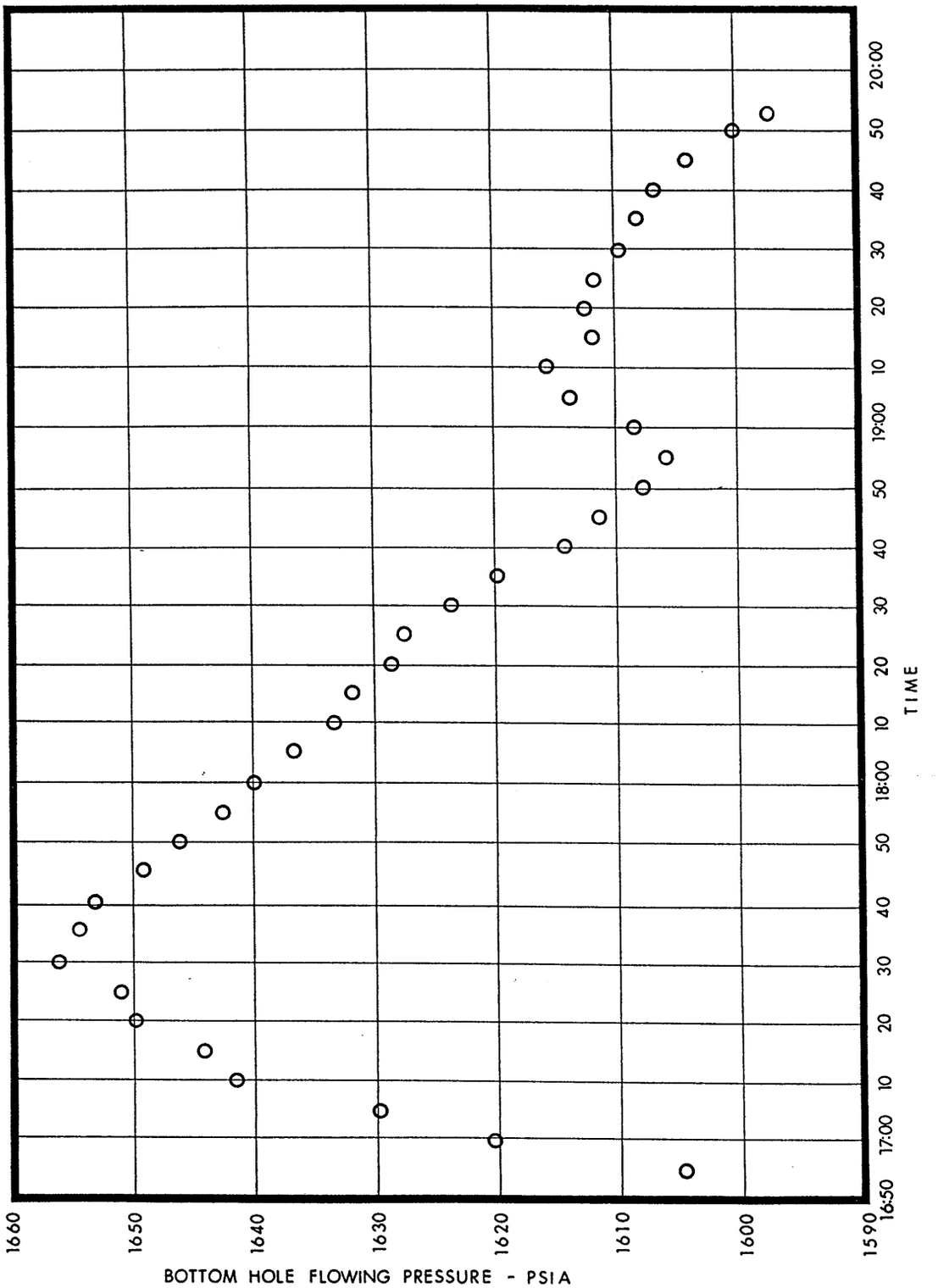

VISCOSITY of CO2
(Variations with temp-deg F and press)
CENTIPOISES
0.120
0.110
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0
2
4
6
(Thousands)
PRESSURE - PSIA
104
140
158
176
212
392

FIGURE 9



PINE LODGE 1 (DST 4)

