Analysis of Testing Data for Oil, Gas, and Multi-Phase Wells

Otis P. Armstrong P.E. Sept 2007 www.oiljetpump.com.

Abstract

Calculation of oil, gas, and multiphase well performance by two spreadsheets are described here-in. Excel file "welltesting-oil.xls" relates to evaluation of oil formations and the file "welltesting-gas.xls" relates to evaluation of gas, gas condensate and multiphase formations. It is suggested user save (rename) a project copy of each file prior to data input. The calculation objectives are:

- Determine well performance by "Skin Factor, S;" and well flow effiency;
- Resolve Formation permeability k, millidarcy,
- Estimate Well productivity factor J, expressed as either BPD/dPsi or mSCFD/dPsi
- Analyze Drillstem Tests and Wireline Formation tests,
- Assess results of Build-up (shut-in) or Drawdown, (flow) tests.
- use above and Geometric factors to calculate, J, BPD/dPsi, or impact there on.

Also detailed are routines for evaluation of:

- Initial hydrocarbon pore volume,
- Future productivity estimate, and
- Validate well tests by "radius of investigation" and "well bore storage".

Each spreadsheet procedure is validated by reference calculations, which user should review, but calculation limitations are reviewed here-in. One or more reference calculation is found on each sheet. These *.xls solutions can also estimate physical properties with a minimal input and allow evolution of values, if such details are available.

Background

These codes were developed in reply to questions on how to determine well productivity factor., J, and guides user on data requirements. The J factor can be calculated using formation permeability and well bore skin factor or directly evaluated. These spreadsheets also provide a baseline of initial hydrocarbon pore volume for future comparison. Evaluation of a hydrocarbon deposit may involve several man-years of assessment, for which commercial codes are available. At initial production stage, available data may be insufficient to accurately use such routines. For mature production, statistical decline analysis will not evaluate possible productivity gains available from well stimulation, nor EOR operations. On the other hand, well test results are useful guides for: planning future work, determining data collection requirements, and optimization of field operations.

Application

Well testing is classified on two broad category, 1) infinite acting and 2) uniform rate of pressure decrease or psuedo steady state, which happens after passage of the infinite acting period. In the first instance testing is concerned with external pressure and in the later instance the test is concerned with average pressure. Skin factor is found only after a determination is made of wellbore storage effect. The evaluation of infinite action is based on the absence of boundary effects. A general method of looking at these criteria is to plot bottom hole pressure as y and log of time for flowing test and log of Horner time for shut in tests and identify inflection points. The inflection points typically denote changes in flow regime, Early time; wellbore effects, Middle time; ideal for permeability determination, Late time; on-set of boundary effects.

For gas well shut-in tests, three Horner pressure build up options are:

- real gas potential, valid for any pressure range
- pressure squared, typically valid pressures below 2000psi
- simple pressure, typically valid pressures above 3000psi

Additional guidelines are provided for application of each method in spreadsheet user notes.

For gas well deliverability flow testing the available options are:

- Empirical method, with routine for estimation of stabilized deliverability coefficient
- Theoretical method with Isochronical flow test
- Theoretical method with modified Isochronical flow test.

The problem of superposition is an important aspect of pressure buildup testing. The Horner approximation is to calculate producing time based on "cumulative production/most recent production rate" when the ratio (dt_last)/(dt_next to last) exceeds 2, the Horner producing time is considered valid for evaluating well performance by pressure build-up, Lee pg19. In the event this selection criteria is not meet, then plotting by the more complicated superposition method is required.

Lee[10] points out that when gas wells can be evaluated by the simple pressure plots, it is useful to express flow in mSCFD and Bg in RB/mSCF, then interpretation follows the generic model of oil wells, with calculation of flow effiency and psuedo skin.

Summary

The following is a basic summary of equations used in evaluation

Property		Buildup- Shut in Well	Drawdown-Well Flowing
kH		$162.6Q_o\mu_oB_o/m$	$162.6\mu_oB_o/b$
A		$\log(k/(\Phi^*\mu_o^*C_t^*R_w^2)$ or use Pirson Approx.	$\log(k/(\Phi^*\mu_o^*C_t^*R_w^2))$ or Pirson Approx
Skin, S		$1.15(\{(P_1-P_{wf})/m\} - A+3.23)$	1.15(a/b - A + 3.23)
dP Skin		0.87m(skin)	0.87Q(b)(skin)
effiency		$(P_e- P_{wf}- dP_{skin})/(P_e- P_{wf})$	$(P^*- P_{wf}- dP_{skin})/(P^*- P_{wf})$
Phy Prop's		$(P_e+P_{wf})/2$	$(P\_{initial})$
Slope		m ~ Regressed slope[(P-Pwf) vs Log(H_t)]	b ~ Regr(P*-Pwf)/Q vs Log(H_t)
Intercept		P_e	P*/Q

The following two tables describe what routines are executed in each file and sheet there-of.

