STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

Compiled by E.A. Utz, Gas Engineer

SAN JUAN BASIN

METHOD OF CALCULATING PRESSURE LOSS DUE TO FRICTION IN GAS WELL STRINGS

ACKNOWLEDGMENT

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Like appreciation is also expressed to Mr. Norman Woodruff, El Paso Natural Gas Company, Chairman of the Industry Committee appointed by the Commission to study gas well testing in Southeast New Mexico, and to the following committee members for their willing and effective work in analyzing the various methods of calculating pressure loss due to friction.

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USE OF THE TABLES

Nomenclature

Q	=	M^2cfd @ 15.025 and 60° F. (Measured Flow)
P_c	=	Shut-in wellhead pressure, psia. (7 day)
P_w	=	Static wellhead working pressure, psia.
P_t	=	Flowing wellhead working pressure, psia (7 day average meter pressure plus measured friction loss between meter and wellhead.
F_c	=	Factor dependent upon size of flow string, pressure base, temperature and compressibility factor. See Table I of F_c values.
$(1-e^{-s})$	=	Factor dependent upon GL, temperature and compressibility factor. See Table II of $(1-e^{-s})$ values.
G	=	Specific gravity of gas. (Air = 1.00)
L	=	Length of flowing column, ft.

Tables

I. Values of F_c for various sizes of flow strings.

II. Values of $(1-e^{-s})$ for various values of GL.

Procedure

1. From Table I, obtain the value of F_c corresponding to the internal diameter of the pipe.
2. From Table II, obtain the value of $(1-e^{-s})$ corresponding to the value of GL.
3. From the test data, obtain the rate of flow (Q) and the corresponding Working Pressure. (P_t)
4. Multiply F_c (Table I value) times Q.
5. Square the term F_cQ.
6. Multiply $(F_cQ)^2$ by $(1-e^{-s})$. Table II value.
7. Add the value of $(F_cQ)^2$ $(1-e^{-s})$ to P^2_t to obtain P^2_w.
8. Extract square root of P_w^2 to obtain P_w.

EXAMPLE FOR CALCULATING STATIC WELLHEAD WORKING PRESSURE (P_w) FOR GAS WELLS IN SAN JUAN BASIN NORTHWEST NEW MEXICO.

Test Data from Form C-122-A (Revised 8-1-54) necessary for P_w calculation.

1. 1.995" = Size of Flow String I.D. (if not known I.D. may be determined from Table I by referring to O.D. and #/ft. columns.)
2. L = 5000' = Length of Flow String (If lower sections of tubing is perforated, the top of perforations shall determine L. Where flow is through the casing and casing is set above producing formation the casing shoe shall determine L. For casing flow where casing is set through producing formation and slotted or perforated the top of the perforations shall determine L.)
3. G = .861 = Specific gravity of flowing gas. (Air = 1.0)
4. P_t = 565 = 7 day average wellhead flowing pressure. (Column j Form C-122-A)
5. Q = 2.500 = 7 day average volume of flow M^2CFD. (Volume shown under flow rate calculation in millions cu. ft. per day.)

Begin calculation as follows:

6. Determine Table I value (F_c) for 1.995' I.D. Tubing. This is 9.402.
7. Multiply G x L. GL = 3405. Show this value in GL column at bottom of C-122-A.
8. Determine Table II value ($1-e^{-s}$) for GL of 3405. This is .219. Show this value in ($1-e^{-s}$) column at bottom of C-122-A.

9. Multiply Table I value of 9.402 (F_c) by Q (2.500) and square the product. $(9.402 \times 2.500)^2 = 552.5$. Show this value in $(F_c Q)^2$ column at bottom of C-122-A.

10. Multiply 552.5 by Table II value of .219 ($1-e^{-s}$). $552.5 \times .219 = 120.9$ (thousands). Show this value in R^2 column at bottom of C-122-A.

11. Square 565 (P_t, item 4 above, column j on C-122-A). $(565)^2 = 319.2$ (thousands). Show 319.2 in P_t^2 column C-122-A.

12. Add 319.2 (P_t^2) to 120.9 (R^2) and extract the square root of the sum. $319.2 + 120.9 = 440.1$ (thousands).

    $\sqrt{440.1} = 663.4 = P_w$ (Calculated static wellhead working pressure). Show 663.4 in P_w column C-122-A. Note that 440.1 is in thousands and therefore is an even number for square root extraction.

13. This is the P_w value to be used in the deliverability calculation on Form C-122-A.

TABLE I

Values of F_c for Various Tubing Sizes

(Use only for internal diameters less than 4.277 in.)

Note: $$F_c = \left(\frac{0.10797}{d^{2.612}}\right)\left(\frac{P_b}{14.65}\right)(T)\ (Z)$$

Values shown based on P_b = 15.025
T = 573
Z = 0.90

Nominal Size, In.	O.D. In.	#/Ft.	I.D. In.	F_c
1	1.315	1.80	1.049	50.40
1 1/4	1.660	2.40	1.380	24.62
1 1/2	1.990	2.75	1.610	16.46
2	2.375	4.70	1.995	9.402
2 1/2	2.875	6.50	2.441	5.551
	3.500	9.30	2.992	3.262
	4.000	11.00	3.476	2.205
	4.500	12.70	3.958	1.571
	4.750	16.25	4.082	1.450
	4.750	18.00	4.000	1.528
	5.000	18.00	4.276	1.284
	5.000	21.00	4.154	1.384

$$F_c \text{ (for Annulus)} = \left[\frac{0.10797}{(d_1 + d_2)(d_1 - d_2)^{1.612}}\right]\left(\frac{P_b}{14.65}\right)(T)\ (Z)$$

d_1 = I.D. of casing - in.

d_2 = O.D. of tubing - in.

TABLE I

(Continued)

Values of F_c for Various Casing Sizes

(Use only for Internal Diameters greater than 4.277 in.)