3 HOUR DRAWDOWN

Questa Australia Pty Ltd

AUTHOR:	C.I.:
DRAFTED: C.R.	REPORT NO.:
DATE:	FIGURE NO.: 10

APPENDIX 1

Date: 30/8/90 Ticket No: 359406 Page No: 1.2

TEST PERIOD SUMMARY

Gauge No.: 73016 Depth: 6277.09 ft Blanked off: No

ID	PERIOD	DESCRIPTION	PRESSURE (psi)	DURATION (min)
A		Initial Hydrostatic	3226.57	
B	1	Start Draw-down	71.39	
C		End Draw-down	77.67	5.52
C	2	Start Build-up	77.67	
D		End Build-up	1907.31	59.75
E	3	Start Draw-down	107.20	
F		End Draw-down	179.13	119.28
F	4	Start Build-up	179.13	
G		End Build-up	1322.40	125.52
H	5	Start Draw-down	763.01	
I		End Draw-down	914.15	4.32
I	6	Start Build-up	914.15	
J		End Build-up	2735.10	60.23
K	7	Start Draw-down	991.39	
L		End Draw-down	1597.26	193.92
L	8	Start Build-up	1597.26	
M		End Build-up	2568.31	181.45
N		Final Hydrostatic	3091.14	

NOTE: for Pressure vs. Time Plot, see next page.

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.1

PRESSURE VS TIME

GRC gauge no.: 73016 Gauge Depth: 6277.09 ft
Memory Recorder No.: 70700

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
30-Aug-90		Data Print Frequency: 999		
03:44:09				SURFACE PRESSURE = PSIG
03:44:09				START GRC-EMR710 GAUGE
03:50:00				MAKE UP TOOLS - RUN IN HOLE
07:30:00				ROTATE 50rpm FOR 20min.
08:00:00				MAKE UP SURFACE EQUIP.
08:13:00				SET 15,000lbs. ONN TOOL
08:16:00				TOOL OPEN - WEAK BLOW
08:21:00				TOOL CLOSED
08:23:45		2741.558	141.7	
09:21:00				TOOL OPEN - VERY WEAK BLOW
09:46:00				TOOL OPEN - VERY WEAK BLOW
10:00:00				CLOSE CHOKE MANIFOLD
11:22:00				CLOSE TOOL
13:03:21		1494.024	126.4	
13:04:04		1430.509	126.1	
13:22:00				PULL PACKERS FREE
13:30:00				LAY OUT 8 DRILL PIPE FOR DST#4
14:28:00				START ROTATE
14:53:00				CHECK OVERPULL - PACKERS FREE
14:54:00				START ROTATE
15:20:00				PULL SLIPS
15:22:00				SIT WEIGHT ON TOOL
15:24:00				RIG UP SURFACE EQUIP.
15:28:00				SET WEIGHT ON TOOL
15:31:00				TOOL OPEN - STRONG BLOW
15:34:00				TOOL OPEN - STRONG BLOW
15:35:00				TOOL OPEN - STRONG BLOW
15:36:00				TOOL OPEN - STRONG BLOW
15:37:00				TOOL CLOSED
16:49:00				TOOL OPEN - CO2 TO SURFACE
16:54:00				TOOL OPEN - CO2 TO SURFACE
17:02:00				TOOL OPEN - CO2 TO SURFACE
17:07:00				TOOL OPEN - CO2 TO SURFACE
17:26:00				TOOL OPEN - CO2 TO SURFACE
17:33:00				TOOL OPEN - CO2 TO SURFACE
17:42:00				TOOL OPEN - CO2 TO SURFACE
17:43:40		11.428	57.2	
18:00:00				TOOL OPEN - CO2 TO SURFACE
18:30:00				TOOL OPEN - CO2 TO SURFACE
18:59:00				TOOL OPEN - CO2 TO SURFACE
19:15:00				TOOL OPEN - CO2 TO SURFACE
19:30:00				TOOL OPEN - CO2 TO SURFACE
19:45:00				TOOL OPEN - CO2 TO SURFACE
19:47:00				TOOL CLOSED
22:23:30		10.819	46.5	
22:23:59		10.819	46.5	

PRESSURE VS TIME

GRC gauge no.: 73016 Gauge Depth: 6277.09 ft
Memory Recorder No.: 70700

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency: 1		
		*** Start of Period 5 ***		
15:31:40	0.0000	763.010	164.8	
15:31:54	0.0039	800.864	164.8	
15:32:09	0.0081	1029.082	164.8	
15:32:23	0.0119	1008.707	164.8	
15:32:37	0.0158	970.488	164.9	
15:33:06	0.0239	908.665	164.0	
15:33:21	0.0281	910.259	163.2	
15:33:35	0.0319	911.002	162.3	
15:33:49	0.0358	894.929	161.5	
15:34:04	0.0400	893.123	160.6	
15:34:18	0.0439	894.752	159.8	
15:34:47	0.0519	898.382	157.8	
15:35:01	0.0558	900.260	156.7	
15:35:16	0.0600	891.477	155.5	
15:35:30	0.0639	902.987	154.4	
15:35:45	0.0681	907.664	153.3	
15:35:59	0.0719	914.148	152.2	
		*** End of Period 5 ***		

