PRESSURE DIFFERENCES BETWEEN SURVEYS
OCD-ORDERED PRESSURE SURVEYS JUNE 1987, NOVEMBER 1987 AND FEBRUARY 1988
GAVILAN - WEST PUERTO CHIQUITO
(FOR WELLS IN WHICH PRESSURES WERE MEASURED WITH BOTTOM HOLE PRESSURE GAUGES)

| | Meridian Hill Fed #1 | | | Mallon Johnson | | | Mallon Fisher | | | Mallon Howard 1-8 | | | Reading & Bates How. Fed. 43-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June 1987 | | | | 1223 | 1229 | 1229 | | | | | | | 1048 | 1065 | 1069 |
| November 1987 | | | | | | | 987 | 986 | 985 | | | | 783 | 796 | 800 |
| Difference | | | | | | | | | | | | | -265 | -269 | -269 |
| November 1987 | 940 | 953 | 960 | | | | | | | | | | 783 | 796 | 800 |
| February 1988 | 944 | 957 | 965 | | | | | | | 926 | 927 | 928 | 747 | 761 | 764 |
| Difference | +4 | +4 | +5 | | | | | | | | | | -36 | -35 | -36 |
| (June-Feb Diff.) | | | | | | | | | | | | | (-301) | (-304) | (-305) |

| | Mesa Grande Bearcat | | | Meridian Hill Fed 2-Y | | | Sun Boyt & Lola #1 | | | Sun Wildfire | | | Mobil B-37 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June 1987 | 1041* | 1057 | 1061 | 1114 | 1127 | 1131 | 856 | 877 | 880 | 1191 | 1182 | 1179 | 1034 | 1051 | 1055 |
| November 1987 | 768 | 782 | 787 | | | | 720 | 736 | 741 | 1028 | 1021 | 1017 | 772 | 783 | 787 |
| Difference | -273 | -275 | -274 | | | | -136 | -141 | -139 | -163 | -161 | -162 | -262 | -268 | -268 |
| November 1987 | 768 | 782 | 787 | | | | 720 | 736 | 741 | 1028 | 1021 | 1017 | 772 | 783 | 787 |
| February 1988 | 734 | 749 | 753 | | | | 750 | 768 | 773 | 972 | 965 | 961 | 734 | 745 | 748 |
| Difference | -34 | -33 | -34 | | | | +30 | +32 | +32 | -56 | -56 | -56 | -38 | -38 | -39 |
| (June-Feb Diff.) | (-307) | (-308) | (-308) | | | | (-106) | (-109) | (-107) | (-219) | (-217) | (-218) | (-300) | (-306) | (-307) |

| | B-M-G COU E-6 | | | B-M-G COU A-20 | | | B-M-G COU B-32 | | | B-M-G COU K-13 ** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June 1987 | 1172 | 1170 | 1169 | 1187 | 1191 | 1193 | 1190 | 1194 | 1197 | 1478 | | |
| November 1987 | 954 | 953 | 951 | 967 | 972 | 975 | 973 | 977 | 982 | 1482 | | |
| Difference | -218 | -217 | -218 | -220 | -219 | -218 | -217 | -217 | -215 | +4 | | |
| November 1987 | 954 | 953 | 951 | 967 | 972 | 975 | 973 | 977 | 982 | 1482 | | |
| February 1988 | 954 | 952 | 951 | 950 | 956 | 959 | 948 | 952 | 957 | 1440 | | |
| Difference | 0 | -1 | 0 | -17 | -16 | -16 | -25 | -25 | -25 | -42 | | |
| (June-Feb Diff.) | (-218) | (-218) | (-218) | (-237) | (-235) | (-234) | (-242) | (-242) | (-240) | (-38) | | |

| | Sun Loddy | | | | | | Sun High Adventure #1 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June 1987 | 1089 | 1066 | 1060 | 1089 | 1066 | 1060 | 1103 | 1072 | 1065 | 1103 | 1072 | 1065 |
| November 1987 | 840 | 824 | 817 | 892 | 876 | 869 | 820 | 799 | 789 | 894 | 873 | 863 |
| Difference | -249 | -242* | -243 | -197 | -190 | -191 | -283 | -273* | -276 | -209 | -199 | -202 |
| November 1987 | 840 | 824 | 817 | 892 | 876 | 869 | 820 | 799 | 789 | 894 | 873 | 863 |
| February 1988 | 803 | 786 | 779 | 803 | 786 | 779 | 775 | 753 | 745 | 775 | 753 | 745 |
| Difference | -37 | -38 | -38 | -89 | -90 | -90 | -45 | -46 | -44 | -119 | -120 | -118 |
| (June-Feb Diff.) | (-286) | (-280) | (-281) | (-286) | (-280) | (-281) | (-328) | (-319) | (-320) | (-328) | (-319) | (-320) |

* B-M-G best estimate (where values differ significantly).
** Not datum pressures.

# PRESSURES ADJUSTED TO DATUM OF +370' ABOVE SEA LEVEL
# FOR THE
# JUNE 1987, NOVEMBER 1987 AND FEBRUARY 1988
# OCD-ORDERED PRESSURE SURVEYS: GAVILAN - WEST PUERTO CHIQUITO

In this section are basic details of analyses showing conversion of measured pressures to datum of +370 feet above sea level.