Note: $F_c = \left(\frac{0.10337}{d^{2.582}}\right) \left(\frac{P_b}{14.65}\right) (T) (Z)$

Values shown based on P_b = 15.025
T = 573
Z = 0.90

O.D. In.	#/Ft.	I.D. In.	F_c
5.000	13.00	4.494	1.129
5.000	15.00	4.408	1.187
5.500	14.00	5.012	0.8518
5.500	15.00	4.976	0.8678
5.500	17.00	4.892	0.9068
5.500	20.00	4.778	0.9633
5.500	23.00	4.670	1.022
5.500	25.00	4.580	1.075
6.000	15.00	5.524	0.6627
6.000	17.00	5.450	0.6861
6.000	20.00	5.352	0.7190
6.000	23.00	5.240	0.7594
6.000	26.00	5.140	0.7982
6.625	20.00	6.049	0.5241
6.625	22.00	5.989	0.5378
6.625	24.00	5.921	0.5539
6.625	26.00	5.855	0.5702
6.625	28.00	5.791	0.5866
6.625	31.80	5.675	0.6181
6.625	34.00	5.595	0.6412
7.000	20.00	6.456	0.4430
7.000	22.00	6.398	0.4534
7.000	24.00	6.336	0.4651
7.000	26.00	6.276	0.4766
7.000	28.00	6.214	0.4890
7.000	30.00	6.154	0.5014

TABLE 1

(Continued)

Values of F_c for Various Casing Sizes

O.D. In.	#/Ft.	I.D. In.	F_c
7.000	40.00	5.836	0.5749
7.625	26.40	6.969	0.3636
7.625	29.70	6.875	0.3766
7.625	33.70	6.765	0.3927
7.625	38.70	6.625	0.4145
7.625	45.00	6.445	0.4450
8.000	26.00	7.386	0.3130
8.125	28.00	7.485	0.3024
8.125	32.00	7.385	0.3131
8.125	35.50	7.285	0.3243
8.125	39.50	7.185	0.3361
8.625	17.50	8.249	0.2353
8.625	20.00	8.191	0.2396
8.625	24.00	8.097	0.2469
8.625	28.00	8.003	0.2544
8.625	32.00	7.907	0.2625
8.625	36.00	7.825	0.2697
8.625	38.00	7.775	0.2741
8.625	43.00	7.651	0.2858
9.000	34.00	8.290	0.2323
9.000	38.00	8.196	0.2392
9.000	40.00	8.150	0.2427
9.000	45.00	8.032	0.2521
9.625	36.00	8.921	0.1922
9.625	40.00	8.835	0.1971
9.625	43.50	8.755	0.2017
9.625	47.00	8.681	0.2063
9.625	53.50	8.535	0.2155
9.625	58.00	8.435	0.2222
10.000	33.00	9.384	0.2204
10.000	55.50	8.908	0.1929
10.000	61.20	8.790	0.1998
10.750	32.75	10.192	0.1363
10.750	35.75	10.136	0.1382
10.750	40.00	10.050	0.1413
10.750	45.50	9.950	0.1450
10.750	48.00	9.902	0.1469
10.750	54.00	9.784	0.1514

TABLE I

(Continued)

Values of F_c for various casing-tubing combinations. (Annular Flow).

CASING			TUBING			
O.D. In.	I.D. In.	#/Ft.	O.D. In.	I.D. In.	#/Ft.	F_c
7.625	6.625	39	2.375	1.995	4.7	.651
7.000	6.366	23	2.375	1.995	4.7	.740
7.000	6.276	26	2.375	1.995	4.7	.744
7.000	6.366	23	2.875	2.441	6.5	.865
6.625	6.049	20	2.375	1.995	4.7	.875
7.000	6.276	26	2.875	2.441	6.5	.910
6.625	6.049	20	2.875	2.441	6.5	1.041
6.625	5.921	24	3.500	2.992	9.3	1.540
5.500	4.892	17	2.375	1.995	4.7	1.812
5.500	4.892	17	3.000	-	-	2.735
7.750	6.456	20	1.315	1.049	1.68	.527
6.155	4.976	15	1.315	1.049	1.68	1.117

$$F_c \text{ (for Annulus)} = \left[\frac{0.10337}{(d_1 + d_2)(d_1 - d_2)^{1.582}} \right] \left(\frac{P_b}{14.65} \right) (T)\ (Z)$$

d_1 = I.D. of casing - in.

d_2 = O.D. of tubing - in.

TABLE II

Values of $(1 - e^{-S})$ for Various Values of GL

Note: $S = \left(\frac{0.0375\ GL}{TZ}\right)$

Values shown based on T = 573
Z = 0.90

From	To	$(1 - e^{-S})$	From	To	$(1 - e^{-S})$
947	960	0.067	1549	1564	0.107
961	976	0.068	1565	1579	0.108
977	990	0.069	1580	1594	0.109
991	1005	0.070	1595	1609	0.110
1006	1020	0.071	1610	1624	0.111
1021	1034	0.072	1625	1641	0.112
1035	1049	0.073	1642	1657	0.113
1050	1065	0.074	1658	1672	0.114
1065	1080	0.075	1673	1687	0.115
1081	1094	0.076	1688	1703	0.116
1095	1109	0.077	1704	1718	0.117
1110	1124	0.078	1719	1734	0.118
1125	1138	0.079	1735	1750	0.119
1139	1153	0.080	1751	1766	0.120
1154	1169	0.081	1767	1781	0.121
1170	1184	0.082	1782	1797	0.122
1185	1199	0.083	1798	1812	0.123
1200	1214	0.084	1813	1828	0.124
1215	1228	0.085	1829	1844	0.125
1229	1243	0.086	1845	1859	0.126
1244	1258	0.087	1860	1875	0.127
1259	1274	0.088	1876	1891	0.128
1275	1289	0.089	1892	1907	0.129
1290	1304	0.090	1908	1923	0.130
1305	1319	0.091	1924	1939	0.131
1320	1334	0.092	1940	1954	0.132
1335	1349	0.093	1955	1970	0.133
1350	1364	0.094	1971	1986	0.134
1365	1380	0.095	1987	2002	0.135
1381	1395	0.096	2003	2017	0.136
1396	1410	0.097	2018	2033	0.137
1411	1426	0.098	2034	2050	0.138
1427	1441	0.099	2050	2066	0.139
1442	1456	0.100	2067	2082	0.140
1457	1474	0.101	2083	2098	0.141
1475	1487	0.102	2099	2114	0.142
1488	1502	0.103	2115	2130	0.143
1503	1518	0.104	2131	2146	0.144
1519	1533	0.105	2147	2162	0.145
1534	1548	0.106	2163	2178	0.146

TABLE II
(Continued)