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.8

PRESSURE VS TIME

GRC gauge no.: 73016 Gauge Depth: 6277.09 ft
Memory Recorder No.: 70700

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency: 4 *** Start of Period 6 ***		
15:36:28	0.0081	1625.954	151.0	
15:37:25	0.0239	2312.863	150.8	
15:38:37	0.0439	2495.099	152.0	
15:39:49	0.0639	2541.338	153.9	
15:40:47	0.0800	2567.317	154.8	
15:41:59	0.1000	2594.536	155.5	
15:43:11	0.1200	2615.373	155.8	
15:44:09	0.1361	2627.977	155.9	
15:45:21	0.1561	2641.010	156.0	
15:46:33	0.1761	2651.691	156.0	
15:47:30	0.1919	2658.680	156.0	
15:48:42	0.2119	2666.571	156.1	
15:49:54	0.2319	2673.446	156.2	
15:50:52	0.2481	2678.058	156.2	
15:52:04	0.2681	2683.615	156.3	
15:53:16	0.2881	2688.616	156.5	
15:54:13	0.3039	2692.058	156.6	
15:55:25	0.3239	2696.021	156.7	
15:56:37	0.3439	2699.653	156.8	
15:57:35	0.3600	2702.151	156.9	
15:58:47	0.3800	2705.348	157.1	
15:59:59	0.4000	2707.856	157.2	
16:00:57	0.4161	2709.787	157.3	
16:02:09	0.4361	2711.907	157.4	
16:03:21	0.4561	2713.921	157.6	
16:04:18	0.4719	2715.397	157.6	
16:05:30	0.4919	2717.081	157.8	
16:06:42	0.5119	2718.803	157.9	
16:07:40	0.5281	2719.598	158.0	
16:08:52	0.5481	2721.055	158.1	
16:10:04	0.5681	2722.198	158.2	
16:11:01	0.5839	2722.994	158.3	
16:12:13	0.6039	2724.127	158.4	
16:13:25	0.6239	2725.034	158.5	
16:14:23	0.6400	2725.678	158.5	
16:15:35	0.6600	2726.640	158.6	
16:16:47	0.6800	2727.347	158.7	
16:17:45	0.6961	2727.915	158.8	
16:18:57	0.7161	2728.564	158.9	
16:20:09	0.7361	2729.392	158.9	
16:21:06	0.7519	2729.847	159.0	
16:22:18	0.7719	2730.458	159.0	
16:23:30	0.7919	2730.993	159.1	
16:24:28	0.8081	2731.259	159.2	
16:25:40	0.8281	2731.822	159.2	

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.9

PRESSURE VS TIME

GRC gauge no.: 73016
Memory Recorder No.: 70700
Gauge Depth: 6277.09 ft

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency: 4		
16:26:52	0.8481	2732.319	159.3	
16:27:49	0.8639	2732.585	159.4	
16:29:01	0.8839	2733.007	159.4	
16:30:13	0.9039	2733.350	159.5	
16:31:11	0.9200	2733.767	159.5	
16:32:23	0.9400	2734.055	159.6	
16:33:35	0.9600	2734.580	159.6	
16:34:33	0.9761	2734.845	159.7	
16:35:45	0.9961	2734.982	158.1	
16:36:13	1.0039	2735.095		
		*** End of Period 6 ***		
		Data Print Frequency: 999		
16:36:28		1279.562	156.6	