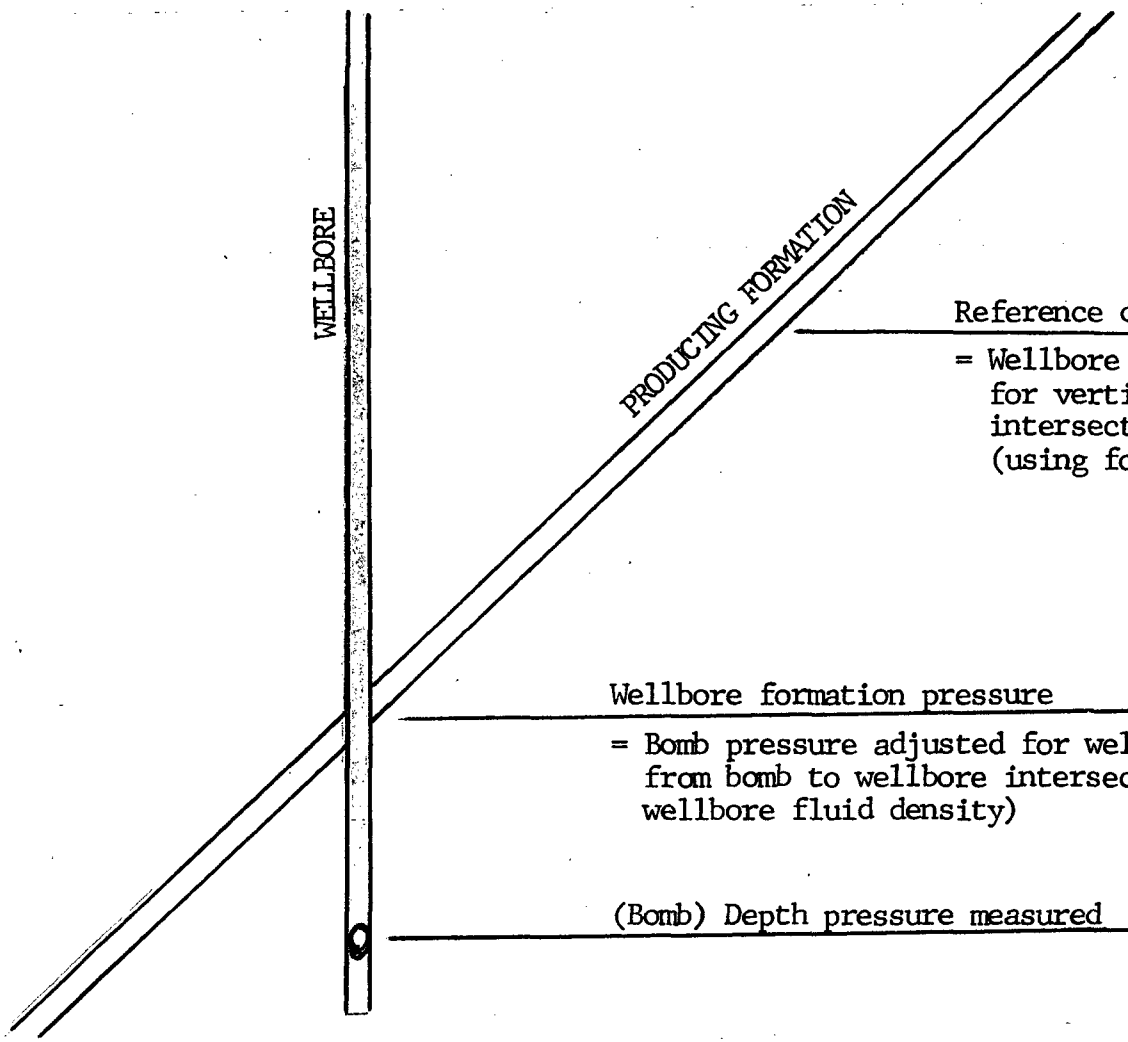
A pressure from the survey is selected near the depth of the top of the B zone; and this pressure corrected by wellbore fluid density to the top of the B zone. From this point the pressure is corrected to datum using the vertical distance from the wellbore intersection with formation (top of the B zone) to datum using formation fluid density as shown on the sketch on the facing page.

The reservoir density is unknown. Adjustments to datum were used employing three different reservoir densities:

1. Density of mobile fluids (GOR converted to formation temperatures and pressures).
2. B-M-G's best estimate for reservoir density based on pressure.
3. B-M-G's estimate of maximum reservoir density.

These reservoir densities are described on the next two pages.

ADJUSIMENT OF MEASURED WELLBORE
PRESSURES TO DATUM




Reference datum pressure

= Wellbore formation pressure adjusted for vertical distance from wellbore intersection with formation to datum (using formation fluid density)

Wellbore formation pressure

= Bomb pressure adjusted for wellbore vertical distance from bomb to wellbore intersection with formation (using wellbore fluid density)

(Bomb) Depth pressure measured

# RESERVOIR FLUID DENSITIES
## GAVILAN - WEST PUERTO CHIQUITO BOUNDARY AREA

In some reservoirs the density for adjusting pressures to datum is simply the density of the continuous non-wetting phase. For example the gas cap area in the Canada Ojitos Unit has a density of the gas down to the effective gas-oil contact. Below that, in some areas, the density is that of oil. The location of the gas-oil contact is unknown, so this complicates the analysis.

For Gavilan and the boundary area with West Puerto Chiquito, the problem is different; but still indefinite when the conditions are such that pressures are substantially below the bubble point and produced GOR's substantially above the solution GOR. For these times, which includes the OCC-ordered pressure surveys of June and November 1987 and February 1988, B-M-G estimated reservoir densities as shown herein.

The different reservoir fluid densities which B-M-G used in converting measured pressures to datum are shown on the graph on the facing page. The densities recommended by B-M-G are arbitrary estimates that might help in using the data. The main point to be made here, however, is that the densities are unknown - and recognition made of the possible attendant errors. The various densities are described below.

Upper curve:
This curve B-M-G believes would be the probable maximum density. This is the density which would occur if the reservoir were expanded from one pressure to the next ($V/V_{SAT}$ as given by reservoir fluid samples).

Lower solid line:
This is the density if the reservoir contained only gas (gas gradient).

Dotted curve:
This is the density for the approximate average GOR which has accompanied the corresponding pressure in Gavilan (density of mobile fluids). (The GOR is converted to density at reservoir conditions of temperature and pressure.)