Values of $(1 - e^{-s})$ for Various Values of GL

GL			GL		
From	To	$(1 - e^{-s})$	From	To	$(1 - e^{-s})$
2179	2194	0.147	3026	3042	0.198
2195	2210	0.148	3043	3060	0.199
2211	2227	0.149	3061	3077	0.200
2227	2243	0.150	3078	3094	0.201
2244	2259	0.151	3095	3111	0.202
2260	2275	0.152	3112	3128	0.203
2276	2292	0.153	3129	3146	0.204
2293	2308	0.154	3147	3163	0.205
2309	2324	0.155	3164	3180	0.206
2325	2340	0.156	3181	3197	0.207
2341	2356	0.157	3198	3215	0.208
2357	2373	0.158	3216	3232	0.209
2374	2389	0.159	3233	3250	0.210
2390	2405	0.160	3251	3267	0.211
2406	2422	0.161	3268	3284	0.212
2423	2438	0.162	3285	3303	0.213
2439	2455	0.163	3304	3318	0.214
2455	2471	0.164	3319	3336	0.215
2472	2488	0.165	3337	3354	0.216
2489	2504	0.166	3355	3372	0.217
2505	2521	0.167	3373	3389	0.218
2522	2537	0.168	3390	3407	0.219
2538	2554	0.169	3408	3425	0.220
2555	2570	0.170	3426	3442	0.221
2571	2587	0.171	3443	3460	0.222
2588	2603	0.172	3461	3478	0.223
2604	2620	0.173	3479	3496	0.224
2621	2637	0.174	3497	3513	0.225
2638	2653	0.175	3514	3531	0.226
2654	2670	0.176	3532	3549	0.227
2671	2687	0.177	3550	3567	0.228
2688	2703	0.178	3568	3585	0.229
2704	2720	0.179	3586	3602	0.230
2721	2737	0.180	3603	3620	0.231
2738	2754	0.181	3621	3638	0.232
2755	2771	0.182	3639	3656	0.233
2772	2788	0.183	3657	3674	0.234
2789	2805	0.184	3675	3692	0.235
2806	2822	0.185	3693	3710	0.236
2823	2838	0.186	3711	3728	0.237
2838	2855	0.187	3729	3747	0.238
2855	2872	0.188	3748	3765	0.239
2873	2889	0.189	3766	3783	0.240
2890	2906	0.190	3784	3801	0.241
2907	2923	0.191	3802	3819	0.242
2924	2940	0.192	3820	3837	0.243
2941	2957	0.193	3838	3855	0.244
2958	2975	0.194	3856	3874	0.245
2976	2991	0.195	3875	3892	0.246
2992	3008	0.196	3893	3910	0.247
3009	3025	0.197	3911	3928	0.248

TABLE II
(Continued)
Values of $(1 - e^{-s})$ for Various Values of GL

GL From	GL To	$(1 - e^{-s})$	GL From	GL To	$(1 - e^{-s})$
3929	3947	0.249	4896	4915	0.300
3948	3965	0.250	4916	4934	0.301
3966	3984	0.251	4935	4954	0.302
3985	4002	0.252	4955	4973	0.303
4003	4021	0.253	4974	4993	0.304
4022	4039	0.254	4994	5013	0.305
4040	4057	0.255	5014	5033	0.306
4058	4075	0.256	5034	5053	0.307
4076	4094	0.257	5054	5073	0.308
4095	4112	0.258	5074	5093	0.309
4113	4131	0.259	5094	5113	0.310
4132	4150	0.260	5114	5132	0.311
4151	4168	0.261	5133	5152	0.312
4169	4187	0.262	5153	5172	0.313
4188	4205	0.263	5173	5193	0.314
4206	4224	0.264	5194	5213	0.315
4225	4243	0.265	5214	5233	0.316
4244	4262	0.266	5234	5253	0.317
4263	4281	0.267	5254	5273	0.318
4282	4300	0.268	5274	5293	0.319
4301	4318	0.269	5294	5313	0.320
4319	4337	0.270	5314	5334	0.321
4338	4356	0.271	5335	5354	0.322
4357	4374	0.272	5355	5374	0.323
4375	4393	0.273	5375	5395	0.324
4394	4412	0.274	5396	5415	0.325
4413	4431	0.275	5416	5435	0.326
4432	4450	0.276	5436	5456	0.327
4451	4469	0.277	5457	5476	0.328
4470	4488	0.278	5477	5497	0.329
4489	4508	0.279	5498	5518	0.330
4509	4527	0.280	5519	5537	0.331
4528	4546	0.281	5538	5558	0.332
4547	4565	0.282	5559	5579	0.333
4566	4585	0.283	5580	5600	0.334
4586	4603	0.284	5601	5621	0.335
4604	4622	0.285	5622	5641	0.336
4623	4642	0.286	5642	5662	0.337
4643	4661	0.287	5663	5682	0.338
4662	4680	0.288	5683	5704	0.339
4681	4700	0.289	5705	5724	0.340
4701	4719	0.290	5725	5745	0.341
4720	4739	0.291	5746	5765	0.342
4740	4758	0.292	5766	5787	0.343
4759	4778	0.293	5788	5808	0.344
4779	4797	0.294	5809	5829	0.345
4798	4816	0.295	5830	5850	0.346
4817	4836	0.296	5851	5871	0.347
4837	4855	0.297	5872	5892	0.348
4856	4875	0.298	5893	5913	0.349
4876	4895	0.299	5914	5935	0.350

SOURCE OF THE TERM F_c USED IN THE CALCULATION OF EQUIVALENT STATIC COLUMN WELLHEAD PRESSURES

The calculation of the equivalent static column wellhead pressure corresponding to a flowing wellhead pressure is carried out through use of the following equation:

$$P_w^2 = P_t^2 + F^2T^2Z^2 \left(1 - e^{-s}\right) - - - - - - - -(1)$$

where:

$$F^2 = \frac{2.6665\ f\ Q^2}{d^5}$$

$$S = \frac{0.0375\ GL}{TZ}$$

G = specific gravity (air = 1.00)
L = length of flow string, ft.
P = pressure, psia (P^2 in thousands)
Q = rate of flow, M^2cfd @ 14.65 psia, and 60°F.
T = effective absolute temperature, °R.
Z = effective compressibility factor.
d = internal diameter of flow string, in.
f = coefficient of friction, dimensionless.

Through use of the complete turbulence portion of the curves published by Lewis F. Moody in November 1944, Transactions of the A.S.M.E., it is possible to determine the value of (f) for various sizes of pipe at a constant absolute roughness of 0.0006 in., which value is considered valid for clean pipe.

Using the values of (f) so determined, it is possible to arrive at a correlation of friction coefficient (f) vs. internal diameter (d) which is reasonably correct. It was found for an absolute roughness of 0.0006 in. that the value of (f) could be expressed as follows:

$$f = \left[\frac{4.372 \times 10^{-3}}{d^{0.224}}\right]$$ for diameters less than 4.277 in.

and,

$$f = \left[\frac{4.007 \times 10^{-3}}{d^{0.164}}\right]$$ for diameters greater than 4.277 in.

If the expression $(F_cQ)^2$ is allowed to represent the expression $(F^2T^2Z^2)$ in Equation (1), then the value of F_c can be shown to be those given in Table I.

EL PASO NATURAL GAS COMPANY

Memorandum

To Mr. L. D. Galloway

From Gas Engineering

Date August 30, 1962

Place Farmington, New Mexico

C3

A meeting was held in Farmington on August 1, 1962 to discuss possible changes in the mode of calculation of the deliverability tests for wells in the San Juan Basin. At this meeting I was asked to compile certain data regarding "Multipliers" used in converting from the actual flow rates (Q) to the deliverability (D) for wells in certain pools. The 1960 Annual Deliverability Test for 3859 wells was used in this study. The multiplier for each well was converted from a basis of Pd = 50% Pc to a value of Pd = 75% Pc. Then a count was made of the number of wells in brackets as: Under 1.0, 1.0 to 1.5, 1.5 to 2.0, etc. A tabulation was made for the South Blanco Pictured Cliff Pool using Pd = 65% Pc.