File	Sheet	Objective
welltest_gas_L.xls	basic	determine equivalent for J & skin. Input Physical[11, 12] prop'ty 1st
welltest_gas_L.xls	GasMbal	Calcs related to gas well testing* & reserve calc P/Z method, closed
welltest_gas_L.xls	HorngazP	k , skin, well flow eff. from Horner Pressure build data
welltest_gas_L.xls	H_WGO_P	Horner eval of simultaneous water, gas, and oil flows [10p102-3]
welltest_gas_L.xls	H_Gz_PP	Horner Gas Eval by the pressure squared method
welltest_gas_L.xls	H_Gz_RL	Horner Gas Eval by the real gas method PP/zu
welltest_gas_L.xls	Qg.PPzu	Horner Real Gas Draw Down flow test
welltest_gas_L.xls	AOF_StabQ	empirical & theor. gas AOF & Deliv. Flow calc IsoCh.& mod I/C [10p82-3]
welltest_gas_L.xls	Stab	Field Pressure decline (closed system) stabilized C by emp. clc
welltest_gas_L.xls	PZU	Macro for gas physical properties always run prior to other evals

* Choke Disch. Coeff's from Craft Holden Graves, *Well Design*, 1962 Prentice Hall, p427, Eval. for Critical & Non-Critical flow conditions using C_p/C_v by Physical[11, 12] prop'ty

File	Sheet	Objective
welltesting_oil_L.xls	basic	determine equivalent for J & skin. Input Physical[11, 12] prop'ty 1st
welltesting_oil_L.xls	o.1rate.bld	Horner eval of Skin, eff, and average k for single rate before shut-in
welltesting_oil_L.xls	AvgP_muskat	Determine Average Press; Muskat Method[9], Arps Graph Eval [1,14]
welltesting_oil_L.xls	o.MulRate.Bld	Superposition three rate pressure build test [12_p144.153]
welltesting_oil_L.xls	o.flow.drw	Horner flow test for well flow 1 rate or slowly varying rate [10 p54]
welltesting_oil_L.xls	o.flow.drw2	MultiRate oil well flow test for skin, flow effiency and k [12]
welltesting_oil_L.xls	o.flow.drw3	Method of superposition three flow rate test [10p60]
welltesting_oil_L.xls	oil_Bail	Steady-State Oil Well Eval by bailing Test[2, 3 p309]
welltesting_oil_L.xls	WLT	'Wire line testing, k based on Spherical Pressure Eqn. [10 p98,& 21]
welltesting_oil_L.xls	DST. Plot	Horner Eval of Drill Stem Tests[21, 25] by Pirson Method[17, 18]

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Appendix 1 Horner Test Details

Well Testing is classified based on either 1) infinite acting reservoir or 2) psuedo-steady-state. The psuedo steady state condition is when pressure decline acts at a uniform rate in the reservoir, Ä psi/day. Steady-state conditions, imply a uniform rate of pressure decrease on the whole unit. For which any external pressure is based on average pressure, always decreasing for decreasing unit mass. For non-steady state condition, a fixed amount of time is required for a uniform pressure gradient to adjust through out the area surrounding the well bore, in addition to the time for the fluid to enter the well bore, (well bore storage effect). Summarized below are basic flow equations for flow conditions of non-steady-state and steady state.

time region	PDE	eq.	$J=BPD/(dpsi)=q/(p_e-p_w)$	eq
non-steady state, NSS	$\partial^2P/\partial r^2+1/r(\partial p/\partial r)=\eta(\partial p/\partial t)$	1a	$(14.2Kh)/[(B_o\mu)E_i\{-r_w^2/2\eta t\}]$ †	1b
non-steady state ++t	$\partial^2P/\partial r^2+1/r(\partial p/\partial r)=\eta(\partial p/\partial t)$	2a	$(14.2Kh)/[(B_o\mu)\ln(r_w^2/2.2\eta t\}]$	2b
Steady state in-comp	$\partial^2P/\partial r^2+1/r(\partial p/\partial r)=0$	3a	$(7.08Kh)/[B_o\mu\ln(r_e/r_w)]$	3b
Steady state comp	$\partial^2P/\partial r^2+1/r(\partial p/\partial r)=Ä/\eta$	4a	$(7.08Kh)/[B_o\mu\ln(r_e/r_w - ½)]$ Ŧ	4b
non-steady state time	$t<948(\mu c \Phi)(r_e^2)/k$ NSS valid t	5a	$\eta=6.33K/(\mu c \Phi)$ **	5b
Skin effect[23]	$S=(k_e-k_a)/k_a]\ln\{r_a/r_w\}$	6a	dp skin =qBuS/7.08kh	6b

