



AMERICAN INSTITUTE OF FORMATION EVALUATION

SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

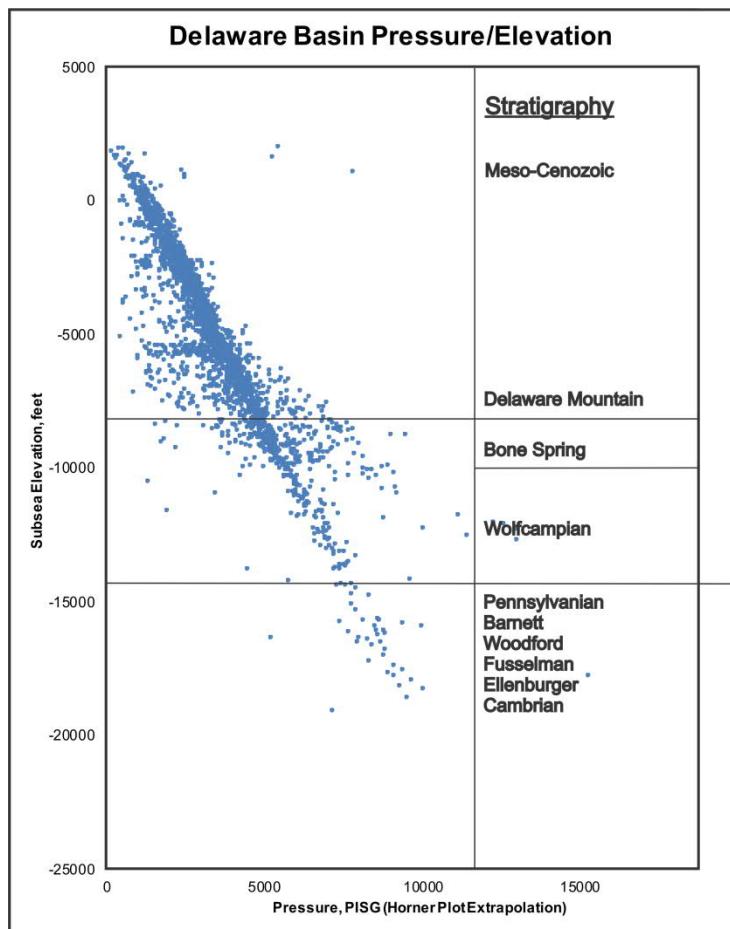
Delaware Basin DST Data and Preliminary Pressure System Evaluation

AIFE Delaware Basin DST Data

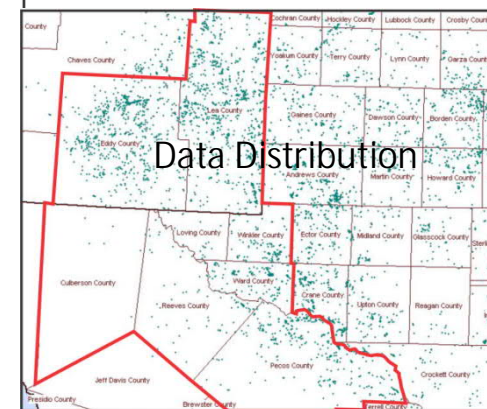
- > **3,000** Analyzed Drill Stem Tests
- DSTs from 1948 through 2018
- > **4000** Horner Plot Extrapolations
- > 2000 BHT Measurements
- Fluid Recoveries and Types including Gas to Surface, first, last and maximum readings
- Over **1700** Salinity Measurements
- Calculated Potentiometric Surface values
- Reservoir Damage and Permeability Ratings
- Additional Data: Test Quality Code, Formation Assignments, Time/Pressure Points, Tubular Internal diameters, Mud Type and Weight
- Online access for Individual DST Reports