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.10

PRESSURE VS TIME

GRC gauge no.: 73016
Memory Recorder No.: 70700

Gauge Depth: 6277.09 ft

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency: 4		
		*** Start of Period 7 ***		
16:39:06	0.0000	991.386	133.9	
16:40:18	0.0200	999.874	129.6	
16:41:16	0.0361	1047.460	126.2	
16:42:28	0.0561	1103.692	122.7	
16:43:40	0.0761	1165.728	119.8	
16:44:37	0.0919	1220.015	118.4	
16:45:49	0.1119	1285.499	117.6	
16:47:01	0.1319	1349.439	117.9	
16:47:59	0.1481	1930.316	119.4	
16:49:11	0.1681	1660.717	120.7	
16:50:23	0.1881	1503.324	121.8	
16:51:21	0.2042	1537.430	122.7	
16:52:33	0.2242	1578.663	124.9	
16:53:45	0.2442	1592.997	127.5	
16:54:42	0.2600	1600.031	129.0	
16:55:54	0.2800	1609.976	130.5	
16:57:06	0.3000	1622.929	131.8	
16:58:04	0.3161	1630.770	132.8	
16:59:16	0.3361	1639.845	133.9	
17:00:28	0.3561	1620.587	134.8	
17:01:25	0.3719	1621.498	135.3	
17:02:37	0.3919	1624.611	135.9	
17:03:49	0.4119	1627.009	136.6	
17:04:04	0.4161	1628.139	136.7	
17:05:01	0.4319	1629.889	137.1	
17:06:13	0.4519	1633.975	137.7	
17:07:25	0.4719	1638.693	138.1	
17:08:23	0.4881	1638.984	138.5	
17:09:35	0.5081	1640.734	138.9	
17:10:47	0.5281	1641.653	139.2	
17:11:45	0.5442	1641.653	139.5	
17:12:57	0.5642	1644.232	139.8	
17:14:09	0.5842	1645.586	140.1	
17:15:06	0.6000	1644.054	140.4	
17:16:18	0.6200	1644.974	140.6	
17:17:30	0.6400	1645.219	140.8	
17:18:28	0.6561	1647.954	141.0	
17:19:40	0.6761	1648.481	141.2	
17:20:52	0.6961	1649.945	141.5	
17:21:49	0.7119	1650.492	141.6	
17:23:01	0.7319	1649.224	141.8	
17:24:13	0.7519	1649.795	142.0	
17:25:11	0.7681	1651.035	142.1	
17:26:23	0.7881	1652.178	142.3	
17:27:35	0.8081	1652.410	142.4	

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.11

PRESSURE VS TIME

GRC gauge no.: 73016
Memory Recorder No.: 70700
Gauge Depth: 6277.09 ft

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency:	4	
17:28:33	0.8242	1654.744	142.5	
17:29:45	0.8442	1656.241	142.7	
17:30:57	0.8642	1654.977	142.9	
17:31:54	0.8800	1655.488	143.0	
17:33:06	0.9000	1655.191	143.1	
17:34:18	0.9200	1653.534	143.2	
17:35:16	0.9361	1654.410	143.3	
17:36:28	0.9561	1653.154	143.4	
17:37:40	0.9761	1653.320	143.5	
17:38:37	0.9919	1654.086	143.6	
17:39:49	1.0119	1653.075	143.7	
17:41:01	1.0319	1652.552	143.7	
17:41:59	1.0481	1651.167	143.8	
17:43:11	1.0681	1651.118	143.9	
17:44:23	1.0881	1649.940	144.0	
17:45:21	1.1042	1649.065	144.0	
17:46:33	1.1242	1648.900	144.0	
17:47:45	1.1442	1648.429	144.1	
17:48:42	1.1600	1647.408	144.2	
17:49:54	1.1800	1646.026	144.2	
17:51:06	1.2000	1644.257	144.3	
17:52:04	1.2161	1643.893	144.3	
17:53:16	1.2361	1643.728	144.3	
17:54:28	1.2561	1643.006	144.4	
17:55:25	1.2719	1642.386	144.4	
17:56:37	1.2919	1642.138	144.4	
17:57:49	1.3119	1641.332	144.5	
17:58:47	1.3281	1640.530	144.5	
17:59:59	1.3481	1639.856	144.5	
18:01:11	1.3681	1639.269	144.6	
18:02:09	1.3842	1638.576	144.6	
18:03:21	1.4042	1636.980	144.6	
18:04:33	1.4242	1636.564	144.6	
18:05:30	1.4400	1636.418	144.7	
18:06:42	1.4600	1635.139	144.7	
18:07:54	1.4800	1634.020	144.7	
18:08:52	1.4961	1634.166	144.7	
18:10:04	1.5161	1633.236	144.8	
18:11:16	1.5361	1631.739	144.8	
18:12:13	1.5519	1632.941	144.8	
18:13:25	1.5719	1632.649	144.8	
18:14:37	1.5919	1631.808	144.8	
18:15:35	1.6081	1631.880	144.9	
18:16:47	1.6281	1630.940	144.9	
18:17:59	1.6481	1629.140	144.9	
18:18:57	1.6642	1629.067	144.9	