‡ $E_i(-x)$ ≡ exponential integral[14] ≈ $\ln x-x/1!+x^2/2*2!-x^3/3*3!+x^4/4*4!$ -etc+etc which for small x (<0.02), large time, a more compact expression of $E_i(-x)$ is ln(1.78X), the expression used to develop Horner's equation. in practice the minimum time for Horner Ei approximation is t(hrs)>3.79E5(por v/v)(μ, cp)(R_w^2 ft^2)/(k md)

†based on time in days and K in Darcy, K=(k, md)/1000, h & r in feet, u in cp, c 1/psi, and porosity in v/v

Ŧ use ¾ in place of ½ if using average pressure in place of external pressure

* for time in hours, r in feet, c 1/psi, k md, porosity in v/v

** for time in day, r in feet and Darcy/(cp 1/psi) use 6.33 but if time in hours & k in md use constant of 0.000264

The basis of Horner analysis[3,9] is finding total dp using Eq. 3b to calculate dp near the well bore, by k_a & (r_a/r_w) and Eq. 2b find dp outside the zone of altered permeability. Horner introduced the plotting function Δ/(T+Δ) by superposition to show (p_e-p_Δ)~ log(Δ/(T+Δ)), T being the total producing time and Δ being elapsed time since shut-in. Prior to Horner's method[6, 7] the productivity ratio of a well could only be determined based on core permeability or the productivity of other wells in the same formation. However, Horner's method requires a pressure transient wave initiated in a relatively uniform pressure distribution by flow change large enough to affect a measurable pressure transient. The effects of which are evaluated prior to onset of boundary effects, defined by Eq.5a but after the passage of well bore storage effects or minimum required time for E_i validity. Simplified Graphical analysis uses the approximation of - A+3.23 = -0.405.

By analogy, the above PDE's are collectively known as the diffusivity equation in radial form. For example heat diffusion is measured as Temperature; electron diffusion; as Voltage, Molecular diffusion; as Concentration. Using the heat analogy, a build up transient thermal wave may be initiated by placing a heat source inside an annular rod at an initial temperature. Conversely, a Drawdown transient thermal wave my be initiated with placement of a cold sink, flowing liquid N2. If the rod is perfectly insulated, it will reach a constant temperature, with passage of time. Irrespective of insulation, the annular rod initially develops temperature gradient, but without perfect insulation a permanent T grad develops within the annular rod. Skin effect is the quantification of an inner insulation layer upon the development of the rods' temperature gradient.

Appendix 2 Gas Well Testing

Methods of Gas Well Testing have a perspective sufficiently different from oil wells, the basis of which merit additional detail. The empirical gas well test equation, based on steady state radial flow, (flow across external boundary = flow at well bore or zero pressure decline Eq3a and time such that radius of investigation exceeds external radius) at standard conditions of 60F, 14.7psia is: $q(\text{mSCFD}) = [p^2_e - p^2_w]\{0.703kh/[\mu Tz\ln(r_e/r_w)]\}$. If steady state flow conditions exist, the empirical method suggest a log-log plot of q vs $[p^2_e - p^2_w]$ should yield an equation of the form $\log Q = C' + n\log[p^2_e - p^2_w]$ or $Q = C[p^2_e - p^2_w]^n$. The latter form being known as the empirical gas flow equation, with C termed the stabilized flow coefficient[3, 4]. The empirical gas deliverability equation can be recognized as an expansion of Eq.3b, with Bg expanded at exterior and well pressures. The AOF, Atmospheric Open Flow, is an extrapolated flow value using, C, n, p_e with p_w of 14.7.

The routine STAB is Mehan's procedure based on Potteman's method of determining the stabilized flow coefficient in the empirical method. STAB also includes routines for estimation of gas pressure, gas flow of the deposit vs production, and initial volume estimation. Using multiples of C allows evaluation based on N producing wells. Since initial test results cannot accurately evaluate degree, if any, of water drive, the evaluation uses a closed basis.