The results of these converted multipliers are attached hereto.

H. L. Kendrick
Sr. Gas Engineer

HLK:slm
cc: Mr. E. C. Arnold
Mr. A. R. Kendrick
Mr. W. B. Smith
Mr. Elvis Utz
--
Mr. Gerald Hickson
Mr. R. F. Lemon
Mr. J. B. Magruder
Mr. D. H. Rainey
Mr. G. C. Whitworth
Mr. F. N. Woodruff
--
Mr. W. G. Cutler
File (2)

SOUTH BLANCO PICTURED CLIFF POOL

Using 0.75 P_c for P_d

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
24-2	21	19	1	1		
24-3	46	35	4		1	6
24-4	22	8	9	1	2	2
25-3	40	31	2	1	2	4
25-4	61	44	10	3	2	2
25-5	58	35	16	5		2
25-6	30	26	4			
26-4	11		2	6	2	1
26-5	76	58	7	6	1	4
26-6	78	55	21	2		
26-7	65	58	3	2		2
26-8	6	3	3			
27-5	10	7	2	1		
27-6	57	51	6			
27-7	92	91	1			
27-8	96	90	4	1	1	
27-9	63	49	13	1		
28-6	2	1	1			
28-7	10	6	3			1
28-8	15	11	1	2	1	
28-9	14	14				
TOTALS:	873	692	113	32	12	24
PER-CENTS:		79.3	12.9	3.7	1.4	2.7

30 wells with multipliers greater than 1.5 are classified as exempt marginal.

$\frac{24}{872} =$

$\frac{P_c - P_d}{P_c - P_w}$

TAPACITO PICTURED CLIFF POOL

Using 0.75 Pc for Pd

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
25-3	22	14	6		1	1
26-3	20	9	7	3	1	
26-4	27	3	9	9	2	4
26-5	1					1
27-4	11	2	8	1		
27-5	17	2	6	6	3	
TOTALS:	98	30	36	19	7	6
PER-CENTS:		30.6	36.7	19.4	7.1	6.1

6 wells with multipliers greater than 1.5 are classified as exempt marginal.

UNDESIGNATED PICTURED CLIFF POOL

Using 0.75 Pc for Pd

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
25-10	1	1				
26-9	1	1				
26-10	1	1				
27-4	1		1			
28-3	1	1				
29-8	1	1				
30-9	3	3				
TOTALS:	9	8	1			
PER-CENTS:		88.9	11.1			

WEST KUTZ PICTURED CLIFF POOL

Using 0.75 P_c for P_d

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
26-10	14	1	12	1		
26-11	2	2				
27-10	12	6	5			1
27-11	40	26	6	7		1
27-12	30	16	3	4	3	4
28-11	2	1		1		
28-12	33	1	6	13	5	8
28-13	4				1	3
39-12	6	5	1			
29-13	6			5	1	
TOTALS:	149	58	33	31	10	17
PER-CENTS:		38.9	22.1	20.8	6.7	11.4

38 wells with multipliers greater than 1.5 are classified as exempt marginal.

BLANCO MESA VERDE POOL

Using 0.75 P_c for P_d

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
26-2	3	3				
26-3	21	18	2	1		
26-4	10	3	6	1		
26-5	6	5	1			
26-6	2	1	1			
26-7	3	1	1		1	
27-3	20	19	1			
27-4	16	8	5	1	1	1
27-5	44	13	26	5		
27-6	48	17	18	11	1	1
27-7	29	10	11	5	2	1
27-8	36	21	13	2		
27-9	8	7	1			
28-3	2	2				
28-4	14	6	5	2	1	
28-5	44	16	23	4	1	
28-6	43	15	23	4	1	
28-7	47	16	25	4		2
28-8	45	34	10		1	
28-9	39	15	23			1
29-4	6	1	2	1	2	
29-5	38	17	19	1	1	
29-6	54	30	23	1		
29-7	65	27	34	4		
29-8	64	52	11			1
29-9	63	38	21	3	1	
29-10	7	4	1	1		1
30-4	2	1	1			
30-5	23	9	11	1	2	
30-6	60	37	19	3		1
30-7	68	44	18	6		
30-8	62	42	19	1		
30-9	64	36	26	1	1	
30-10	55	34	13	5	1	2
30-11	12	3	6	2	1	
30-12	2	2				
31-5	7		4	1	2	
31-6	20	3	8	5	3	1
31-7	28	6	8	9	2	3
31-8	48	21	17	5	4	1
31-9	65	39	15	5	4	2
31-10	71	64	7			
31-11	56	40	10	4	2	
31-12	45	24	15	4	1	1
31-13	4	4				
32-5	2		2			
32-6	11	8	3			
32-7	17	9	4	1	1	2
32-8	9	2	1	4		2
32-9	25	9	8	8		
32-10	49	23	14	5	6	1

BLANCO MESA VERDE POOL

Using 0.75 P_c for P_d

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
32-11	51	26	21	3	1	
32-12	35	24	10			1
32-13	7	4	2	1		
TOTALS:						
	1675	913	568	125	44	25
Per Cents:		54.51	33.91	7.46	2.63	1.49

107 wells with multipliers greater than 1.5 are NOT classified as exempt marginal.

87 wells that are classified as exempt marginal had a shut-in pressure of 600 psia or less.

AZTEC PICTURED CLIFF POOL

Using 0.75 Pc for Pd

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
28-8	5	3		1	1	
28-9	53	50	1	1	1	
28-10	18	16	2			
29-8	1	1				
29-9	8	4	1	2	1	
29-10	81	75	5	1		
29-11	18	14	2	1		1
30-10	42	39	2		1	
30-11	85	78	5		1	1
31-11	12	10	1		1	
31-12	1				1	
TOTALS:	324	290	19	6	7	2
PER-CENTS:		89.5	5.9	1.9	2.2	0.6

6 wells with multipliers greater than 1.5 are classified as exempt marginal.

BALLARD PICTURED CLIFF POOL

Using 0.75 P_c for P_d

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
23-3	8	8				
23-4	3	3				
23-5	16	15	1			
23-6	3	2	1			
24-4	2	2				
24-5	44	32	11		1	
24-6	42	33	8	1		
24-7	7	7				
25-6	14	10	4			
25-7	40	36	4			
25-8	33	12	12	8	1	
26-7	16	15	1			
26-8	58	53	5			
26-9	68	62	6			
27-8	4	4				
27-9	23	15	6	2		
TOTALS:	381	309	59	11	2	
PER-CENTS:		81.1	15.5	2.9	0.5	

5 wells with multipliers greater than 1.5 are classified as exempt marginal.

