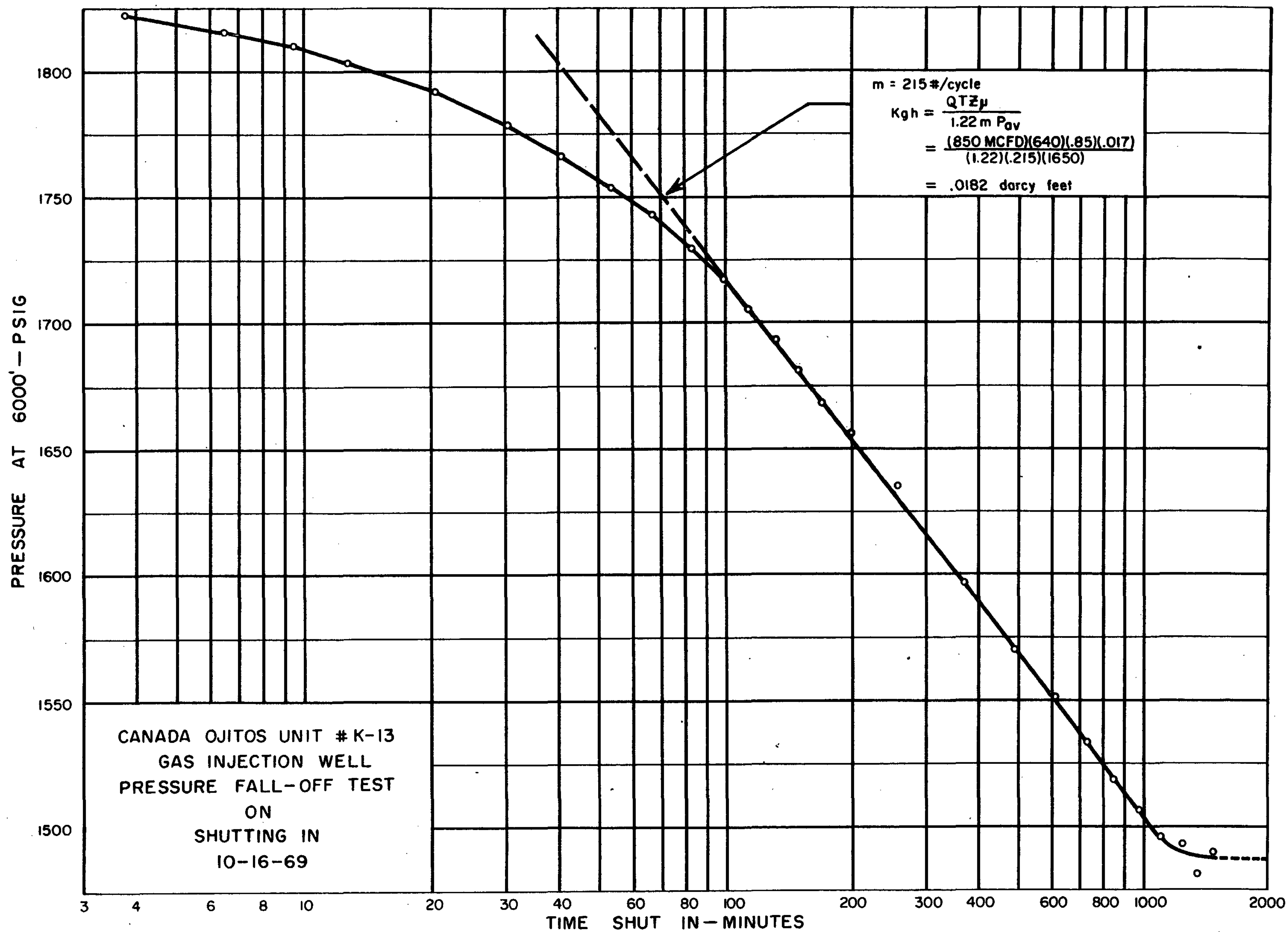


APPENDIX I FIGURE NO. I-3

FRACTURE LENGTH AND TIGHT BLOCK SIZE FOR CANADA OJITOS UNIT K-13 INJECTION WELL AS DETERMINED FROM PRESSURE FALL-OFF TESTS

To minimize wellbore storage error in estimating tight block sizes - or distance from well to high capacity fracture systems - it was recognized in 1969 that a gas injection well with tubing under a packer would be best. The K-13 was selected for such a test.