Two dashed lines:
These are B-M-G's recommendation for use in converting pressures to datum until more precise information is available.

(One of the problems in estimating reservoir densities is that they probably are not uniform across the reservoir - particularly the top structure, high GOR wells in Gavilan, where the reservoir density will approach that of gas.)

PRESSURES ADJUSTED TO DATUM OF +370' ABOVE SEA LEVEL
FOR THE
JUNE 1987, NOVEMBER 1987 AND FEBRUARY 1988
OCD-ORDERED PRESSURE SURVEYS: GAVILAN - WEST PUERTO CHIQUITO
PAGE 2

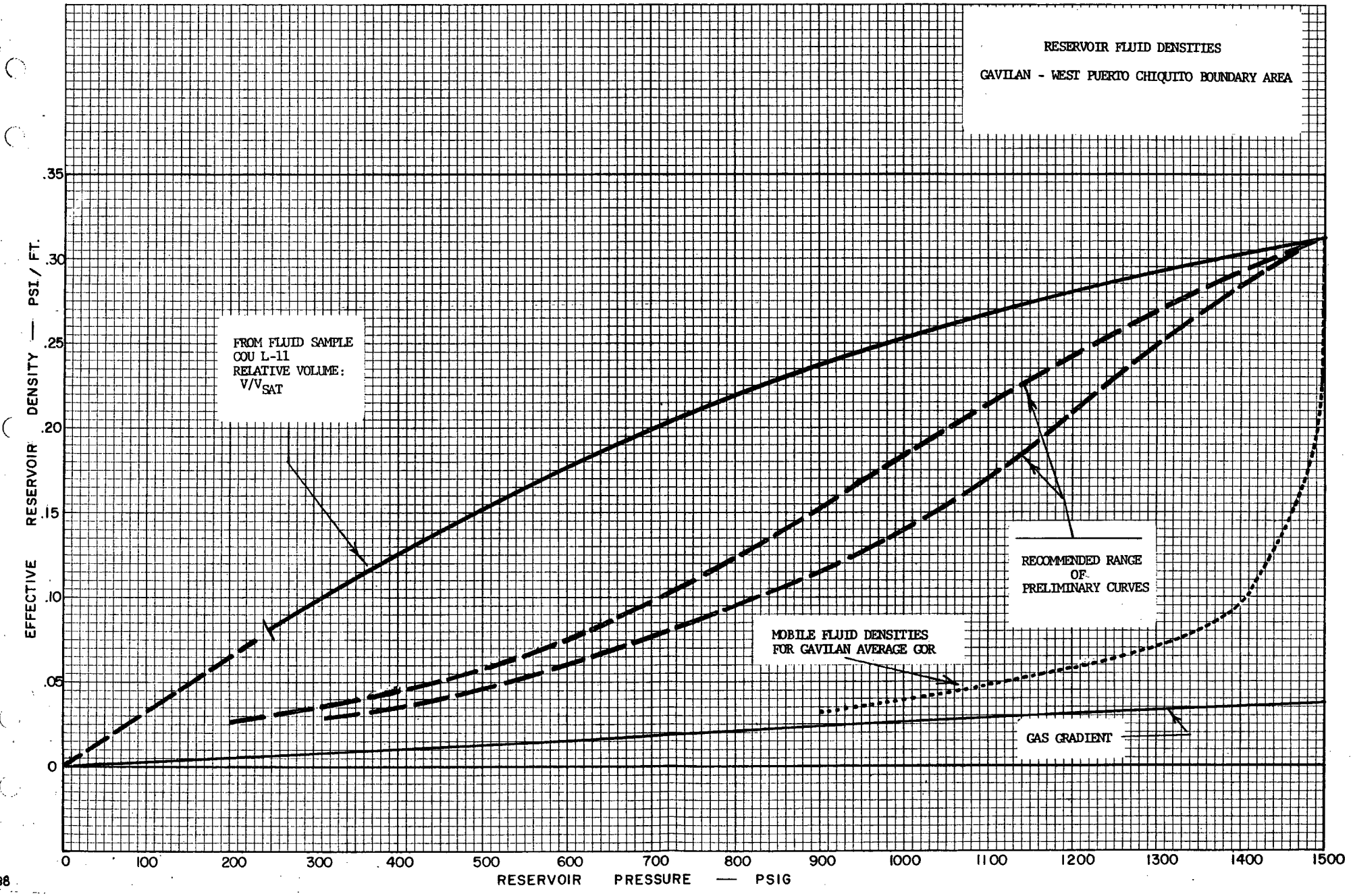
| | Mesa Grande Bearcat | | | Meridian Hill Fed. 2-Y | | | Merrion Krystina | Sun Boyt & Lola #1 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1) Elevation | | 7249 KB | | | 7467 KB | | 7314 KB | | 7351 KB | |
| 2) Depth to top B | | 6777 | | | 7013 | | 6769 | | 6848 | |
| 3) Depth of +370 datum | | 6879 | | | 7097 | | | | 6981 | |
| June, 1987 survey | | | | | | | | | | |
| 4) Gas-Oil Ratio (cf/bbl) | | 7800 | | | 3300 | | | | 3600 | |
| 5) Reference pressure | | 1034 | | | 1109 | | | | 847 | |
| 6) and depth | | 6750 | | | 7000 | | | | 6800 | |
| 7) Distance to B zone | | +27 | | | +13 | | | | +48 | |
| 8) Wellbore gradient | | .030 | | | .03 | | | | .020 | |
| 9) ΔP to B zone | | +1 | | | - | | | | +1.0 | |
| 10) B zone pressure | | 1035 | | | 1109 | | | | 848 | |
| 11) B zone to +370 (feet) | | +102 | | | 84 | | | | +133 | |
| 12) Reservoir density | .04 | .22 | .26 | .06 | .22 | .26 | | .06 | .22 | .24 |
| 13) ΔP to datum | +4 | +22 | +26 | +5 | +18 | +22 | | +8 | +29 | +32 |
| 14) Datum pressure | 1041 | 1057 | 1061 | 1114 | 1127 | 1131 | | 856 | 877 | 880 |
| November, 1987 survey | | | | | | | | | | |
| 15) Gas-Oil Ratio (cf/bbl) | | 8000 | | | | | | | 3600 | |
| 16) Reference pressure | | 765 | | | | | | | 698 | |
| 17) and depth | | 6770 | | | | | | | 6800 | |
| 18) Distance to B zone | | +7 | | | | | | | 48 | |
| 19) Wellbore gradient | | .025 | | | | | | | .32 | |
| 20) ΔP to B zone | | - | | | | | | | 15 | |
| 21) B zone pressure | | 765 | | | | | | | 713 | |
| 22) B zone to +370 (feet) | | +102 | | | | | | | +133 | |
| 23) Reservoir density | .03 | .17 | .22 | | | | | .05 | .17 | .21 |
| 24) ΔP to datum | +3 | +17 | +22 | | | | | +7 | +23 | +28 |
| 25) Datum pressure | 768 | 782 | 787 | | | | | 720 | 736 | 741 |
| February, 1988 survey | | | | | | | | | | |
| 26) Gas-Oil Ratio (cf/bbl) | | 43,000 | | | | | | | 3600 | |
| 27) Reference pressure | | 732 | | | | | | | 730 | |
| 28) and depth | | 6770 | | | | | | | 6800 | |
| 29) Distance to B zone | | +7 | | | | | | | 48 | |
| 30) Wellbore gradient | | .025 | | | | | | | .32 | |
| 31) ΔP to B zone | | - | | | | | | | 15 | |
| 32) B zone pressure | | 732 | | | | | | | 745 | |
| 33) B zone to +370 (feet) | | +102 | | | | | | | +133 | |
| 34) Reservoir density | .02 | .17 | .21 | | | | | .04 | .17 | .21 |
| 35) ΔP to datum | +2 | +17 | +21 | | | | | +5 | +23 | +28 |
| 36) Datum pressure | 734 | 749 | 753 | | | | | 750 | 768 | 773 |