BLANCO PICTURED CLIFF POOL

Using 0.75 P_c for P_d

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
29-8	2	2				
29-9	20	20				
30-9	13	13				
30-10	1	1				
TOTALS:	36	36				
PER-CENT:		100				

CHOZA MESA PICTURED CLIFF POOL

Using 0.75 P_c for P_d

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
28-4	2	2				
29-3	1	1				
29-4	4	3	1			
TOTALS:	7	6	1			
PER-CENTS		85.7	14.3			

EAST BLANCO PICTURED CLIFF POOL

Using 0.75 P_c for Pd

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
30-4	21	18	1	1		1
TOTALS:	21	18	1	1		1
PER-CENTS		85.7	4.8	4.8		4.8

FULCHER KUTZ PICTURED CLIFF POOL

Using 0.75 Pc for Pd

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
27-9	28	18	10			
27-10	83	72	7	2	2	
28-10	62	59	3			
28-11	14	13	1			
29-10	1	1				
29-11	17	12	4	1		
29-12	17	8	7	2		
29-13	1	1				
30-12	2	2				
TOTALS:	225	186	32	5	2	
PER-CENTS:		82.7	14.2	2.2	0.9	

7 wells with multipliers greater than 1.5 are classified as exempt marginal

GAVILAN PICTURED CLIFF POOL

Using 0.75 P_c for Pd

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
24-1	2	2				
25-1	5	5				
25-2	20	20				
26-2	9	9				
26-3	13	10	3			
27-3	12	12				
TOTALS:	61	58	3			
PER-CENTS:		95.1	4.9			

SOUTH BLANCO PICTURED CLIFF POOL

Using 0.65 Pc for Pd

LOCATION TOWNSHIP	NUMBER OF WELLS	MULTIPLIER UNDER 1.0	MULTIPLIER 1.0 - 1.5	MULTIPLIER 1.5 - 2.0	MULTIPLIER 2.0 - 2.5	MULT. 2.5 & OVER
24-2	21	18	1	1	1	0
24-3	46	31	6	2	0	7
24-4	22	4	9	4	1	4
25-3	40	23	8	3	0	6
25-4	61	35	17	2	2	5
25-5	58	25	17	11	3	2
25-6	30	21	7	2	0	0
26-4	11	0	1	2	5	3
26-5	76	46	12	10	2	6
26-6	78	44	21	12	1	0
26-7	65	44	14	3	2	2
26-8	6	2	2	2	0	0
27-5	10	6	2	1	1	0
27-6	57	47	9	1	0	0
27-7	92	82	9	1	0	0
27-8	96	71	20	3	1	1
27-9	63	33	26	3	1	0
28-6	2	0	2	0	0	0
28-7	10	1	6	2	0	1
28-8	19	9	3	1	1	1
28-9	14	8	6	0	0	0
TOTALS:	873	550	198	66	21	38
PER-CENTS:		63.0	22.7	7.6	2.4	4.3

FORM 10-31

EL PASO NATURAL GAS COMPANY

Memorandum

MAIN OFFICE OCC
1962 MAR 24 PM 1

To: Mr. L. D. Galloway

Date: March 23, 1962

From: Gas & Production Engineering

Place: Farmington, New Mexico 40

A conference was held in Farmington on March 8, 1962, to discuss possible changes to be made in the manner of conducting, calculating and reporting of Annual Deliverability and Shut-in Pressure tests in the San Juan Basin Area. The names of persons in attendance from the New Mexico Oil Conservation Commission and El Paso Natural Gas Company are listed at the end of this memorandum.

The conclusions reached at this time were:

1. No shortening of flow or pre-flow periods should be made at this time.
2. Use either casing or tubing shut-in pressure, whichever is higher, provided the well is not bridged, for P_c. (The present rules stipulate that the shut-in pressure of the flowing string be used for P_c);
3. Bridged wells and the lower zone of dually completed wells are to use a value of P_c as determined from:
   a. Actual wellhead pressure, if the Deliverability Multiplier Factor is below a yet to be determined value. (i.e. figures of 1.50 and 2.00 were discussed), or
   b. Average pressure of off-set wells, or
   c. Correct wellhead pressure determined by calculations from bottom hole pressure bomb data eliminating effects of liquid accumulation in the wellbore;
4. To recommend the changing of the deliverability pressure (P_d) from the presently stipulated 50% $P_c = P_d$ in each pool to the ratio that the calculated working pressure (P_w) bears to the shut-in pressure (P_c) based on a summation of the previous years actual values of shut-in and working pressures as taken from the Annual Deliverability Tests.

This would raise the deliverability pressure from 50% of shut-in pressure to approximately 70% of shut-in pressure, thus eliminating the large multipliers now occuring where the seven day shut-in pressure is approaching the working pressure. (See attached Table)

It was felt that the data presented may not be completely adequate in all respects. El Paso, therefore, plans to conduct more bottom hole pressure surveys in areas where low wellhead shut-in pressures have been measured. This survey is needed to help evaluate the above recommendations.

Thirteen bottom hole pressure surveys were conducted just prior to this meeting. A copy of these surveys are included with this memorandum.

A table of "Deliverability Multiplier Factors" has been calculated and a copy is attached hereto.

Those in attendance at this meeting were:

New Mexico Oil Conservation Commission, Santa Fe, New Mexico
Mr. Elvis Utz

New Mexico Oil Conservation Commission, Aztec, New Mexico
Mr. Emery C. Arnold
Mr. A. R. Kendrick
Mr. W. B. Smith

El Paso Natural Gas Company, El Paso, Texas
Gerald Hickson
R. F. Lemon
J. B. Magruder
D. H. Rainey
G. C. Whitworth
F. N. Woodruff

El Paso Natural Gas Company, Farmington, New Mexico
L. D. Galloway
H. L. Kendrick

H. L. Kendrick
Sr. Gas Engineer

HLK:bjo

cc: Above Names (1)
W. G. Cutler
File - 2

DELIVERABILITY MULTIPLIER FACTORS

$$D = Q \frac{P_c^2 - P_c^2}{P_c^2 - P_w^2}^n$$

Q = Average Daily Volume, MCF/D
P_c = Wellhead Shut-in Pressure, PSIA
P_d = Deliverability Pressure, PSIA
P_w = Working Pressure, PSIA
n = Slope (0.75 or 0.85)