The graph on the facing page shows pressure fall-off test conducted on the Canada Ojitos Unit K-13 in 1969.

It shows an approximate Kgh of .018 darcy feet.

At the time this 1969 pressure fall-off test was made, the formation pressures were estimated by measuring surface pressures with dead weight pressure gauge and converting the pressures to bottom hole conditions. From the method of estimating sizes of tight blocks used by B-M-G in the '60's, a fracture block size in the range of 20 to 30 acres was estimated and filed in the Operator's report to the Department of the Interior in June 1981.

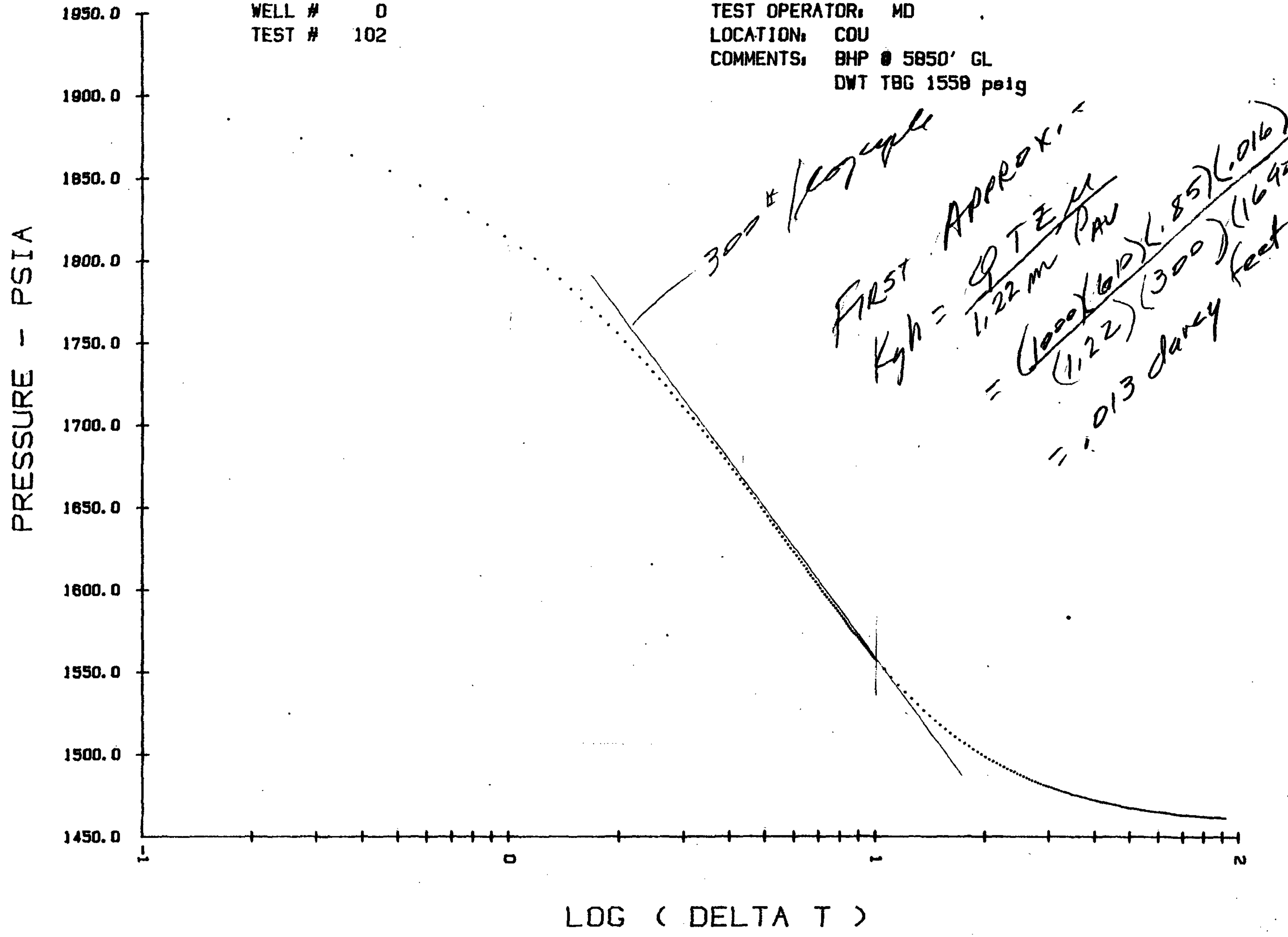
Recognizing there could be some error in estimating the bottom hole pressures from surface pressures - particularly from the consequence of the unknown average temperature of the gas column immediately on shutting in the well. Also it is difficult to measure surface dead weight pressures the first few minutes of shut in time.