The "theoretical flow equations" are an expansion of Eq.4b, with Bg expanded at exterior and bottom hole pressures, plus an additional term to account for turbulence near the well bore and the usual skin pressure drop. $q(\text{mSCFD})[\mu Tz(\ln(r_e/r_w) - 0.75 + S + D|q|)] = [p^2_a - p^2_w]\{0.703kh\}$. This reduces to plotting $[p^2_a - p^2_w]/q = a + bq$. For theoretical flow equation the AOF is a quadratic solution, $AOF = [-a + \sqrt{(a^2 + 4b(p_a^2 - 14.7^2))}]/2b$.

Isochronal well testing is a series of flowing and shut in pressure test. True isochronal tests require wells shut in sufficient time for each well test to be conducted with a flat transient pressure distribution. Achievement of this profile often requires excessive times. The modified (4 flow) Isochronal test conducts flow and shut-in tests of equal duration but with increasing flow rate. This pattern of testing should yield parallel transient pressure distributions or constant n and the shut-in pressure of each preceding test is used as average pressure in the next test. Since this test method gives values of Skin' at decreasing flow rates, the turbulence effect may be estimated by plotting "apparent skin" vs flow and extrapolation to zero flow.

The use of psuedo-pressure in gas well testing seeks to remove uncertainty associated with the non-ideality of gases. The routine of this solution follows Lee's method of trapezoidal numerical integration of the term P/uz.

The sheet GasMbal provides routines for flow line pressure drop, bottom hole pressure evaluation, flow thru chokes, gas separator & well material balance of water, gas & condensate, plus gas reserve estimation.

Appendix 3 Physical Properties Calculation Routine Description

The basis of either spreadsheet is a hydrocarbon physical property package (PPP) using code from the HP41CV rom module (Ramey, HJ & Meehan, DN rev.C 05.1983). The I/O to the PPP is on the "Basic" sheet and may be adapted to subsequent pages by the user or the user may input laboratory data, if available.

Estimation of Gas Phase critical pressure and temperature offers options to use either gas specific gravity (with correction for diluents, N_2, H_2S, CO_2) or use gas component analysis. The Z factor is calculated by using R-K cubic form for initial estimate and solved by the Dranchuk-Purvis-Robinson implicit N-R reduced density method, which is a fit of the BWR EOS for Standing-Katz Z factor data. The method is valid between Tr(1.05, 3) and Pr(0, 30). Ramey states results are tentative for Tr<1.2 because of questionable experimental data used to generate the Z surface. Not withstanding, this exception, many subsurface processes calculated are constant composition and isothermal. So the calculation method used here is to generate a table of Z(T, P) at required temperate, then regress Z(P) to a cubic form in the required pressure range.

Gas Isothermal compressibility implements the Trube method of Ramey, p30-1 and is valid for the valid range of Z.

Gas formation factor is presented in various forms, as is a drop menu for determining standard conditions for 16 different locations.

Gas viscosity is calculated by the Lee-Gonzalez method used by Ramey. The listed validity range is T, F(40, 460) and PSI(14.7, 1e4).

When estimating Pc and Tc from gas SG, Ramey used M.B.Standings' routine with the Wichert-Aziz correction for diluents. The listed validity ranges are $CO_2+H_2S<80\%$ and $CO_2+H_2S+N_2<100\%$, Condensate fluids gas SG(0.56, 1.30) and Misc. Gas SG(0.56, 1.71).

Gas Properties from composition follows Ramey Table of pg 52, with exception of n-Octane Bi, which is a typographical error, listed as 0.006693, correct is 0.06693. Also included is an empirical correlation for Cp/Cv based on gas SG.

Oil isothermal compressibility determines if conditions are above or below bubble point and reported as single value. The routine follows Ramey's method based on the Vasquez-Beggs correlation. If separator conditions are unknown or if it is desired to eliminate the correction for separator conditions, enter a value of Sep T =0 and Sep P = 114.7. The listed validity ranges are SepT, F(76, 150) Sep.Psi(30, 535) and oil API(15.3, 59.5), when above bubble point; SG-gas(0.51, 1.35) and Psia(111, 9485) and when conditions are below BP for API(15.3, 30), gas SG(0.51, 1.35) and Psia(14.7, 4542) and for API(30.6, 59.5) gas SG(0.53, 1.26) and Psia(14.7, 6025)

Oil Formation factor is reported as the 2-phase volume factor, Bo, which is automatically corrected based on pressure being above or below the bubble point pressure. Bo follows the listed validity ranges of oil isothermal compressibility, above.