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.12

PRESSURE VS TIME

GRC gauge no.: 73016
Memory Recorder No.: 70700

Gauge Depth: 6277.09 ft

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency:	4	
18:20:09	1.6842	1628.615	144.9	
18:21:21	1.7042	1630.142	145.0	
18:22:18	1.7200	1627.081	145.0	
18:23:30	1.7400	1628.331	145.0	
18:24:42	1.7600	1626.640	145.0	
18:25:40	1.7761	1627.624	145.0	
18:26:52	1.7961	1625.944	145.1	
18:28:04	1.8161	1625.165	145.1	
18:29:01	1.8319	1625.383	145.1	
18:30:13	1.8519	1623.475	145.1	
18:31:25	1.8719	1621.883	145.1	
18:32:23	1.8881	1621.446	145.1	
18:33:35	1.9081	1620.317	145.1	
18:34:47	1.9281	1619.574	145.1	
18:35:45	1.9442	1618.809	145.1	
18:36:57	1.9642	1617.764	145.1	
18:38:09	1.9842	1615.666	145.1	
18:39:06	2.0000	1616.285	145.1	
18:40:18	2.0200	1614.002	145.1	
18:41:30	2.0400	1614.428	145.1	
18:42:28	2.0561	1613.154	145.1	
18:43:40	2.0761	1612.644	145.1	
18:44:52	2.0961	1611.235	145.1	
18:45:49	2.1119	1610.398	145.1	
18:47:01	2.1319	1609.914	145.1	
18:48:13	2.1519	1608.567	145.1	
18:49:11	2.1681	1608.894	145.1	
18:50:23	2.1881	1607.656	145.1	
18:51:35	2.2081	1607.147	145.1	
18:52:33	2.2242	1606.273	145.1	
18:53:45	2.2442	1606.579	145.1	
18:54:57	2.2642	1605.815	145.1	
18:55:54	2.2800	1605.778	145.1	
18:57:06	2.3000	1604.868	145.1	
18:58:18	2.3200	1603.740	145.1	
18:59:16	2.3361	1605.669	145.1	
19:00:28	2.3561	1608.239	145.1	
19:01:40	2.3761	1611.705	145.2	
19:02:37	2.3919	1614.253	145.3	
19:03:49	2.4119	1614.668	145.3	
19:05:01	2.4319	1613.765	145.3	
19:05:59	2.4481	1615.148	145.4	
19:07:11	2.4681	1617.133	145.4	
19:08:23	2.4881	1617.016	145.5	
19:09:21	2.5042	1617.416	145.5	
19:10:33	2.5242	1615.395	145.6	

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.13

PRESSURE VS TIME

GRC gauge no.: 73016 **Gauge Depth: 6277.09 ft**
Memory Recorder No.: 70700

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency:	4	
19:11:45	2.5442	1614.590	145.6	
19:12:42	2.5600	1614.372	145.6	
19:13:54	2.5800	1613.702	145.6	
19:15:06	2.6000	1611.976	145.6	
19:16:04	2.6161	1612.012	145.7	
19:17:16	2.6361	1613.174	145.7	
19:18:28	2.6561	1613.217	145.7	
19:19:25	2.6719	1612.562	145.8	
19:20:37	2.6919	1614.462	145.8	
19:21:49	2.7119	1611.848	145.8	
19:22:47	2.7281	1612.539	145.8	
19:23:59	2.7481	1613.435	145.8	
19:25:11	2.7681	1611.880	145.9	
19:26:09	2.7842	1611.953	145.9	
19:27:21	2.8042	1611.247	145.9	
19:28:33	2.8242	1610.832	145.9	
19:29:30	2.8400	1609.558	145.9	
19:30:42	2.8600	1610.915	145.9	
19:31:54	2.8800	1608.534	145.9	
19:32:52	2.8961	1608.607	146.0	
19:34:04	2.9161	1607.672	146.0	
19:35:16	2.9361	1608.047	146.0	
19:36:13	2.9519	1607.464	146.0	
19:37:25	2.9719	1607.439	146.0	
19:38:37	2.9919	1608.614	146.0	
19:39:35	3.0081	1608.906	146.0	
19:40:47	3.0281	1606.827	146.0	
19:41:59	3.0481	1605.309	146.0	
19:42:57	3.0642	1604.836	146.0	
19:44:09	3.0842	1604.763	146.0	
19:45:21	3.1042	1604.097	146.0	
19:46:18	3.1200	1604.425	146.0	
19:47:30	3.1400	1604.327	146.1	
19:48:42	3.1600	1603.948	146.1	
19:49:40	3.1761	1603.074	146.1	
19:50:52	3.1961	1600.334	146.0	
19:52:04	3.2161	1599.330	146.0	
19:53:01	3.2319	1597.256	146.0	
19:53:01	3.2319	1597.256		