To make a check on this tight block size, the Unit Operator employed one of the sensitive bottom hole pressure gauges and conducted another follow-up test in May 1987; and analyzed this test with the type curves to estimate fracture length and from that tight block size.

For the same estimated pore volume of the tight block, the 1987 test shows 25 to 40 acres for the tight block size (as shown on the following pages).

DATE: 5/ 1/87
START TIME: 9/51/40
GAUGE #69160
WELL # 0
TEST # 102

COMPANY: BMG
CLIENT:
WELL NAME: K-13
TEST OPERATOR: MD
LOCATION: COU
COMMENTS: BHP @ 5850' GL
DWT TBG 1558 psig



*** SEMI-LOG PLOT ***

MAY 1987
PRESSURE FALL-OFF TEST
CANADA OJITOS UNIT K-13

Graph of the May 1987 pressure fall-off test is shown on the graph on the facing page, along with first approximation of Kgh.

Plot of this information was made utilizing log-log type curve and the difference in squares of gas pseudo-pressures, as shown on the following pages, along with statistics and graphs of pressure versus pseudo-pressure.

CANADA OJITOS UNIT K-13
PRESSURE FALL-OFF TEST
MAY 1, 1987

1,000 MCF/D ON SHUT IN
LOG-LOG PLOT
(PLOT ON FACING PAGE)