Note regarding reservoir fluid densities: For each well on Lines 12, 23 and 34 are three different reservoir fluid densities. The lefthand column is for density equal to that of "mobile fluids" (GOR converted to reservoir conditions). The center column is B-M-G's estimate of probable density and the third column is B-M-G's estimate of probable maximum density.

PRESSURES ADJUSTED TO DATUM OF +370' ABOVE SEA LEVEL
FOR THE
JUNE 1987, NOVEMBER 1987 AND FEBRUARY 1988
OCD-ORDERED PRESSURE SURVEYS: GAVILAN - WEST PUERTO CHIQUITO

| | Meridian Hill Fed #1 | Mallon Johnson | Mallon Fisher | Mallon Howard 1-8 | Reading & Bates Howard Federal 43-15 |
|---|---|---|---|---|---|
| 1) Elevation | 7480 KB | 7430 KB | 7660 KB | 7523 KB | 7261 KB |
| 2) Depth to top B | 7017 | 7029 | 7307 | 7150 | 6799 |
| 3) Depth of +370 datum | 7110 | 7060 | 7290 | 7153 | 6891 |
| **June, 1987 survey** | | | | | |
| 4) Gas-Oil Ratio (cf/bbl) | | 27,000 | | | 83,000 |
| 5) Reference pressure | | 1429 | | | 1045 |
| 6) and depth | | 7611 | | | 6790 |
| 7) Distance to B zone | | -582 | | | +9 |
| 8) Wellbore gradient | | .355 | | | .030 |
| 9) Δ P to B zone | | -207 | | | +.27 |
| 10) B zone pressure | | 1222 | | | 1045 |
| 11) B zone to +370 (feet) | | +31 | | | +92 |
| 12) Reservoir density | .03 .22 .24 | | | | .03 .22 .26 |
| 13) Δ P to datum | +1 +7 +7 | | | | +3 +20 +24 |
| 14) Datum pressure | 1223 1229 1229 | | | | 1048 1065 1069 |
| **November, 1987 survey** | | | | | |
| 15) Gas-Oil Ratio (cf/bbl) | 33,000 | | 1,300 | | 52,000 |
| 16) Reference pressure | 936 | | 978 | | 780 |
| 17) and depth | 6955 | | 7275 | | 6793 |
| 18) Distance to B zone | +62 | | +32 | | +6 |
| 19) Wellbore gradient | .023 | | .34 | | .020 |
| 20) Δ P to B zone | +1.5 | | +11 | | - |
| 21) B zone pressure | 937.5 | | 989 | | 780 |
| 22) B zone to +370 (feet) | +93 | | -17 | | +92 |
| 23) Reservoir density | .03 .17 .25 | | .09 .17 .25 | | .03 .17 .22 |
| 24) Δ P to datum | +3 +15.8 +23 | | -2 -3 -4 | | +3 +16 +20 |
| 25) Datum pressure | 940 953 960 | | 987 986 985 | | 783 796 800 |
| **February, 1988 survey** | | | | | |
| 26) Gas-Oil Ratio (cf/bbl) | 72,000 | | | 12,000 | 71,000 |
| 27) Reference pressure | 940 | | | 909 | 739 |
| 28) and depth | 6955 | | | 7100 | 6500 |
| 29) Distance to B zone | +62 | | | +50 | +299 |
| 30) Wellbore gradient | .024 | | | .348 | .02 |
| 31) Δ P to B zone | +1.5 | | | 17.4 | +6 |
| 32) B zone pressure | 941.5 | | | 926.4 | 745 |
| 33) B zone to +370 (feet) | +93 | | | +3 | +92 |
| 34) Reservoir density | .02 .17 .25 | | | .02 .17 .24 | .02 .17 .21 |
| 35) Δ P to datum | +2 +15.8 +23 | | | +0 +0.5 +1 | +2 +16 +19 |
| 36) Datum pressure | 944 957 965 | | | 926 927 928 | 747 761 764 |

Note regarding reservoir fluid densities: For each well on Lines 12, 23 and 34 are three different reservoir fluid densities. The lefthand column is for density equal to that of "mobile fluids" (GOR converted to reservoir conditions). The center column is B-M-G's estimate of probable density and the third column is B-M-G's estimate of probable maximum density.