AIFE Preliminary Formation Pressure Report

- Report includes Pressure versus Elevation analyses of Bone Spring, Wolfcamp and deeper reservoirs
- Documents occurrence of overpressured and normally pressured accumulations in the deep Delaware Basin
- Focused on tests deeper than top Paleozoic section to Basement
- Utilizes maximum pressure from Horner Plot Extrapolations
- **Includes majority of recent Texas and New Mexico tests run 2002 to 2018**



Pressure System
Evaluation by Ryan Fisher
M.Sc. Geology, Manitou
Consulting, LLC



Counties Included in
Evaluation:
New Mexico: Eddy, Lea
Texas: Culberson, Loving,
Pecos, Reeves, Ward and
Winkler

Learn more: <http://dstdata.com/index.htm>
Contact Steve Misner: aife@cox.net



AMERICAN INSTITUTE OF FORMATION EVALUATION

SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

- **Delaware Basin DST Data and Preliminary Report**

AIFE's entire Delaware Basin contains over 9,400 analyzed Drill Stem tests. The analysis are only completed from the original DST report, and include incremental detail on each shut-in with a radius of curvature and Horner extrapolated pressures, where applicable.

For the purposes of this Study we are examining the pressure relationships for the Bone Spring Formation and deeper in the Delaware Basin, comprising just over 3000 A to D quality codes.

My name is Steve Misner, and I am the owner of the AIFE DST Database. I have been involved with the testing industry since my teens, and my Stepdad was the head of the Calgary office of Johnston/Schlumberger in the 1960's. In the mid-70's I worked for his engineering firm, analyzing and reading Drill Stem tests, AOF's, stop gradients, RFT's, and 4 point isochronal tests. I was additionally in charge of the maintenance and calibration of the downhole pressure recorders.

In 1979, I joined Baker Industries in Calgary, becoming the Supervisor of their Lynes United Services Division, Data Quality Control. Baker, attempting to be ahead of the competition, had computerized their engineering and were creating an analyzed DST database covering Canada. This division consisted of 23 employees and by 1982 had analyzed 32,000 DST's in Canada.



AMERICAN INSTITUTE OF FORMATION EVALUATION

SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

- In 1982 I acquired the Canadian DST Database and related software, and staff commenced the creation of the U.S. library, being contracted by Amoco to analyze their in-house tests situated in the Denver office.
- At this point the New Mexico and Texas data files consisted of 4,500 tests, Amoco provided access to their files, which included the Companies Amoco had acquired over the years; Pan American, Standard Oil, and Stanolind to name a few.
- In 1983 Arco Oil and Gas, via their Midland division, permitted AIFE access to their DST files. AIFE had microfilm staff on site in Midland and microfilmed over 23,000 Drill Stem Tests.
- In 1986 AIFE acquired the historical records of Roger Hoeger, a consulting geologist in Denver, Colorado who had collected some 60,000 tests during his 40 year career, via Petroleum Research Corporation. Mr. Hoeger's tests were primarily in the Rocky Mountain Region, with approximately 8,000 being in the States of New Mexico and Texas
- In 1987 AIFE worked with Baker Industries, one of the largest Testing Companies, and collected tests run by Lynes (16631), Virg's (12798), Foster (8536), Star Hughes (2721). I personally traveled to each of Baker's warehouses and arranged for microfilming of their records.
- AIFE has worked with Rig Testers and Permian Testers of Midland, TX and incorporated their records into the AIFE database.
- Most recently AIFE has acquired the current tests run in New Mexico and Texas from 2002 to 2018. These tests provide a snapshot of the wildcat wells drilled during this period, with sometimes surprising results. These tests are only provided to clients who have executed confidentiality agreements with AIFE.
- I have had a lifelong commitment to the DST library covering the U.S. and Canada.