Oil Viscosity, μ_o, is automatically reported based on bubble point conditions. Ramey's documentation on pg.74 is corrected to (P/PBP)^A, not P/PBP^A as typed. Uo follows very nearly the listed validity ranges of oil isothermal compressibility, above.

Gas to Oil ratio, GOR or Rs, is automatically reported based on bubble point conditions. Rs follows very nearly the listed validity ranges of oil isothermal compressibility, above.

Bubble Point Pressure, PBP, follows very nearly the listed validity ranges of oil isothermal compressibility, above.

Water isothermal compressibility, C_w, follows Ramey's calculation method, based on M.B. Standing with validity ranges; T,F(80, 250), Psi(1000, 6000), NaCl v/v(0, 0.25).

Water Formation volume factor, B_w, follows Ramey's calculation method, based on M.B. Standing with validity ranges; T, F(100, 250), Psi(1k, 5k), NaCl v/v(0, 0.25).

Water Viscosity, μ_w, follows Ramey's calculation method, based on M.B. Standing with validity ranges; T, F(32, 572), Psi(psat, 11,600), NaCl v/v(0, 0.25).

	NaCl v/v	Psia	T,F	C_w 1/psi	B_w	visc cp
This	0.058	600	105	2.75e-6	1.01	0.704
HP Meehan p 24	0.058	600	105	2.75e-6	1.01	0.717

Gas-Water ratio, Rsw, follows Ramey's calculation method, with validity ranges; T,F(90,250), Psi(500, 5,000), NaCl v/v(0, 0.03). Which for 0.025 NaCl, at 150F and 3100 psi the program calculates 13.91 vs 13.91 for the HP routine.

Rock Compressibility, CFR, follows Ramey's calculation method, with validity ranges; Porosity range v/v(0.02, 0.26). Which for por=0.2 HP calcs 3.64e-6 and program calculation is:

cfr 1/psi	3.65E-06

Condensate Reservoirs GOR & Dew Point Pressure - see basic section P46
Dew Point Pressure is calculated by Meehan's' Equations of P14. The GOR of gas condensate systems is calculated via Mehan equations of pg18, with exception, the factor of OilG in %C5+ is corrected to 0.07286 not the 0.7286 as published, the corrected value gives answers that agree w/ Meehan's' HP41 runs.

Material Balance Gas Production, Mehan p27
This is found in the gas_test file, sheet gasMbal, but use the "basic" sheet, for input values. Mehan's correlation is used for water content of gas [f(P,T,NaCl)] & GEC. Reported separator gas flow is assumed as Dry Sales Gas. Using a mass balance envelope to enclose separator, base of production string, off gas and sep. water leg flow and neglecting water in sep. condensate liquid, H2O balance is: H2O in =H2O out. OUT= $Q_g(Y_{w\text{-}sep})$ + $BPD_w(\#_w/BBL)$ and H2O IN= $(Q_{cond}+Q_g)(Y_{w\text{-}BH})$ + $BPD_{BH}(\#_w/BBL)$. Evaluation of Yw is based on Mehan correlation, using Separator P&T and Bottom hole P&T. Note that water liquid volumes are stock tank Barrels and Bottom hole liquid flow, the value must be corrected by Bw. BH Liquid H2O is
$BPD_{BH}=[Q_g(Y_{w\text{-}sep}) + BPD_w(\#_w/BBL)-(Q_{cond}+Q_g)(Y_{w\text{-}BH})]/(\#_w/BBL)$ 8.34#W=1gal & 42gal=1 BBL
RB-H2O = $BPD_{BH}=[Q_g(Y_{w\text{-}sep}-Y_{w\text{-}BH}) - (Q_{cond})(Y_{w\text{-}BH})]/(\#_w/BBL)+ BPD_w]/Bw$
Gas Flow BH = $(Q_{cond}+Q_g)/(1-y_{w\text{-}BH})$ where $y_{w\text{-}BH}$=MMSCFw/MMSCF 18#W=379SCF

Total Compressibility, CFR, follows Ramey's calculation method, with validity ranges; as above with oil saturation =(1-S_g-S_w).