P_d % of P_c	P_w % of P_c	Multiplier (Q x M = D) n = 0.75	n = 0.85
50	50	1.0000	1.0000
50	55	1.0559	1.0636
50	60	1.1263	1.1443
50	65	1.2166	1.2488
50	70	1.3354	1.3879
50	75	1.4981	1.5811
50	80	1.7341	1.8661
50	85	2.1079	2.3282
50	90	2.8004	3.2126
50	95	4.6189	5.6643
50	83.81	2.0000	------
50	75.05	1.5000	------
50	81.74	------	2.0000
50	73.12	------	1.5000
55	55	1.0000	1.0000
55	60	1.0666	1.0758
55	65	1.1520	1.1740
55	70	1.2646	1.3049
55	75	1.4188	1.4865
55	80	1.6422	1.7545
55	85	1.9962	2.1090
55	90	2.6521	3.0204
55	95	4.3742	5.3255
55	85.04	2.0000	------
55	77.06	1.5000	------
55	83.16	------	2.0000
55	75.31	------	1.5000
60	60	1.0000	1.0000
60	65	1.0801	1.0913
60	70	1.1857	1.2129
60	75	1.3301	1.3817
60	80	1.5396	1.6307
60	85	1.8715	2.0346
60	90	2.4864	2.8074
60	95	4.1009	4.9499
60	86.38	2.0000	------
60	79.20	1.5000	------
60	84.67	------	2.0000
60	77.64	------	1.5000

DELIVERABILITY MULTIPLIER FACTORS

PAGE 2

P_d % of P_c	P_w % of P_c	Multiplier (Q x M = D) n = 0.75	n = 0.85
65	65	1.0000	1.0000
65	70	1.0977	1.1114
65	75	1.2315	1.2662
65	80	1.4254	1.4943
65	85	1.7326	1.8644
65	90	2.3019	2.5726
65	95	3.7967	4.5359
65	87.80	2.0000	------
65	81.47	1.5000	------
65	86.28	------	2.0000
65	80.10	------	1.5000
70	70	1.0000	1.0000
70	75	1.1219	1.1392
70	80	1.2985	1.3445
70	85	1.5784	1.6775
70	90	2.0971	2.3147
70	95	3.4588	4.0811
70	89.31	2.0000	------
70	83.85	1.5000	------
70	88.00	------	2.0000
70	82.67	------	1.5000
75	75	1.0000	1.0000
75	80	1.1574	1.1802
75	85	1.4069	1.4724
75	90	1.8692	2.0318
75	95	3.0830	3.5824
75	90.91	2.0000	------
75	86.33	1.5000	------
75	89.81	------	2.0000
75	85.35	------	1.5000
80	80	1.0000	1.0000
80	85	1.2155	1.2475
80	90	1.6149	1.7215
80	95	2.6636	3.0353
80	92.59	2.0000	------
80	88.90	1.5000	------
80	91.70	------	2.0000
80	88.13	------	1.5000

DELIVERABILITY MULTIPLIER FACTORS

PAGE 3

P_d % of P_c	P_w % of P_c	Multiplier (Q x M = D) n = 0.75	n = 0.85
85	85	1.0000	1.0000
85	90	1.3285	1.3798
85	95	2.1912	2.4328
85	94.33	2.0000	------
85	91.56	1.5000	------
85	93.66	------	2.0000
85	90.98	------	1.5000
90	90	1.0000	1.0000
90	95	1.6493	1.7631
90	96.16	2.0000	------
90	94.31	1.5000	------
90	95.71	------	2.0000
90	93.92	------	1.5000
95	95	1.0000	1.0000
95	98.05	2.0000	------
95	97.12	1.5000	------
95	97.82	------	2.0000
95	96.93	------	1.5000

Form 21-R5R (10-56

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company EPNG W.O. No.

Field Blanco NE Sec. 24-31-10

Lease Atlantic Well No. 2

Date 2-27-62 Time Status of Well Shut-in 11 days

Pay MV Top 5119 ft. Bottom 5760 ft. T.D. 5760 ft. Datum ft.

Tubing 2.375 Depth 5734 ft. B.H.C. ft. Plug or Pin Packer ft.

Casing 7 Depth 5075 ft. Perfs. open ft. Liner Tree Connection

Depth Feet	Pressure lbs. sq. in.	Pressure Gradient lbs. ft.
Lube	835	
1000	867	.032
2000	892	.025
3000	917	.025
5500	972	.022
5550	975	.060
5600	975	----
5650	977	.040
5712	985	.129

Casing Press. 836 D.W.T.

Tubing Press. 836 D.W.T.

Oil Level none ft.

Water Level ft.

Hours Shut In Flowing

Temp. 5712 Ft. 168 F.

Elevat. K.B. ft. Ground ft.

Last Test Date

Press. Last Test Psig

B.H.P. Change Days

Loss ss/day

Choke Size

Oil Bbls. /day

Water Bbls. /day

Total Bbls. /day

Orifice in. Line in.

Static (sp) Differential in.

Gas Sp. Gr. .685 T

Cu. ft. /day

GOR cu. ft. /Bbl.

Gl R cu. ft. /bbl.

PRODUCTIVITY INDEX - LBS. DAY LBS. DROP

Last Cumulative Production Present Cumulative Production Production Between Tests

Instrument: Humble Number 1222 Recovery Factor Bbls. point 4 Loss

Run By T. B. Grant Calibration No. 30862 Calculated By

Calculations and Remarks:

Calculated BHP = 984 psia

Form 23-85B (10-56

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company EPNG W.O. No.

Field Blanco NE Sec. 26-31-10

Lease Atlantic Well No. 6-A

Date 2-27-62 Time Status of Well Shut-in 8 days

Pay MV Top 4798 ft. Bottom 5492 ft. T.D. 5492 ft. Datum ft.

Tubing 2.375 Depth 5487 ft. B.H.C. ft. Plug or Pin Packer ft.

Casing 7 Depth 4700 ft. Perfs. open ft. Liner Tree Connection

Depth Feet	Pressure lbs. sq. in.	Pressure Gradient lbs. ft.
Lube	865	
1000	897	.032
2000	925	.028
3000	951	.026
5200	1007	.025
5300	1009	.020
5400	1021	.120
5438	1043	.579

Casing Press.	833	D.W.T.
Tubing Press.	867	D.W.T.
Oil Level		ft.
Water Level	5385 (Mud)	ft.
Hours Shut In	Flowing	
Temp. 5438 Ft.	171 F.	°F.
Elevation K.B.	ft. Ground	ft.
Last Test Date		
Press. Last Test		Psig
B.H.P. Change	es in	Days
Loss		es/day
Choke Size		
Oil Bbls./day		
Water Bbls./day		
Total Bbls./day		
Orifice	in. Line	in.
Static	es. Differential	in.
Gas Specific	.695 Ft	
Cu. ft./bbl.		
GOR		cu. ft./Bbl.
GPM		cu. ft./Bbl.

PRODUCTIVITY INDEX BBLS. DAY/LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument: Humble	Number 1222	Recovery Factor Bbls./pound Loss
Run by: T. B. Grant	Calibration No. 30862	Calculated by

Calculations and Remarks:

Calculated BHP = 1016 psia

Form 23-R6B (10-56

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company **EPNG** W.O. No.