AMERICAN INSTITUTE OF FORMATION EVALUATION

SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

- The AIFE DST Library represents the most comprehensive pressure file on the Delaware Basin available.
- A large number of the records collected by AIFE no longer exist, having been 'purged' by the testing companies and operators.
- The analysis and computerization of the AIFE Drill Stem Tests was completed by staff with many years of training; at the time the AIFE database was constructed its' staff had already analyzed over 220,000 Canadian DST's.
- Subsequent to the completion of the DST Libraries AIFE staff were employed by Government and private industry as pressure specialists.
- The AIFE DST library was designed as an engineering database, with the addition of Horner Extrapolation(s) and Quality Codes.
- The Delaware Basin Data Set – within the States of New Mexico and Texas it is often difficult on older wells to determine the proper API-number. Wells included in the study are only those for which AIFE has been able to identify proper API-numbers with the state agencies. All tests are analyzed according to the AIFE Quality Codes as outlined in the next slide. Study participants will receive the initial AIFE Pressure and Recovery excel files upon execution and delivery of the "Study Commitment" documents to AIFE, and will receive access to the online DST library for the Delaware Basin Data Set upon payment of the Study Fee.

The normal AIFE fee for this data set is \$25,000, WITHOUT the new tests run from 2002-2018, nor the Pressure report. It is my desire that the industry have access to reliable, accurate pressure data and can see the difference it makes in regional analysis, this database is also intended to serve as a benchmark for further work.....Steve Misner

aife@cox.net



AMERICAN INSTITUTE OF FORMATION EVALUATION

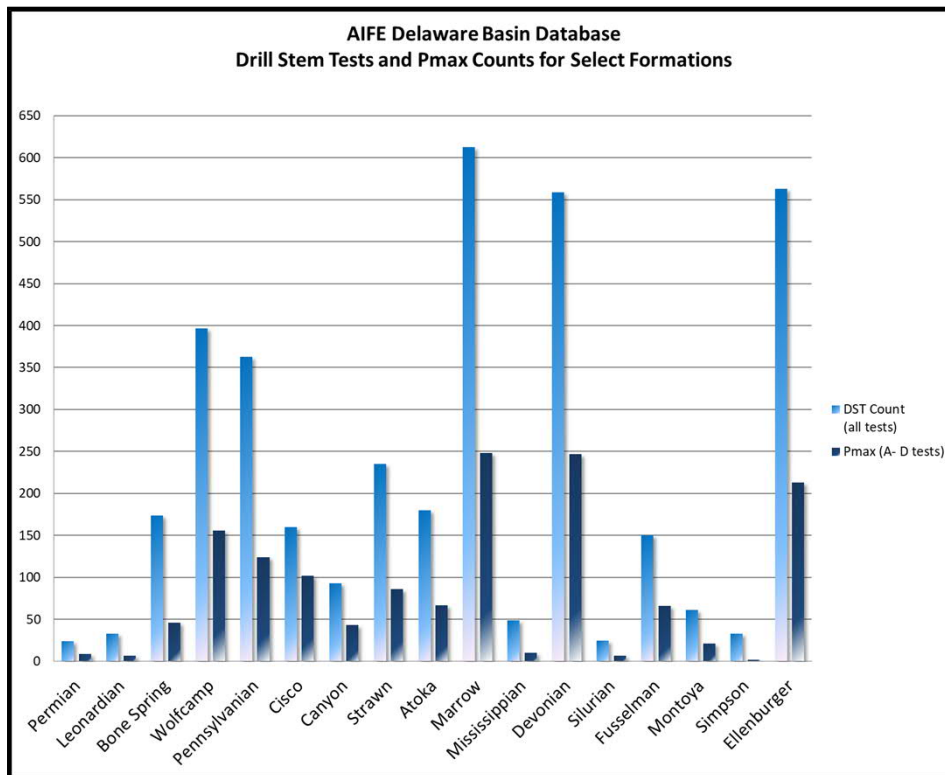
SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

AIFE Preliminary Formation Pressure Report

- Report includes Pressure versus Elevation analyses of Bone Spring, Wolfcamp and deeper reservoirs