*** End of Period 7 ***

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.14

PRESSURE VS TIME

GRC gauge no.: 73016 Gauge Depth: 6277.09 ft
Memory Recorder No.: 70700

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency: 4		
		*** Start of Period 8 ***		
19:53:30	0.0081	1753.878	146.2	
19:54:28	0.0242	2000.101	146.9	
19:55:40	0.0442	2067.983	147.9	
19:56:52	0.0642	2141.799	149.0	
19:57:49	0.0800	2192.090	149.5	
19:59:01	0.1000	2246.648	150.0	
20:00:13	0.1200	2290.708	150.4	
20:01:11	0.1361	2319.634	150.5	
20:02:23	0.1561	2349.335	150.7	
20:03:35	0.1761	2374.024	150.8	
20:04:33	0.1922	2385.513	150.9	
20:05:45	0.2122	2381.590	150.9	
20:06:57	0.2322	2368.729	150.9	
20:07:54	0.2481	2360.052	150.9	
20:09:06	0.2681	2352.549	150.9	
20:10:18	0.2881	2348.695	150.8	
20:11:16	0.3042	2347.611	150.8	
20:12:28	0.3242	2347.542	150.8	
20:13:40	0.3442	2348.745	150.7	
20:14:37	0.3600	2350.464	150.7	
20:15:49	0.3800	2352.949	150.7	
20:17:01	0.4000	2355.848	150.8	
20:17:59	0.4161	2358.391	150.8	
20:19:11	0.4361	2361.723	150.8	
20:20:23	0.4561	2365.168	150.9	
20:21:21	0.4722	2367.712	150.9	
20:22:33	0.4922	2370.804	150.9	
20:23:45	0.5122	2374.586	151.0	
20:24:42	0.5281	2377.206	151.1	
20:25:54	0.5481	2380.479	151.1	
20:27:06	0.5681	2383.743	151.2	
20:28:04	0.5842	2386.288	151.3	
20:29:16	0.6042	2389.403	151.3	
20:30:28	0.6242	2392.640	151.4	
20:31:25	0.6400	2394.999	151.5	
20:32:37	0.6600	2398.142	151.5	
20:33:49	0.6800	2400.985	151.6	
20:34:47	0.6961	2403.232	151.7	
20:35:59	0.7161	2406.246	151.7	
20:37:11	0.7361	2409.090	151.8	
20:38:09	0.7522	2411.188	151.9	
20:39:21	0.7722	2414.070	151.9	
20:40:33	0.7922	2416.663	152.0	
20:41:30	0.8081	2418.799	152.1	
20:42:42	0.8281	2421.494	152.1	

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.15

PRESSURE VS TIME

GRC gauge no.: 73016
Memory Recorder No.: 70700

Gauge Depth: 6277.09 ft

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
1-Aug-90		Data Print Frequency:	4	
20:43:54	0.8481	2424.029	152.2	
20:44:52	0.8642	2426.053	152.2	
20:46:04	0.8842	2428.562	152.3	
20:47:16	0.9042	2431.006	152.4	
20:48:13	0.9200	2432.880	152.4	
20:49:25	0.9400	2435.324	152.5	
20:50:37	0.9600	2437.646	152.6	
20:51:35	0.9761	2439.483	152.6	
20:52:47	0.9961	2441.768	152.7	
20:53:59	1.0161	2444.053	152.7	
20:54:57	1.0322	2445.815	152.8	
20:56:09	1.0522	2447.902	152.8	
20:57:21	1.0722	2450.150	152.9	
20:58:18	1.0881	2451.838	152.9	
20:59:30	1.1081	2453.926	153.0	
21:00:42	1.1281	2455.949	153.1	
21:01:40	1.1442	2457.599	153.1	
21:02:52	1.1642	2459.500	153.2	
21:04:04	1.1842	2461.513	153.2	
21:05:01	1.2000	2463.126	153.3	
21:06:13	1.2200	2464.914	153.3	
21:07:25	1.2400	2466.890	153.4	
21:08:23	1.2561	2468.316	153.4	
21:09:35	1.2761	2470.142	153.5	
21:10:47	1.2961	2472.016	153.5	
21:11:45	1.3122	2473.443	153.6	
21:12:57	1.3322	2475.108	153.6	
21:14:09	1.3522	2476.972	153.7	
21:15:06	1.3681	2478.286	153.7	
21:16:18	1.3881	2479.990	153.8	
21:17:30	1.4081	2481.703	153.8	
21:18:28	1.4242	2483.055	153.9	
21:19:40	1.4442	2484.496	153.9	
21:20:52	1.4642	2486.173	154.0	
21:21:49	1.4800	2487.374	154.0	
21:23:01	1.5000	2488.891	154.1	
21:24:13	1.5200	2490.492	154.1	
21:25:11	1.5361	2491.694	154.1	
21:26:23	1.5561	2493.210	154.2	
21:27:35	1.5761	2494.764	154.2	
21:28:33	1.5922	2495.892	154.3	
21:29:45	1.6122	2497.408	154.3	
21:30:57	1.6322	2498.850	154.4	
21:31:54	1.6481	2499.939	154.4	
21:33:06	1.6681	2501.381	154.4	
21:34:18	1.6881	2502.785	154.5	