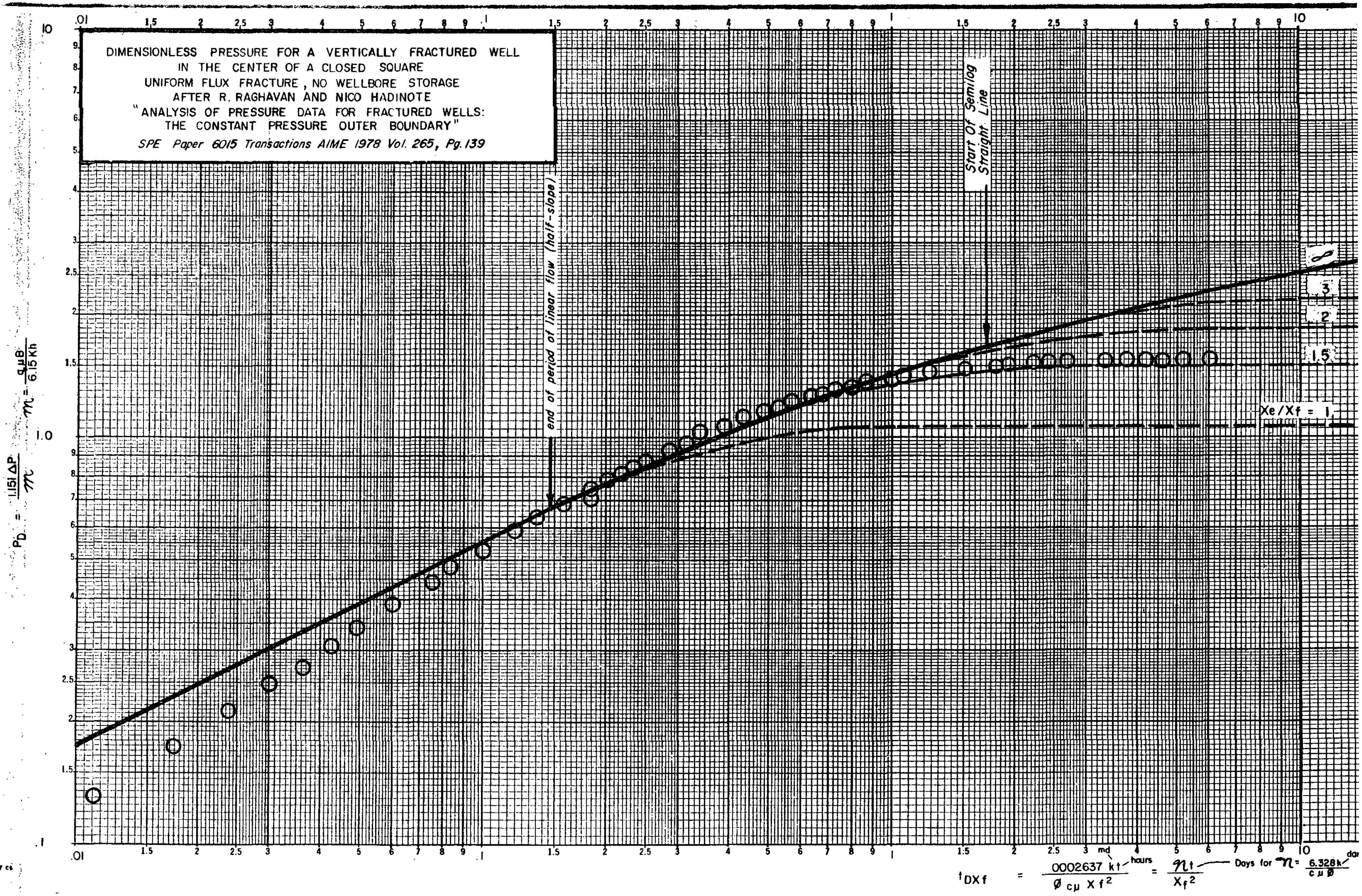
MATCH POINT: $t_D = 1.0$ $\quad P_D = 1.35$

$t = 15.5$ hours $\quad f\ (\Delta P) = 1.25$

$$m = \frac{1.151\ f\ (\Delta P)}{P_D} = \frac{1.151 \times 1.25}{1.35} \times 10^{6}$$

$$= 1.07 \times 10^{6}$$

With this value of m, calculate P_D for plotting on semilog type curve (see next section).



DIMENSIONLESS PRESSURE FOR A VERTICALLY FRACTURED WELL
IN THE CENTER OF A CLOSED SQUARE
UNIFORM FLUX FRACTURE, NO WELLBORE STORAGE
AFTER R. RAGHAVAN AND NICO HADINOTE
"ANALYSIS OF PRESSURE DATA FOR FRACTURED WELLS:
THE CONSTANT PRESSURE OUTER BOUNDARY"
SPE Paper 6015 Transactions AIME 1978 Vol. 265, Pg. 139
end of period of linear flow (half-slope)
Start Of Semilog Straight Line
Xe / Xf = 1
1.5
2
3
∞
$P_D = \frac{1.151 \Delta P}{m}$ $m = \frac{q \mu B}{6.15 Kh}$
$t_{DXf} = \frac{.0002637\ kt}{\phi c \mu X_f^2} = \frac{\eta t}{X_f^2}$
hours
md
Days for $\eta = \frac{6.328 k}{c \mu \phi}$