RESERVOIR FLUID DENSITIES
GAVILAN - WEST PUERTO CHIQUITO BOUNDARY AREA
EFFECTIVE RESERVOIR DENSITY — PSI / FT.
.35
.30
.25
.20
.15
.10
.05
0
FROM FLUID SAMPLE
COU L-11
RELATIVE VOLUME:
V/V$_{SAT}$
RECOMMENDED RANGE
OF
PRELIMINARY CURVES
MOBILE FLUID DENSITIES
FOR GAVILAN AVERAGE GOR
GAS GRADIENT
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
RESERVOIR PRESSURE — PSIG

PRESSURES ADJUSTED TO DATUM OF +370' ABOVE SEA LEVEL
FOR THE
JUNE 1987, NOVEMBER 1987 AND FEBRUARY 1988
OCD-ORDERED PRESSURE SURVEYS: GAVILAN - WEST PUERTO CHIQUITO


| | Sun Wildfire * | Mobil B-37 | B-M-G COU E-6 | B-M-G COU A-20 | B-M-G COU B-32 |
|---|---|---|---|---|---|
| 1) Elevation | 7727 | 7134 KB | 7493 GL | 7432 GL | 7599 GL |
| 2) Depth to to B | 7408 | 6683 KB | 7136 GL | 7026 GL | 7178 GL |
| 3) Depth of +370 | 7357 | 6764 KB | 7123 GL | 7062 GL | 7229 GL |
| **June, 1987 survey** | | | | | |
| 4) Gas-Oil Ratio (cf/bbl) | (NR) | 8100 | 4400 | 1500 | 880 |
| 5) Reference pressure | 1191 | 1031 | 1169 | 1179.5 | 1181 |
| 6) and depth | 7400 | 6608 (GL?) | 7065 GL | 6954 GL | 7104 GL |
| 7) Distance to B zone | +8 | +83 | +71 | +72 | +74 |
| 8) Wellbore gradient | .32 | .03 | .03 & .32 | .03 & .32 | .03 |
| 9) Δ P to B zone | +2 | +2 | +4 | +3.5 | +2 |
| 10) B zone pressure | 1193 | 1031 | 1173 | 1183 | 1183 |
| 11) B zone to +370 (feet) | -51 | +81 | -13 | +36 | +51 |
| 12) Reservoir density | .04 .22 .27 | .04 .22 .27 | .05 .22 .28 | .10 .22 .28 | .14 .22 .28 |
| 13) Δ P to datum | -2 -11 -14 | +3 +18 +22 | -1 -3 -4 | +4 +8 +10 | +7 +11 +14 |
| 14) Datum pressure | 1191 1182 1179 | 1034 1051 1055 | 1172 1170 1169 | 1187 1191 1193 | 1190 1194 1197 |
| **November, 1987 survey** | | | | | |
| 15) Gas-Oil Ratio (cf/bbl) | (NR) | 4100 | 4500 | 5000 | 1250 |
| 16) Reference pressure | 1028 | 767 | 966 psia | 964.7 | 981.5 psia |
| 17) and depth | 7400 | 6600 GL, 6614 KB | 7125 | 6954 | 7290 |
| 18) Distance to B zone | +8 | +69 | +11 | +72 | -112 |
| 19) Wellbore gradient | .32 | .022 | .022 | .022 | .022 |
| 20) Δ P to B zone | +2 | +2 | - | +1.6 | -2.4 |
| 21) B zone pressure | 1030 | 769 | 955 psig | 966 | 968 psig |
| 22) B zone to +370 (feet) | -51 | +81 | -13 | +36 | +51 |
| 23) Reservoir density | .04 .17 .26 | .04 .17 .22 | .04 .17 .24 | .04 .17 .24 | .10 .17 .27 |
| 24) Δ P to datum | -2 -9 -13 | +3 +14 +18 | -1 -2 -4 | +1 +6 +9 | +5 +9 +14 |
| 25) Datum pressure | 1028 1021 1017 | 772 783 787 | 954 953 951 | 967 972 975 | 973 977 982 |
| **February, 1988 survey** | | | | | |
| 26) Gas-Oil Ratio (cf/bbl) | (NR) | 4100 | 5000 | 7500 | 1200 |
| 27) Reference pressure | 972 | 730 | 952.2 | 947.8 | 940.5 |
| 28) and depth | 7400 | 6680 KB | 7065 | 6954 | 7090 |
| 29) Distance to B zone | +8 | +3 | +71 | +72 | +88 |
| 30) Wellbore gradient | .32 | .32 | .024 | .024 | .024 |
| 31) Δ P to B zone | +2 | 1 | +1.7 | +1.6 | +2.4 |
| 32) B zone pressure | 974 | 731 | 954 | 949.4 | 942.9 |
| 33) B zone to +370 (feet) | -51 | +81 | -13 | +36 | +51 |
| 34) Reservoir density | .03 .17 .25 | .04 .17 .21 | .04 .17 .25 | .03 .17 .25 | .10 .17 .27 |
| 35) Δ P to datum | -2 -9 -13 | +3 +14 +17 | -0 -2 -3 | +1 +6.1 +9 | +5 +8.7 +14 |
| 36) Datum pressure | 972 965 961 | 734 745 748 | 954 952 951 | 950 956 959 | 948 952 957 |

Note regarding reservoir fluid densities: For each well on Lines 12, 23 and 34 are three different reservoir fluid densities. The lefthand column is for density equal to that of "mobile fluids" (GOR converted to reservoir conditions). The center column is B-M-G's estimate of probable density and the third column is B-M-G's estimate of probable maximum density.