Field **Blanco** **NE Sec. 34-31-10**

Lease **Atlantic** Well No. **7-B**

Date **2-27-62** Time Status of Well **Shut-in 8 days**

Pay **MV** Top **4672** ft. Bottom **5398** ft. T.D. **5455** ft. Datum ft.

Tubing **2.375** Depth **5405** ft. S.I.P.C. ft. Plug or Pkr. Packer ft.

Casing **7** Depth **4637** ft. Perfs. **open** ft. Liner Tree Connection

Depth Feet	Pressure lbs. sq. in.	Pressure	Gradient p.s.i.
Lube	863		
1000	893	.030	
2000	921	.028	
3000	948	.027	
5200	996	.022	
5298	1002	.061	

854
865
none

5298 165

.694

PRODUCTIVITY INDEX BBLS. DAY LBS. DROP

Last Cumulative Production	Present Cumulative Production	Present Rate Between Tests
		Reservoir Factor
Instrument **Humble**	Number **1222**	Rate Gauge Less
Run by **T. B. Grant**	Calibration No. **30862**	Calculated by

Calculations and Remarks:

Calculated BHP = 1011 psia

Form 23-85B (10-56)

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company EPNG W.O. No.

Field Blanco SW Sec. 28-30-6

Lease Barron Kidd Well No. 1-F-X

Date 2-27-62 Time Status of Well Shut-in 16 days

Pay MV Top 5074 ft. Bottom 5540 ft. T.D. 5667 ft. Datum ft.

Tubing 2.375 Depth 5555 ft. B.H.C. ft. Plug or Pin Packer ft.

Casing 5-1/2 Depth 5667 ft. Perfs 5074 - 5540 ft. Liner

Depth Feet	Pressure lbs. sq. in.	Pressure	Gradient lbs. ft.
Lube	903		
1000	932		.029
2000	957		.025
3000	984		.027
5480	1041		.023
5500	1043		.100
5520	1044		.050
5540	1044		----
5555	1053		.600

Casing Pressure 913

Tubing Pressure 907

Fluid Level none

Tool Depth 5550

5555 172

.643

GOR

PRODUCTIVITY INDEX BBLS. DAY LBS. DROP

Last Cumulative Production

Present Cumulative Production

Recovery Factor

Instrument Humble Number 1222

Run by T. B. Grant Calibration No. 30862

Calculations and Remarks:

Calculated BHP = 1057 psia

Form 23-85B (10-56)

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company **EPNG** W.O. No.

Field **Blanco** **NE Sec. 29-29-8**

Lease **Hughes** Well No. **8**

Date **2-26-62** Time Status of Well **Shut-in 10 days**

Pay **MV** Top **4608** ft. Bottom **5342** ft. P.B.D. **5365** ft. Datum ft.

Tubing **2.375** Depth **5348** ft. S.H.C. ft. Plug or Pkr Packer ft.

Casing **7** Depth **4575** ft. Perfs. **open hole** ft. Liner Tree Connection

Depth Feet	Pressure lbs. sq. in.	Pressure	Gradient
Lube	914		
1000	949	.035	
2000	983	.034	
3000	1013	.030	
5000	1071	.029	
5100	1074	.030	
5200	1075	.010	
5250	1077	.040	
5279	1080	.103	

921 D.W.T.

907 D.W.T.

none

5279 **150**

.690

PRODUCTIVITY INDEX - BBLS. DAY - LBS. DROP

Last Cumulative Production	Present Cumulative Production	Productivity Between Tests
		Recovery Factor BBLS. per # Loss
Instrument **Humble**	Number **1222**	
Run by **T. B. Grant**	Calibration No. **30862**	Calculated by

Calculations and Remarks:

Calculated BHP = 1078

Form 23-65R (10-56)

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company EPNG W.O. No.

Field Blanco SW Sec. 22-27-6

Lease Rincon Well No. 33

Date 3-2-62 Time Status of Well Shut-in 176 days

Pay MV Top 4793 ft. Bottom 5485 ft. T.D. 5520 ft. Datum ft.

Tubing 2.375 Depth 5495 ft. S.B.H.C. ft. Plug or Pin Packer ft.

Casing 7 Depth 4745 ft. Perfs. open ft. Liner

Depth Feet	Pressure lbs. sq. in.	Pressure	Gradient
Lube	551		
1000	572	.021	
2000	588	.016	
3000	610	.022	
4202	650	.033	
5000	858	.261	
5200	905	.235	
5400	962	.285	
5450	982	.400	
5495	999	.378	

Casing Press. 855

Tubing Press. 556

Oil Level 4120

Water Level 5450

Element 5495 153

PRODUCTIVITY INDEX (BBLS./DAY LBS. DROP)

Last Cumulative Production | Present Cumulative Production | Production Between Tests

Recovery Factor Bbls./Pound Loss

Instrument Humble Number 1222

Run by T. B. Grant Calibration No. 30862 Calculated by

Calculations and Remarks:

Calculated BHP = 1001 psia

Form 23-85R (10-58

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company **EPNG** W.O. No.

Field **Blanco** **NE Sec. 30-28-5**

Lease **San Juan Unit 28-5** Well No. **32**

Date **3-2-62** Time Status of Well **Shut-in 43 days**

Pay **MV** Top **5546** ft. Bottom **5718** ft. I.D. **5810** ft. Datum ft.

Tubing **2.375** Depth **5711** ft. W.H.C. ft. Packer or Pin Packer ft.

Casing **7.625** Depth **3634** ft. Perfs. **5546 - 5718** ft. Liner **3569-5807** **5-1/2"** Open Hole

Depth Feet	Pressure Lbs./sq. in.	Pressure Difference	Temperature °F
Lube	841		
1000	874	.033	
2000	902	.028	
3000	935	.033	
5200	1000	.030	
5400	1004	.020	
5600	1007	.015	
5628	1007	----	

Tubing Pressure **855** D.S.I.

Casing Pressure **846** D.S.I.

Liquid **None**

Gravity 5628 Ft. **158**

Gas Gravity **.711**

PRODUCTIVITY INDEX BBLS. DAY LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
		Recovery Factor Bbls. Gain / Loss

Instrument **Humble** Number **1222**

Run by **T. B. Grant** Calibration No. **30862** Calculated by

Calculations and Remarks:

Calculated BHP = 1015 psia (Piston)

Form 23-85R (10-56

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company EPNG W.O. No.

Field Blanco NE Sec. 31-28-5

Lease San Juan Unit 28-5 Well No. 51

Date 3-2-62 Time Status of Well Shut-in 42 days

Pay MV Top 5026 ft. Bottom 5502 ft. T.D. 5580 ft. Datum ft.