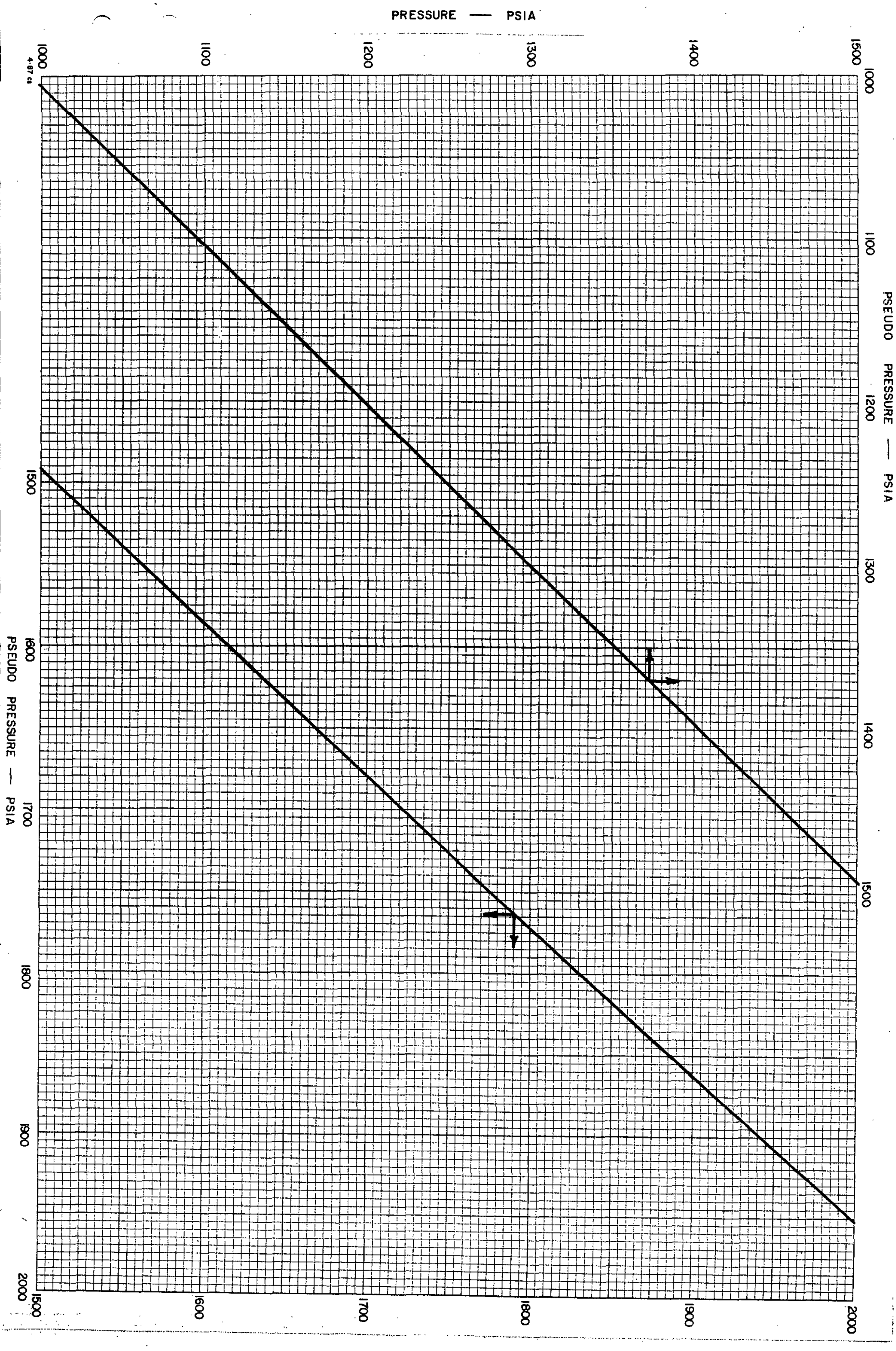
K-13 PRESSURE FALL-OFF
SHUT IN MAY 1, 1987