* No pressure reported for Sun #1 Wildfire. Resrvoir mobile fluid densities for Loddy #1 used here.

PRESSURES ADJUSTED TO DATUM OF +370' ABOVE SEA LEVEL
FOR THE
JUNE 1987, NOVEMBER 1987 AND FEBRUARY 1988
OCD-ORDERED PRESSURE SURVEYS: GAVILAN - WEST PUERTO CHIQUITO
PAGE 4

| | Sun Loddy | | | | | | | Sun High Adventure #1 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1) Elevation | | | | 7167 KB | | | | | | | 7330 KB | | | |
| 2) Depth to to B | | | | 6922 | | | | | | | 7150 | | | |
| 3) Depth of +370 | | | | 6797 | | | | | | | 6960 | | | |
| June, 1987 survey | | | | | | | | | | | | | | |
| 4) Gas-Oil Ratio (cf/bbl) | | | | 7500 | | | | | | | 3600 | | | |
| 5) Reference pressure | | | | 1094 | | | | | | | 1099.5 | | | |
| 6) and depth | | | | 6900 | | | | | | | 7107 | | | |
| 7) Distance to B zone | | | | 22 | | | | | | | +43 | | | |
| 8) Wellbore gradient | | | | .024 | | | | | | | .32 | | | |
| 9) ΔP to B zone | | | | - | | | | | | | +14 | | | |
| 10) B zone pressure | | | | 1094 | | | | | | | 1114 | | | |
| 11) B zone to +370 (feet) | | | | -125 | | | | | | | -190 | | | |
| 12) Reservoir density | | | .04 | .22 | .27 | | | | | .06 | .22 | .26 | | |
| 13) ΔP to datum | | | -5 | -28 | -34 | | | | | -11 | -42 | -49 | | |
| 14) Datum pressure | | | 1089 | 1066 | 1060 | | | | | 1103 | 1072 | 1065 | | |
| November, 1987 survey | | | | | | | | | | | | | | |
| 15) Gas-Oil Ratio (cf/bbl) | | | | 5100 | | | | | | | 2500 | | | |
| 16) Reference pressure | | | | 902 | | | | | | | 911 | | | |
| 17) and depth | | | | 7100 | | | | | | | 7400 | | | |
| 18) Distance to B zone | | | | -178 | | | | | | | -250 | | | |
| 19) Wellbore gradient | | .32** | | | .025** | | | | .32** | | | .025** | | |
| 20) ΔP to B zone | | -57 | | | -5 | | | | -80 | | | -6 | | |
| 21) B zone pressure | | 845 | | | 897 | | | | 831 | | | 905 | | |
| 22) B zone to +370 (feet) | | -125 | | | -125 | | | | -190 | | | -190 | | |
| 23) Reservoir density | .04 | .17 | .22 | | .04 | .17 | .22 | .06 | .17 | .22 | | .06 | .17 | .22 |
| 24) ΔP to datum | -5 | -21 | -28 | | -5 | -21 | -28 | -11 | -32 | -42 | | -11 | -32 | -42 |
| 25) Datum pressure | 840 | 824* | 817 | | 892 | 876 | 869 | 820 | 799* | 789 | | 894 | 873 | 863 |
| February, 1988 survey | | | | | | | | | | | | | | |
| 26) Gas-Oil Ratio (cf/bbl) | | | | 7000 | | | | | | | 2500 | | | |
| 27) Reference pressure | | | | 807 | | | | | | | 820 | | | |
| 28) and depth | | | | 6900 | | | | | | | 7200 | | | |
| 29) Distance to B zone | | | | +22 | | | | | | | -50 | | | |
| 30) Wellbore gradient | | | | .02 | | | | | | | .3 | | | |
| 31) ΔP to B zone | | | | .4 | | | | | | | -15 | | | |
| 32) B zone pressure | | | | 807 | | | | | | | 785 | | | |
| 33) B zone to +370 (feet) | | | | -125 | | | | | | | -190 | | | |
| 34) Reservoir density | | | .03 | .17 | .22 | | | | | .05 | .17 | .21 | | |
| 35) ΔP to datum | | | -4 | -21 | -28 | | | | | -10 | -32 | -40 | | |
| 36) Datum pressure | | | 803 | 786 | 779 | | | | | 775 | 753 | 745 | | |

* B-M-G's estimate of best pressure (where values differ significantly).
** Wellbore gradient not available. Pressures estimate for conditions of all gas and all oil.

Note regarding reservoir fluid densities: For each well on Lines 12, 23 and 34 are three different reservoir fluid densities. The lefthand column is for density equal to that of "mobile fluids" (GOR converted to reservoir conditions). The center column is B-M-G's estimate of probable density and the third column is B-M-G's estimate of probable maximum density.

PRESSURES ADJUSTED TO DATUM OF +370' ABOVE SEA LEVEL
FOR THE
JUNE 1987, NOVEMBER 1987 AND FEBRUARY 1988
OCD-ORDERED PRESSURE SURVEYS: GAVILAN - WEST PUERTO CHIQUITO
PAGE 5