Report Objectives

- Documents occurrence of overpressured and normally pressured accumulations in the deep Delaware Basin
- Pressure/Elevation Charts
- Focused on tests from the top of the Paleozoic section to Basement
- Utilizes maximum pressure from Horner Plot Extrapolations
- Includes recent New Mexico and Texas data up to 2018



Drill Stem Test Pressure Data

A Best Quality

1. Test mechanically sound - No Plugging/No Sticking
2. Recorder used/chart good, pressures compare
3. Flow pressure verify recoveries and/or flow tests
4. Bottom packer held on straddle tests
5. Recorder depths given
6. Recorder within interval tested
7. ISD stabilized, or nearing stabilization with increments
8. Preflow time long enough to release hydrostatic head
9. KB elevation given
10. Two good shut-ins required
11. Pmax Range of approximately 1 to 10 lbs. (7 to 69 kPa) from read shut-in pressure
88. Fluid to surface on flows (irregularities)
99. Flows incriminated

B Nearing Stabilization

12. Slight mechanical difficulties, but does not affect the test
13. Shut-ins not fully stabilized
15. Recorder pressures disagree from 1 to 19 PSI (7 to 131 kPa) after recorder drag and depth difference
17. Pmax range of approximately 20 to 35 lbs. (138 to 241 kPa) from read shut-in pressure
48. Flow pressures to not verify recoveries
88. Plugging, fluid to surface, resets on flows (irregularities)
99. Flows incriminated

C Caution (Plugging)

18. Some mechanical difficulties evident on chart, however, does not appear to affect pressure data
19. Recorder run above the interval
21. Preflow not opened long enough, possibly slightly underplugged
22. Packer may have leaked slightly
24. Recorder pressures disagree from 20 - 39 PSI (138 to 269 kPa) after recorder drag and depth difference
25. Only one recorder must be within interval
26. Pmax range of approximately 30 to 65 lbs. (207 to 586 kPa) from read shut-in pressure
27. Only one good shut-in
88. Plugging, fluid to surface, resets on flows (irregularities)
99. Flows incriminated

D Questionable

28. Not totally mechanically sound
29. Only one recorder run inside above the interval
31. No KB elevation
33. Questionable interval depths
34. Superplugged ISD: ISD follows long valve open period
35. No chart from below bottom packer
36. Recorder pressures disagree from 30 PSI (206.8 kPa) and over after recorder drag and depth difference
37. Pmax range of approximately 80 to 150 lbs. (552 to 1034 kPa) from read shut-in pressure
79. Cannot define a valid P max test indicates (define drawdown)
88. Plugging, fluid to surface, reset on flows (irregularities)
99. Flows incriminated

E Low Perm, Low Pressure

38. Covers all requirements of Code A, however, low permeability and low pressures, unable to extrapolate
39. Low permeability, low pressure, but problems encountered throughout test
40. Low permeability, relatively high pressure for "E" Code
46. Plugging, fluid to surface resets on flows (irregularities)
99. Flows incriminated

F Low Perm, High Pressure

40. Covers all requirements of Code A, however, low permeability and high pressure (CAUTION: Watch for Cushion)
41. Low permeability, high pressure, but problems encountered throughout test
47. Low permeability, relatively low pressure for "F" Code
68. Plugging, fluid to surface resets on flows (irregularities)
99. Flows incriminated

G Mixture (Flow Only)

42. No shut-ins taken
43. No usable pressures
44. No usable data
45. Flow only
63. Unable to obtain initial packer seal
64. Lost seal after tool opened
65. No elements ruptured
66. Top elements ruptured
67. Bottom elements ruptured
68. Both elements ruptured
69. Plugged tool
70. Unable to reach test depth
71. Tool failure
72. Personnel failure
73. Reilly spring turning
74. No reason available
75. Other
76. Mud dropped in annulus when tool open (lost hold)
77. Sticking tools when opening or closing flow
90. Front page only, mixture