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.16

PRESSURE VS TIME

GRC gauge no.: 73016
Memory Recorder No.: 70700
Gauge Depth: 6277.09 ft

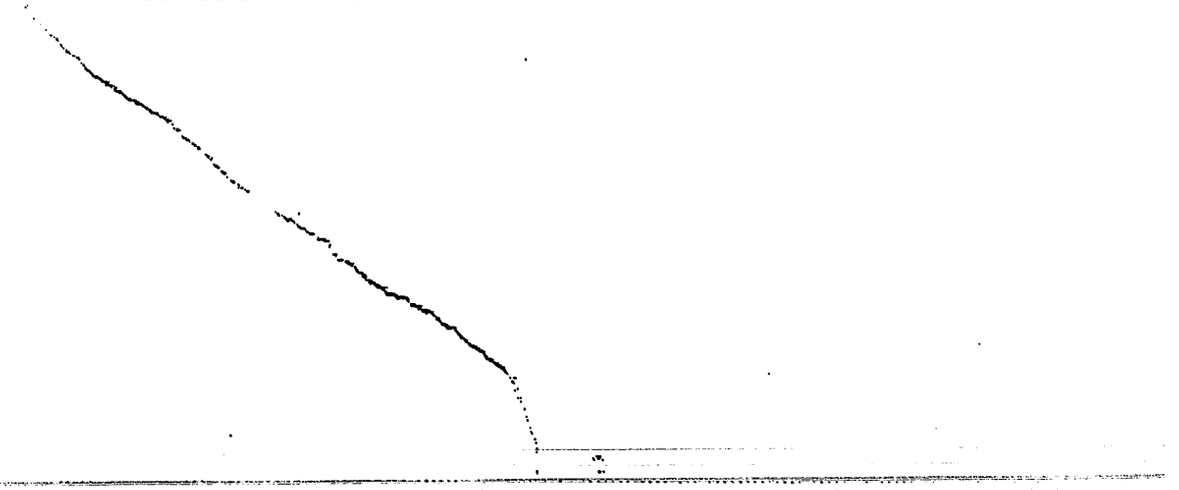
TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency:	4	
21:35:16	1.7042	2503.875	154.5	
21:36:28	1.7242	2505.279	154.6	
21:37:40	1.7442	2506.645	154.6	
21:38:37	1.7600	2507.585	154.7	
21:39:49	1.7800	2508.952	154.7	
21:41:01	1.8000	2510.281	154.7	
21:41:59	1.8161	2511.333	154.8	
21:43:11	1.8361	2512.652	154.8	
21:44:23	1.8561	2513.794	154.9	
21:45:21	1.8722	2514.734	154.9	
21:46:33	1.8922	2515.988	154.9	
21:47:45	1.9122	2517.242	155.0	
21:48:42	1.9281	2518.257	155.0	
21:49:54	1.9481	2519.389	155.1	
21:51:06	1.9681	2520.605	155.1	
21:52:04	1.9842	2521.508	155.1	
21:53:16	2.0042	2522.677	155.2	
21:54:28	2.0242	2523.819	155.2	
21:55:25	2.0400	2524.683	155.3	
21:56:37	2.0600	2525.890	155.3	
21:57:49	2.0800	2526.984	155.3	
21:58:47	2.0961	2527.849	155.4	
21:59:59	2.1161	2528.906	155.4	
22:01:11	2.1361	2529.962	155.4	
22:02:09	2.1522	2530.827	155.5	
22:03:21	2.1722	2531.884	155.5	
22:04:33	2.1922	2532.951	155.5	
22:05:30	2.2081	2533.740	155.6	
22:06:42	2.2281	2534.797	155.6	
22:07:54	2.2481	2535.816	155.6	
22:08:52	2.2642	2536.569	155.7	
22:10:04	2.2842	2537.550	155.7	
22:11:16	2.3042	2538.456	155.8	
22:12:13	2.3200	2539.209	155.8	
22:13:25	2.3400	2540.238	155.8	
22:14:37	2.3600	2541.172	155.9	
22:15:35	2.3761	2541.887	155.9	
22:16:47	2.3961	2542.879	155.9	
22:17:59	2.4161	2543.823	156.0	
22:18:57	2.4322	2544.538	156.0	
22:20:09	2.4522	2545.424	156.0	
22:21:21	2.4722	2546.378	156.1	
22:22:18	2.4881	2547.055	156.1	
22:23:30	2.5081	2547.951	156.1	
22:24:42	2.5281	2548.858	156.1	
22:25:40	2.5442	2549.573	156.2	