Tubing 2.375 Depth 5460 ft. B.H.C. ft. Plug or Pip ft. Packer ft.

Casing 7 Depth 3430 ft. Perfs. 5026 - 5502 (Liner) ft. Liner 3285-5578 4-1/2" Tree Connection

Depth Feet	Pressure lbs. sq. in.	Pressure	Gradient lbs. ft.
Lube	902		
1000	935	.033	
2000	968	.033	
3000	990	.022	
5200	1051	.028	
5240	1056	.125	

Casing Press.	908	D.W.T.
Tubing Press.	902	D.W.T.
Oil Level	none	ft.
Water Level		ft.
Hours Shut In	Flowing	
Temp. 5240 ft.	152 °F.	ft.
Elevation K.B.	ft. Ground	ft.
Last Test Date		
Press. Last Test		Psig
B.H.P. Change		Days
Loss		lbs. day
Choke Size		
Oil Bbls. day		
Water Bbls. day		
Total Bbls. day		
Orifice	Ps. Line	lbs.
Static	psi Differential	lbs.
Gas Sp. Gr. .702	ft.	
Cu. ft. day		
GOR		cu. ft. Bbl.
GLR		cu. ft. Bbl.

PRODUCTIVITY INDEX BBLS. DAY LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument Humble	Number 1222	Recovery Factor Bbls. pound Loss
Run by T. B. Grant	Calibration No. 30862	Calculated by

Calculations and Remarks:

Calculated BHP = 1065 psia

Form 23-85R (10-56

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company EPNG W.O. No.

Field Blanco SW Sec. 2-29-6

Lease San Juan Unit 29-6 Well No. 15

Date 3-1-62 Time Status of Well Shut-in 3 days

Pay MV Top 5213 ft. Bottom 5730 ft. I.D. 5730 ft. Datum ft.

Tubing 2.375 Depth 5663 ft. B.H.C. ft. Plug or Pin Packer ft.

Casing 7 Depth 5214 ft. Perfs. 5213 - 5730 ft. Liner Tree Connection

Depth Feet	Pressure lbs. sq. in.	Pressure	Gradient lbs. ft.
Lube	874		
1000	900	.026	
2000	929	.029	
3000	955	.026	
5300	1010	.024	
5500	1017	.035	
5610	1018	.009	
5630	1019	.050	
5650	1021	.100	
5663	1022	.077	

Casing Press. 882 D.W.T.

Tubing Press. 879 D.W.T.

Oil Level none ft.

Water Level ft.

Hours Shut In Flowing

Temp. 5663 Ft. 166 F. L.

Elevation K.B. ft. Ground ft.

Last Test Date

Press. Last Test Psig

B.H.P. Change in Days

Loss psi/day

Choke Size

Oil Bbls. /day

Water Bbls. /day

Total Bbls. /day

Orifice in. Line in.

Static psi Differential in.

Gas Sp. Gr. .667 Tr

Cu. ft. /day

GOR cu. ft. /Bbl.

GPR cu. ft. /Bbl.

PRODUCTIVITY INDEX BBLS. DAY/LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument Humble	Number 1222	Recovery Factor Bbls. pound Loss
Run by T. B. Grant	Calibration No. 30862	Calculated by

Calculations and Remarks:

Calculated BHP = 1031 psia

Form 23-85R (10-56

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company EPNG W.O. No.

Field Blanco NE Sec. 31-29-6

Lease San Juan Unit 29-6 Well No. 53-31

Date 2-26-62 Time Status of Well Shut-in 31 days

Pay MV Top 5034 ft. Bottom 5600 ft. T.D. 5649 ft. Datum ft.

Tubing 2.375 Depth 5567 ft. B.H.C. ft. Plug or Pin Packer ft.

Casing 5-1/2 Depth 5645 ft. Perfs. 5034 - 5600 ft. Liner Tree Connection

Depth Feet	Pressure lbs. sq. in.	Pressure	Gradient lbs. ft.
Lube	837		
1000	867	.030	
2000	898	.031	
5450	988	.026	
5500	991	.060	
5584	995	.024	

Casing Press.	858	D.W.T.
Tubing Press.	844	D.W.T.
Oil Level	none	ft.
Water Level		ft.
Hours Shut In	Flowing	
Temp. 5584 Ft.	152 °F.	°F.
Elevation K.B.	ft. Ground	ft.
Last Test Date		
Press. Last Test		Psig
B.H.P. Change	as of	Days
Loss		lbs./day
Choke Size		
Oil Bbls./day		
Water Bbls./day		
Total Bbls./day		
Orifice	or Line	in.
Static	or Differential	in.
Gas Sp. Gr. .649	Ft.	
Cu. ft./day		
GOR		cu. ft./Bbl.
GPR	x	cu. ft./Bbl.

PRODUCTIVITY INDEX BBLS. DAY LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument Humble	Number 1222	Recovery Factor Bbls. pound Loss
Run by T. B. Grant	Calibration No. 30862	Calculated by

Calculations and Remarks:

Calculated BHP = 999 psia

Form 23-85R (10-56

EL PASO NATURAL GAS COMPANY

BOTTOM HOLE PRESSURE REPORT

Company EPNG W.O. No.

Field Blanco SW Sec. 21-21-9

Lease Sunray Well No. 1-G

Date 2-28-62 Time Status of Well Shut-in 21 days

Pay MV Top 4800 ft. Bottom 5380 ft. T.D. ft. Datum ft.

Tubing 2.375 Depth 5356 ft. B.H.C. ft. Plug or Pin Packer ft.

Casing 7 Depth 4751 ft. Perfs. open ft. Liner Tree Connection

Depth Feet	Pressure lbs. sq. in.	Pressure	Gradient lbs. ft.
Lube	932		
1000	970		.380
2000	993		.023
5200	1043		.016
5300	1045		.020
5320	1046		.050
5340	1049		.150
5349	1057		.889

Casing Press.	922	D.W.T.
Tubing Press.	917	D.W.T.
Oil Level	none	ft.
Water Level		ft.
Hours Shut In	Flowing	
Temp. 5349	Ft. 171	T.
Elevation K.B.	ft. Ground	ft.
Last Test Date		
Press. Last Test		Psig
B.H.P. Change	lbs. in.	Days
Loss		lbs. day
Choke Size		
Oil BBls./Day		
Water Bbls./day		
Total Bbls./day		
Orifice	in. Line	in.
Static	Differential	in.
Gas Sp. Gr. .658	F	
Cu. ft./day		
GOR		cu. ft./Bbl.
GPR		cu. ft./M.C.F.

PRODUCTIVITY INDEX BBLS. DAY-LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument Humble	Number 1222	Recovery Factor Bbls. pound Loss
Run by T. B. Grant	Calibration No. 30862	Calculated by

Calculations and Remarks:

Calculated BHP = 1066 psia