PRESSURE/RECOVERY CHART QUALITY CODES

These Quality Codes grade drill stem tests according to the following signatures.

aife@cox.net



AMERICAN INSTITUTE OF FORMATION EVALUATION

SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

Pressure System Evaluation by Ryan Fisher M.Sc. Geology, Manitou Consulting, LLC

Drawing upon Ryan's interest in mapping subsurface occurrences of anomalous reservoir pressures, his collaborative goal with Steve Misner and AIFE is to accurately describe and report on the nature of subsurface hydrocarbon accumulations in economically important reservoirs across the United States and Canada utilizing the AIFE database. Current industry activity trends have drawn the team into Texas, and the Delaware Basin in particular, to characterize the nature of Paleozoic hydrocarbon accumulations with respect to their reservoir pressures.

Ryan is a long running geoscientist serving the oil and gas community since 2000. A double graduate of the Colorado School of Mines, Ryan has enjoyed a diverse career, resilient amongst change, by living in wellsite trailers, relishing the 24/7 life of an operations geologist in the office and working big picture regional studies for domestic exploration projects. Sprinkle a stint at a petroleum engineering shop with a global reach and you get a fluent speaker of engineer who believes the AIFE dataset represents an opportunity to analyze, interpret and present data that bridges geology and petroleum engineering disciplines.

Denver, Colorado is home for Ryan along with wife and two daughters, who all enjoy fresh air, clean water and a good laugh.



AMERICAN INSTITUTE OF FORMATION EVALUATION

SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

Delaware Basin Study Commitment

The Study Fee is \$10,000.00 for initial subscribers and includes the tests utilized for plotting/mapping. Subscription is by License agreement.

The study, and the tests contained therein are intended for research and exploration purposes solely and neither are for resale nor publication.

Study release date is January 31, 2022. Subscribers who have executed their license agreements prior to December 15, 2021 will receive the AIFE excel data files upon execution.

AIFE has additionally collected over 1,400 tests historically for which valid API-numbers are being determined. As these tests become available AIFE intends to update this database.

To subscribe please provide your Corporate name, address, and name of signing officer to our confidential email at aife@cox.net and we will forward to you the License agreement.

aife@cox.net



AMERICAN INSTITUTE OF FORMATION EVALUATION

SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

Study Content

AIFE Excel Pressure and Recovery listings of all tests utilized in Study

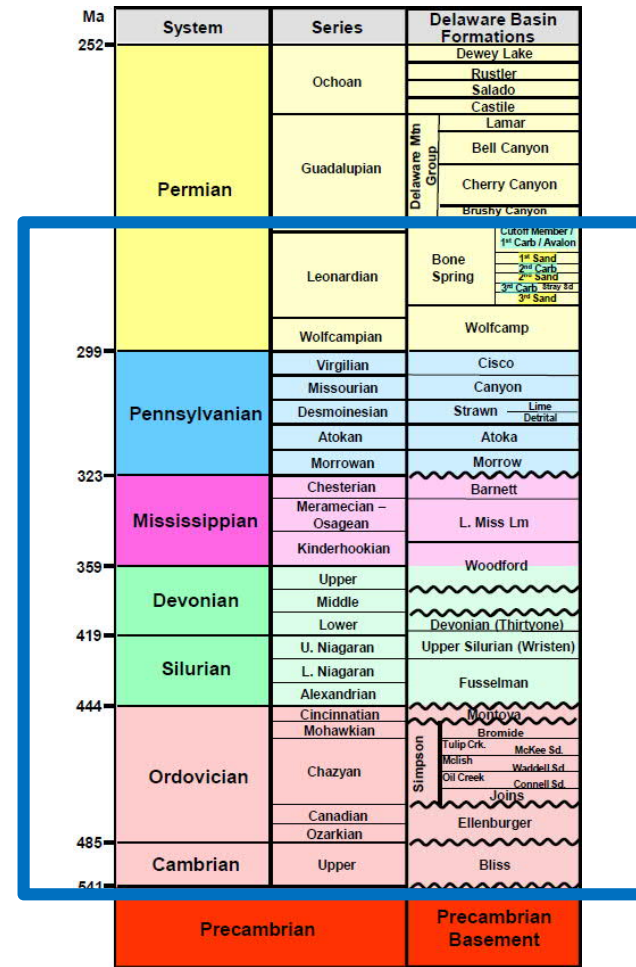
Pressure/Elevation Charts and Discussion