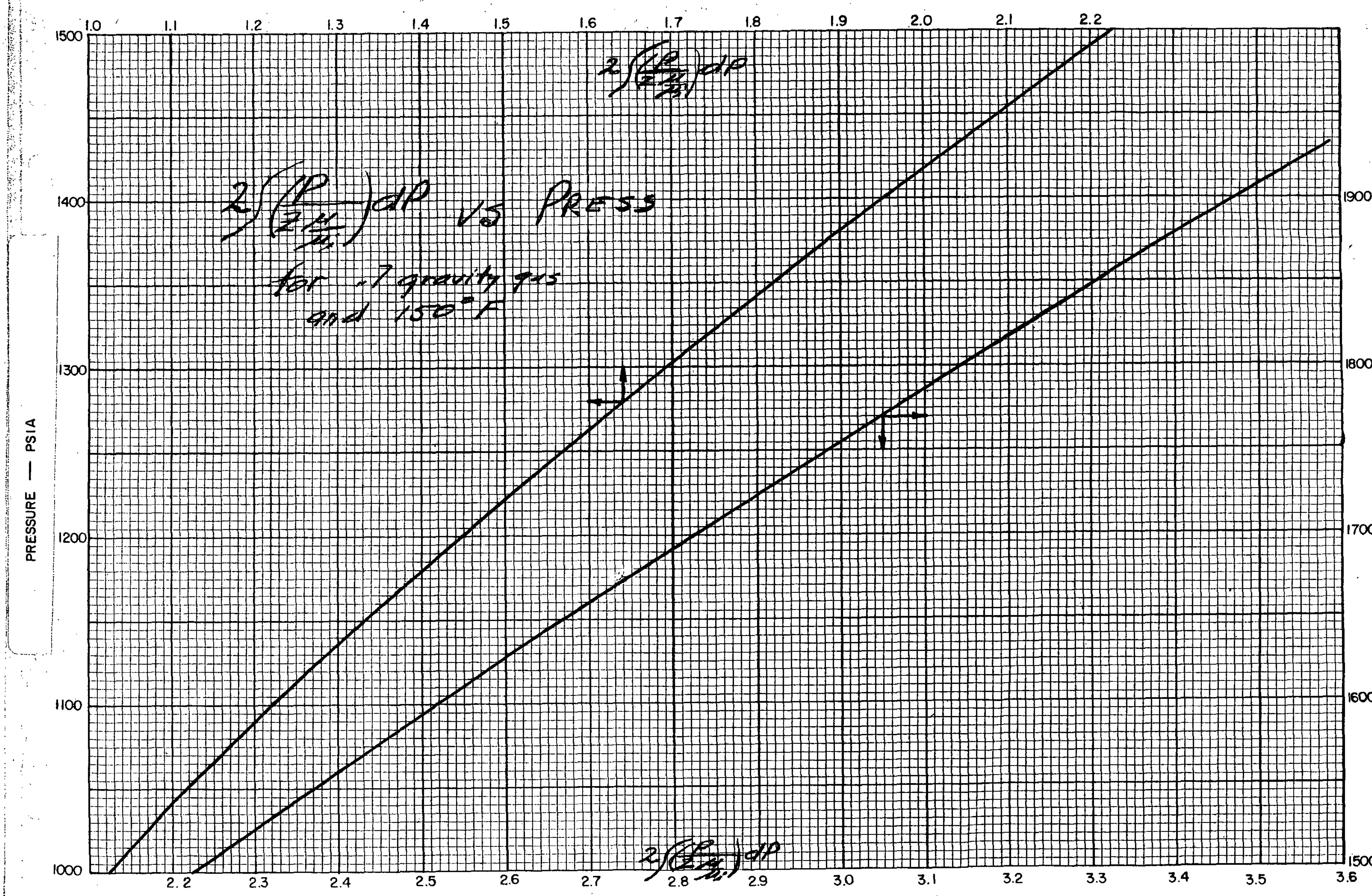
Use diff. of squares of psuedo pressures