	This	HPp120
GOR scf/bbl	460	460
GAS G	0.830	0.830
OIL G,api	39.8	39.8
Toil-resv, F	155	155
Psia-res	2000	2000
por v/v	0.22	0.22
NaCl w/w	0.01	0.01
Tsept F	100	100
PSIG sept	125	125
y-N2	0	0
y-CO2	0	0
Gas & Condy Wells	0	0
Condy:y=1		
STD T, F	60	60
STD Psia	14.65	14.65
H2O sat v/v pore	0.35	0.35
Gas satur v/v por	0.12	0.12
PBP psia	1642.1	1641.5
BTb	1.2596	nd
BO	1.26	nd
GOR(P)	460.0	460.0
BG, cf/scf	0.00635	nd
BG"bbl/scf	0.00113	nd
oil cp(P)	0.660	nd
CG, 1/psi	5.39E-04	nd
CO 1/psi	1.52E-05	nd
rock comp		
cfr 1/psi	3.51E-06	nd
CT 1/psi	1.45E-05	1.453E-05

gas	vol frac	vol frac	vol frac	vol frac	vol frac	vol frac
	this	HPp56	Mh p7	this	Mh p10	this
N2	0.05	0.05	0.05	0.05	0	0
CO2	0.03	0.03	0.03	0.03	0	0
H2S	0.02	0.02	0.02	0.02	0	0
C1	0.74	0.74	0.74	0.74	na	na
nC2	0.08	0.08	0.08	0.08	na	na
nC3	0.06	0.06	0.06	0.06	na	na
iC4	0.00	0.00	0.00	0.00	na	na
nC4	0.02	0.02	0.02	0.02	na	na
iC5	0.00	0.00	0.00	0.00	na	na
nC5	0.00	0.00	0.00	0.00	na	na
nC6	0.00	0.00	0.00	0.00	na	na
nC7	0.00	0.00	0.00	0.00	na	na
nC8	0.00	0.00	0.00	0.00	na	na
nC9	0.00	0.00	0.00	0.00	na	na
nC10	0.00	0.00	0.00	0.00	na	na
O2	0.00	0.00	0.00	0.00	na	na
H2	0.00	0.00	0.00	0.00	na	na
He	0.00	0.00	0.00	0.00	na	na
H2O	0.00	0.00	0.00	0.00	na	na
sum	1.00	1.00	1.00	1.00	na	na
gas SG k3	0.742	0.7419	0.859	0.859	0.872	0.872
Tc* R	385.1	385.1	410.8	410.8	441.9	441.9
Pc* psia	665.4	665.44	673.9	673.9	661.6	661.6
NHV	1013.1	1013.09	1156	1156		
GHVd	1117.7	1117.71	1271	1271		
GHVw	1098.3	1098.26	1249	1249		
CP	0.439	0.439	0.507	0.507	n/a	0.52
CP/CV	1.267	1.267	1.187	1.187	n/a	1.18
T, F	50	50	255	255	180	180
P			500	500	500	500
Z			0.957	0.957	0.916	0.916
Cg			0.0021	0.0021	0.0022	0.0022
Bg			0.0395	0.0395	0.033	0.033
Ug			0.014	0.0140	0.0127	0.0127
P			13500	13500	6200	6200
Z			1.727	1.726	1.0842	1.084
Cg			2.3e-5	2.31e-5	0.001	5.75e-5
Bg			0.0026	0.00264	0.0032	0.0032
Ug			0.0599	0.0599	0.0413	0.0413

	This	Mh-p3	this	Mh-p3
GOR scf/bbl	510	510	510	510
GAS G	0.762	0.762	0.762	0.762
OIL G,api	31.7	31.7	31.7	31.7
Toil-resv, F	155	155	155	155
Psia-res	600	600	2600	2600
por v/v	0.143	0.143	0.143	0.143
NaCl w/w	0.019	0.019	0.019	0.019
Tsept F	95	95	95	95
PSIG sept	125	125	125	125
y-N2	0	0	0	0
y-CO2	0	0	0	0
GOSP gas	0	0	0	0
Condy:y=1				
STD T, F	60	60	60	60
STD Psia	14.65	14.65	14.65	14.65
H2O sat v/v pore	0.325	0.325	0.325	0.325
Gas satur v/v por	0	0	0	0
PBP psia	2512.7	2514.4	2512.7	2514.4
BTb	3.0581	3.0581	1.282	nd
BO	1.09	1.087	1.282	1.283
GOR(P)	93.8	93.1	510	510
BG, cf/scf	0.02659	nd	.054	nd
BG"bbl/scf	0.00474	nd	0.00095	nd
oil cp(P)	2.300	2.307	0.920	0.9184
1CG, 1/psi	1.80E-03	nd	3.57E-04	nd
CO 1/psi	9.50E-04	7e-4	1.3E-05	1.2E-05