Pressure and fluid data presented for Lower Permian through Cambrian rocks Bone Spring, Wolfcamp and more

Online Access to individual DST Reports

Pressure File Contents:

- API_NO – Api number
- CPA_NO – Location
- Lat – Latitude
- Long – Longitude
- Well Name – Well name
- Operator – Well operator
- Depth – Depth at which interval, recorder depths measured from at surface
- KB – Kelly Bushing Elevation
- GR – Ground Elevation
- DF – Drill Floor Elevation
- DST_No – Drill Stem Test Number
- Formation1 – first formation noted as tested, generally preceded by an 'I', indicating source of best reliability
- Formation2 – second formation noted as tested, generally preceded by an 'F', indicating source of second reliability
- Formation3 – third formation noted as tested, generally preceded by an 'R', indicating formation from DST report, least reliable



Modified from Waite, L., 2019, Stratigraphic Framework of the Wolfcamp-Spraberry of the Midland Basin, University of Texas at Dallas



Study Content

Pressure File Contents: (continued)

INT_F – Interval tested from

INT_T – Interval tested to

Start of first flow pressure (PSIG) – first flowing pressure, first flow

End of first flow pressure (PSIG) – end of first flowing pressure, first flow

1st Shut-in Press (PSIG) – first shut-in pressure at end of shut-in

1st flow time – time in minutes of first flow on test

1st SI time – time in minutes of first shut-in on test

SI 1 Extrap – Horner extrapolated Pressure of first shut-in on test (PSIG)

SI 1 Slope – Horner slope of first shut-in on test (PSIG)

The flow and shut-in time and pressure data continue in the same sequence for all remaining flows and shut-ins on the DST, up to a maximum of four

TEST_TYPE - Type of test run, straddle or bottom hole, number of packers

P_MAX – Horner extrapolated pressure assigned for the DST

SUBSEA – Subsea elevation of the recorder (pressure measuring device)

REC_DEPTH – Depth of the recorder relative to surface

REC_USED – The pressure measuring device serial number utilized for Pressure data

REC_TEMP – temperature taken from pressure measuring device (if so equipped)

BH_TEMP – bottom hole temperature as reported on DST

HF – Hydrodynamic Factor – Identification of Predominant recovery (O, W, G or Mud)

QC_ORIG – AIFE Quality assessment of DST – for further detail refer to Acrobat Presentation on Database

PERM – AIFE Qualitative assessment of Permeability, please refer to Acrobat Presentation on Database

DAMAGE – AIFE Qualitative Assessment of Damage, please refer to Acrobat Presentation on Database

SALIN – reported salinity of recoveries

Pot Surface Value – Calculated Potentiometric Surface Value, only calculated on A to D quality tests with HF of 'W'



Recovery File Contents:

API_NO – Api number
CPA_NO – Location
Lat – Latitude
Long – Longitude
Well Name – Well name
Operator – Well operator
Depth – Depth at which interval, recorder depths measured from at surface
KB – Kelly Bushing Elevation
GR – Ground Elevation
DF – Drill Floor Elevation
DST_No – Drill Stem Test Number
Test Date – Date the DST was run
INT_F – Interval tested from
INT_T – Interval tested to
QC_ORIG – AIFE Quality assessment of DST – for further detail refer to quality code slide
Recovery Amounts 1 – amount of recovery in feet or meters recovered in first description