| | B-M-G COU K-13 | B-M-G COU L-27 |
|---|---|---|
| 1) Elevation | | |
| 2) Depth to top B | | |
| 3) Depth of +370 datum | | |
| June, 1987 survey | | |
| 4) Gas-Oil Ratio (cf/bbl) | | |
| 5) Reference pressure | 1478 | |
| 6) and depth | 5850 | |
| 7) Distance to B zone | | |
| 8) Wellbore gradient | | |
| 9) Δ P to B zone | | |
| 10) B zone pressure | | |
| 11) B zone to +370 (feet) | | |
| 12) Reservoir density | | |
| 13) Δ P to datum | | |
| 14) Datum pressure | | |
| November, 1987 survey | | |
| 15) Gas-Oil Ratio (cf/bbl) | | |
| 16) Reference pressure | 1482 | 1388 |
| 17) and depth | 5850 | 6810 |
| 18) Distance to B zone | | |
| 19) Wellbore gradient | | |
| 20) Δ P to B zone | | |
| 21) B zone pressure | | |
| 22) B zone to +370 (feet) | | |
| 23) Reservoir density | | |
| 24) Δ P to datum | | |
| 25) Datum pressure | | |
| February, 1988 survey | | |
| 26) Gas-Oil Ratio (cf/bbl) | | |
| 27) Reference pressure | 1440 | |
| 28) and depth | 5850 | |
| 29) Distance to B zone | | |
| 30) Wellbore gradient | | |
| 31) Δ P to B zone | | |
| 32) B zone pressure | | |
| 33) B zone to +370 (feet) | | |
| 34) Reservoir density | | |
| 35) Δ P to datum | | |
| 36) Datum pressure | | |

Note regarding reservoir fluid densities: For each well on Lines 12, 23 and 34 are three different reservoir fluid densities. The lefthand column is for density equal to that of "mobile fluids" (GOR converted to reservoir conditions). The center column is B-M-G's estimate of probable density and the third column is B-M-G's estimate of probable maximum density.

## PRESSURE DIFFERENCES BETWEEN SURVEYS

Pressure differences between surveys are shown on the schedule on the facing page.

The reduction of errors by using pressure declines in a given well for analysis, rather than absolute pressures can be seen, for example, in the figures for the Mesa Grande Bearcat in which a 20 psi difference exists for a given survey as a consequence of the different estimated reservoir densities. Yet the difference, from one survey to the next, is nearly the same. (June to November, 1 psi difference in decline.)

# PRESSURE INFORMATION
# FROM OIL CONSERVATION DIVISION ORDERED PRESSURE SURVEYS
# OF
# JULY 1987, NOVEMBER 1987 AND FEBRUARY 1988

The most useful data gathered from the pressure surveys is that of pressure decline in an individual well; and this compared with pressure declines in other wells.

Absolute pressures measured are useful only in a general sense - and certainly cannot be used for estimating pressure gradients horizontally across the reservoir except for large pressure differences and interpretations made in a general fashion.

The reasons for this are the inherent errors described in Case 9111, B-M-G Exhibit 1, Section G, Pages 6 and 7, and summarized below:

1. Error of bomb calibration.
2. Error of hole deviation.
3. Error of depth as shown by wireline.
4. Error of surface elevation.
5. Error of density of reservoir fluids.

If the same pressure measuring equipment is used on the same wells from one survey to the next, then the first four of the above errors are eliminated; and there is only the differences in stabilization and change in density of reservoir fluids from one survey to the next to cause an error in the pressure decline measured from one survey to the next.

As to these two matters: stabilization and reservoir fluid densities, the errors from these sources are also minimized where the pressure difference in a well from one period to the next is used, rather than comparing pressures across the reservoir. The reason that stabilization errors are minimized is that - comparing the same shut-in time for both surveys - the error is not the total difference in the measured pressure and the stabilized pressure, but the difference in stabilization in the same well from one survey compared to the next. By the same token, even though reservoir densities might vary substantially throughout the field, the change in reservoir density at one well location from one survey to the next is probably minimal.

Although large pressure differences exist across the reservoir, the pressure declines within certain identified areas were quite consistent. The different decline rates for the different areas appear to be the consequence of external pressure support. These pressure declines, summarized by well groups, are set out on the following page. Wells listed are those that were surveyed in all three survey periods using bottom hole pressure gauges for measurement of pressures.

## INDIVIDUAL WELL PRESSURE DECLINES BETWEEN SURVEYS

| | June-Nov | Nov-Feb | June-Feb |
|---|---|---|---|
| **Gavilan (Central)** | | | |
| Mobil Unit B-37 | -268 | -38 | -306 |
| Howard Federal 43-15 | -269 | -35 | -304 |
| Bearcat | -275 | -33 | -308 |
| High Adventure #1 | -273 | -46 | -319 |
| Average | -271 | -38 | -309 |
| (Psi/Month) | (60) | (13) | |
| **Gavilan (Outer)** | | | |
| Wildfire | -161 | -56 | -217 |
| Loddy | -242 | -38 | -280 |
| Average | -201 | -47 | -248 |
| (Psi/Month) | (45) | (10) | |
| West Puerto Chiquito / Canada Ojitos Unit Exp. Area | | | |
| COU E-6 | -217 | -1 | -218 |
| COU A-20 | -219 | -16 | -235 |
| COU B-32 | -217 | -25 | -242 |
| Average | -218 | -25* | -232 |
| (Psi/Month) | (48) | (8) | |

The June to February pressure declines are shown by areas on the plat next following.

* Small pressure declines are impossible to measure accurately. Pressure decline shown here is that for the B-32, the most representative high capacity well in the group.

# PRESSURE INFORMATION
# FROM OIL CONSERVATION DIVISION ORDERED PRESSURE SURVEYS
# OF
# JULY 1987, NOVEMBER 1987 AND FEBRUARY 1988

## LOW PRODUCTION RATES ARE MORE EFFICIENT FOR THE CANADA OJITOS UNIT

Information from the subject surveys is most useful in analyses involving pressure decline (as opposed to absolute pressures). The test period from July to November resulted in a large enough pressure decline to be definitive. The test period from November 1987 to March 1988 was too short and pressure declines too small to assess behavior in all wells as accurately as might be desired for conclusive answers; however this survey data, along with supplementary information, points to more efficient recovery from the Canada Ojitos Unit of the West Puerto Chiquito Pool when produced at low rates as opposed to high rates.