Date: 30/8/90 Ticket No: 359406 Page No: 3.1.17

PRESSURE VS TIME

GRC gauge no.: 73016 Gauge Depth: 6277.09 ft
Memory Recorder No.: 70700

TIME HH:MM:SS	D TIME (min)	PRESSURE (psi)	TEMP (F)	COMMENTS
31-Aug-90		Data Print Frequency: 4		
22:26:52	2.5642	2550.432	156.2	
22:28:04	2.5842	2551.338	156.2	
22:29:01	2.6000	2551.941	156.3	
22:30:13	2.6200	2552.847	156.3	
22:31:25	2.6400	2553.716	156.3	
22:32:23	2.6561	2554.319	156.4	
22:33:35	2.6761	2555.150	156.4	
22:34:47	2.6961	2556.009	156.4	
22:35:45	2.7122	2556.573	156.5	
22:36:57	2.7322	2557.367	156.5	
22:38:09	2.7522	2558.199	156.5	
22:39:06	2.7681	2558.801	156.6	
22:40:18	2.7881	2559.660	156.6	
22:41:30	2.8081	2560.368	156.6	
22:42:28	2.8242	2560.971	156.6	
22:43:40	2.8442	2561.755	156.7	
22:44:52	2.8642	2562.548	156.7	
22:45:49	2.8800	2563.076	156.7	
22:47:01	2.9000	2563.897	156.7	
22:48:13	2.9200	2564.605	156.8	
22:49:11	2.9361	2565.246	156.8	
22:50:23	2.9561	2564.034	156.8	
22:51:35	2.9761	2565.420	156.9	
22:52:33	2.9922	2563.688	156.9	
22:53:45	3.0122	2567.823	156.9	
22:54:28	3.0242	2568.313		
		*** End of Period 8 ***		
		Data Print Frequency: 999		
22:54:57		3009.445	157.0	
1-Sep-90				
02:23:59		1934.497	136.5	
07:03:49		11.965	46.5	
07:31:25		13.686	47.4	



- Manifold equipped with $\frac{1}{4}$" and $\frac{1}{2}$" choke

We are flowing through the $\frac{1}{2}$" choke -

- a Thermometer is fixed on the chicksan upstream of the choke - isolate chicksan from the outside temperature 2 ft both side of the Thermometer -

INITIAL FLOW 5 mn : Strong blow 2mns after opening - No mud - no oil - no water flowing through the sample hose or the end of the flare line for the 5 mn. opening - Pressure build up to 200 PSI -

PRESSURE BUILD UP 60 mn.

During the initial flow period water was splashing outside the bucket onto the floor - water was still clear despite a greasy feeling between the fingers -

Hydrocarbons traces on rig floor around the bucket : Shiny purple and green -

No trace in flare pit -

FLOW 180 mn

Strong blow but recover mud quickly Presence of mud cake and iced mud. blow slugging due to the presence of the mud -

13 mn Tool open - pressure 260 PSI Suspect guage trouble - unblock line - install new guage - Reading 810 PSI - 66° F -

Still having trouble with iced mud all the way down the flare line - Bypass choke to 2" full bore for about 5 mn. gas blow stronger, building up ice from end of the flare line up to the choke manifold.

17 mn opening 820 PSI 65° F - line jumping.

by intermittence (iced mud) but blow still strong and not slugging -

40 mn opening 840 PSI 66° F.
still mud coming out but blow is regular and the line is not jumping anymore ice back on first chicksan

70 mn opening 850 PSI 64°F.
Everything ok. Mud still coming out.

130 mn 820 PSI 65°F.
ice gone from first chicksan - blow slithly slugging but still a lot of iced mud.
Sample hose blocked filling up gas bottle. Has to use hot water to free it.

160 mn opening 820 PSI. 65°F blow still strong more regular but the mud is always there

The blow has been strong - hardly any slugging for 3 hours
Colour light white - looks dry and not steamy - not to heavy as well - lets say it was a better quality blow than the one on DST #1
No flame at all