Bomb Time (1)	Δ t Time (2)	Pressure Psia (3)	$2\int_0^P \left(\frac{P}{\frac{Z\mu}{\mu_i}}\right) dP$ (4) $(\times 10^6)$	$2\int_0^{1915} \left(\frac{P}{\frac{Z\mu}{\mu_i}}\right) dP$ − col(4) (5) $(\times 10^6)$
	.000	1915.98	3.530	.010
72.176	.008	1912.02	3.515	.025
72.184	.016	1910.11	3.507	.033
72.192	.024	1908.35	3.500	.040
72.200	.032	1906.73	3.496	.044
72.208	.044	1904.46	3.483	.057
72.232	.056	1902.31	3.479	.061
72.244	.068	1900.26	3.475	.065
72.350	.174	1885.47	3.423	.117
72.450	.274	1873.70	3.385	.155
72.550	.374	1863.29	3.350	.190
72.650	.474	1853.78	3.318	.222
72.750	.574	1844.95	3.300	.240
72.850	.674	1836.63	3.264	.276
72.950	.774	1828.79	3.238	.302
73.150	.974	1814.20	3.190	.350
73.350	1.174	1800.79	3.146	.394
73.550	1.374	1788.34	3.108	.432
73.750	1.574	1776.68	3.070	.470
74.050	1.874	1760.46	3.015	.525
74.350	2.174	1746.64	2.975	.565
74.650	2.474	1731.92	2.927	.613
75.050	2.874	1715.14	2.874	.666
75.350	3.174	1703.52	2.838	.702
75.550	3.374	1696.16	2.813	.727
75.850	3.674	1685.69	2.782	.758
76.150	3.974	1675.83	2.750	.790
76.650	4.474	1660.62	2.702	.838
76.950	4.774	1652.18	2.672	.868
77.550	5.374	1636.64	2.613	.927
78.250	6.074	1620.49	2.577	.963
79.050	6.874	1604.28	2.530	1.010
79.750	7.574	1591.79	2.492	1.048
80.450	8.274	1580.54	2.462	1.078
81.150	8.974	1570.48	2.430	1.110

K-13 PRESSURE FALL-OFF
SHUT IN MAY 1, 1987

Bomb Time (1)	Δt Time (2)	Pressure Psia (3)	$2\int_0^{P}\left(\frac{P}{Z\frac{\mu}{\mu_i}}\right)dP$ (4)	$2\int_0^{1915}\left(\frac{P}{Z\frac{\mu}{\mu_i}}\right)dP - col(4)$ (5)
81.950	9.774	1560.33	2.400	1.140
82.750	10.574	1551.39	2.374	1.166
83.750	11.574	1541.72	2.347	1.193
84.750	12.574	1533.44	2.320	1.220
85.750	13.574	1526.32	2.300	1.240
87.750	15.574	1514.92	2.268	1.272
88.750	16.574	1510.34	2.254	1.286
91.750	19.574	1499.63	2.222	1.318
95.250	23.074	1490.86	2.200	1.340
98.250	26.074	1485.37	2.185	1.355
101.750	29.574	1480.55	2.172	1.368
106.250	34.074	1475.99	2.160	1.380
109.750	37.574	1473.31	2.152	1.388
115.250	43.074	1470.12	2.144	1.396
120.250	48.074	1467.99	2.140	1.400
126.750	54.574	1465.93	2.132	1.408
130.250	58.074	1465.07	2.130	1.410
135.750	63.574	1463.98	2.128	1.412
142.250	70.074	1463.02	2.126	1.414
151.750	79.574	1461.98	2.124	1.416
164.250	92.074	1461.17	2.120	1.420


PRESSURE — PSIA
1000
1100
1200
1300
1400
1500
PSEUDO PRESSURE — PSIA
1000
1100
1200
1300
1400
1500
PSEUDO PRESSURE — PSIA
1500
1600
1700
1800
1900
2000
1500
1600
1700
1800
1900
2000



$2\int\left(\frac{P}{Z\frac{\mu}{\mu_1}}\right)dP$ VS PRESS
for .7 gravity gas
and 150°F
$2\int\left(\frac{P}{Z\frac{\mu}{\mu_1}}\right)dP$
PRESSURE — PSIA
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
3.1
3.2
3.3
3.4
3.5
3.6
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900