As shown on the facing page, the recovery coefficient for the proposed expansion area of the Canada Ojitos Unit in terms of stock tank barrels of oil recovered per pound of reservoir pressure decline, is higher for production rates under the current allowable as compared to the high production rates of the last half of 1987.

On the following pages are summaries and details of the pressure surveys, along with information that points out the virtue of using pressure declines for analyses as opposed to absolute pressures because of the inherent errors of the absolute pressures.

COMPARISON OF
OIL RECOVERY EFFICIENCY
CANADA OJITOS UNIT PROPOSED EXPANSION AREA
FOR PERIOD OF HIGH PRODUCTION RATE (JULY TO NOVEMBER 1987)
WITH
PERIOD OF CURRENT ALLOWABLE (NOVEMBER 1987 TO FEBRUARY 1988)

| Test | Period | Oil Production (Bbls) | From Survey | |
|---|---|---|---|---|
| | | | Pressure Decline | Recovery Coefficient (Bbl/#) |
| High Allowable | July - Nov. 1987 | 389,115 | 218 | 1800* |
| Current Allowable | Nov. - Feb. 1988 | 124,526 | 25** | 5000** |

* Average for test period. Coefficient for last part of period increased ± 40%, believed due to pressure maintenance project: greater support at greater pressure differential.

** Small pressure declines are impossible to measure accurately. Pressure decline shown here is that for the B-32, the most representative high capacity well in the group.

Production statistics for the above schedule are shown on the last page in this section.

PROPOSED EXPANSION AREA CANADA OJITOS UNIT
OIL PRODUCTION BETWEEN OIL CONSERVATION DIVISION ORDERED PRESSURE SURVEYS
JULY TO NOVEMBER 1987
AND
NOVEMBER 1987 TO FEBRUARY 1988

| | B-32 | K-8 | B-29 | E-6 | F-30 | N-31 | J-6 | F-18 | F-19 | A-20 | G-5 | F-7 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | JULY THROUGH NOVEMBER 16, 1987 | | | | | | | | | | | | |
| July 1987 | 12938 | 240 | 18104 | 7820 | 10155 | 5288 | 0 | 3830 | 1935 | 128 | 0 | 0 | 60438 |
| August 1987 | 19297 | 19 | 20912 | 11180 | 11599 | 5912 | 1901 | 9806 | 2172 | 1082 | 0 | 0 | 83880 |
| September 1987 | 26922 | 40 | 31439 | 12518 | 12204 | 5592 | 1397 | 9433 | 1346 | 1309 | 1873 | 0 | 104073 |
| October 1987 | 23844 | 0 | 30767 | 9714 | 10332 | 4935 | 128 | 11100 | 136 | 155 | 3058 | 0 | 94169 |
| November 1987 | 10554 | 0 | 15685 | 3949 | 5060 | 1870 | 257 | 4853 | 673 | 526 | 3128 | 0 | 46555 |
| Total | 93555 | 299 | 116907 | 45181 | 49350 | 23597 | 3683 | 39022 | 6262 | 3200 | 8059 | 0 | 389115 |
| | NOVEMBER 16 THROUGH FEBRUARY 19, 1988 | | | | | | | | | | | | |
| November 1987 | 1327 | 0 | 1296 | 0 | 638 | 0 | 0 | 151 | 57 | 0 | 182 | 0 | 3651 |
| December 1987 | 10257 | 76 | 16481 | 2324 | 9502 | 1402 | 293 | 9732 | 631 | 679 | 3084 | 0 | 54461 |
| January 1988 | 14229 | 77 | 0 | 1991 | 8228 | 0 | 198 | 9335 | 213 | 1368 | 4952 | 481 | 41072 |
| February 1988 | 10322 | 27 | 2927 | 0 | 5074 | 0 | 0 | 4586 | 0 | 116 | 2290 | 0 | 25342 |
| Total | 36135 | 180 | 20704 | 4315 | 23442 | 1402 | 491 | 23804 | 901 | 2163 | 10508 | 481 | 124526 |
| Nov. C-115 | 11881 | 0 | 16981 | 3949 | 5698 | 1870 | 257 | 5004 | 730 | 526 | 3310 | 0 | 50206 |
| Nov. field gauges | 12320 | 0 | 17710 | 4063 | 5761 | 2035 | 149 | 5469 | 712 | 585 | 3397 | 0 | 52201 |
| Nov. 20-31 | 1376 | 0 | 1352 | 0 | 664 | 0 | 0 | 165 | 56 | 0 | 187 | 0 | 3800 |
| Nov. 20-31 adjested | 1327 | 0 | 1296 | 0 | 638 | 0 | 0 | 151 | 57 | 0 | 182 | 0 | 3651 |
| Nov. C-115 | 11881 | 0 | 16981 | 3949 | 5698 | 1870 | 257 | 5004 | 730 | 526 | 3310 | 0 | 50206 |
| Less 20-31 prod. | 1327 | 0 | 1296 | 0 | 638 | 0 | 0 | 151 | 57 | 0 | 182 | 0 | 3651 |
| | 10554 | 0 | 15685 | 3949 | 5060 | 1870 | 257 | 4853 | 673 | 526 | 3128 | 0 | 46555 |
| Feb. C-115 | 17128 | 44 | 8868 | 0 | 8583 | 0 | 0 | 7173 | 0 | 116 | 3289 | 0 | 45201 |
| Feb. field gauges | 17497 | 42 | 9435 | 0 | 8701 | 0 | 0 | 7323 | 0 | 133 | 3383 | 0 | 46514 |
| Feb. 1-16 | 10544 | 26 | 3114 | 0 | 5144 | 0 | 0 | 4682 | 0 | 133 | 2355 | 0 | 25998 |
| Feb. 1-16 adjusted | 10322 | 27 | 2927 | 0 | 5074 | 0 | 0 | 4586 | 0 | 116 | 2290 | 0 | 25342 |