Recovery Description 1 – description of first recovery amount
Recovery Code 1 – identification of primary recovery (O, W, G, M) and contaminants
Dependent upon the number of recovery amounts and individual descriptions there may be as many as eight sets of Recovery Amounts per DST with Recovery Descriptions and Recovery Codes for each individual type of recovery

Gas Max – Maximum gas blow during DST
Gas First – First Gas Measurement during DST
Gas Last – Last Gas Measurement during DST

The Pressure and Recovery Files are designed to allow the user to add their own tests or modify particular items in the data file, and can be utilized for Pressure/Elevation charts and regional mapping.



AMERICAN INSTITUTE OF FORMATION EVALUATION

SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

Online Access to individual DST Reports

Each Study participant shall have access to the individual DST reports in the Delaware Basin study via AIFE's online server. Access will be provided for 1 year from the date of purchase of the study. Access can be continued beyond the one year period subject to the license agreement. The online access is intended to provide further detail as required per test plus access to the incremental detail for the shut-in build-ups.

AIFE Online Home Map Search Tools Administrative Help

NOELKE #1-A **DST No: 006**

TEXAS PECOS API No: 42-371-04302-00
 Ground: Latitude: 30.658619
 KB: 2349 Longitude: 101.883270
 Interval: 10035.0 to 10185.0 ft Total Depth: 10185.0 ft
 Operator: SHELL OIL Test Co.: COOK
 Formations: IELBG Type: CBH2P
 FELBG Date: 620208
 RELBG Quality Code: B
 Recorder No: 004063 Recorder Type: AK1
 Recorder Depth: 10184.0 ft Recorder Temp: F
 SubSea: -7835 ft Temp Depth: 10184.0 ft
 Capacity: 9000 psi Bottom Hole Temp: 241.0 F

	Times (min)	Pressure (psi)	Horner		Perm: RH Damage: NO HF: O
			Extrap (L) (psi)	Slope (L) (psi/cycle)	
Preflow:	2.0	330.0			Gas Flow
Initial SI:	30.0	4631.0	4660.72	1013.9190	MAX: 168.0 mcf/d
		237.0			FIRST: 168.0 mcf/d
2nd Flow:	120.0	753.0			LAST: 104.0 mcf/d
Final SI:	30.0	4449.0	4649.55	307.8154	

Initial Hydrostatic: 5425.00
 Final Hydrostatic: 5425.00
 Recovery 3750.00ft FREE OIL.
 Description: 420.01ft HEAVY OIL AND GAS CUT MUD.
 Blow Description: WEAK BLOW INCREASING TO STRONG BLOW IN 2 MINUTES. GAS TO SURFACE IN 6 MINUTES.
 Comments: RELATIVELY HIGH PERMEABILITY PRE-FLOW TIME ESTIMATED. INITIAL SHUT-IN STILLBUILDING SLIGHTLY. FINAL SHUT-IN STILL BUILDING TOO RAPIDLY TO EXTRAPOLATEWITH ANY ANY ACCURACY. PRESSURES COMPARE.

Drill Pipe Type:
 Length: ft
 Weight: lb/ft
 Outer Diameter: in
 Internal Diameter: in

Assigned P-Max: 4660.70
 Pressure/Depth: 0.464 psi/ft

aife@cox.net
 Cushion Type:
 Liquid Cushion:
 Gas Cushion:
 Inhibitor:



AMERICAN INSTITUTE OF FORMATION EVALUATION

SPECIALISTS IN PRESSURE DATA ANALYSIS & COMPUTERIZATION

Individual DST Reports (continued):

AIFE

Online

Home Map Search Tools Administrative Help

- 42-371-04300-00-004-E
- 42-371-04300-00-005-D
- 42-371-04302-00-003-E
- 42-371-04302-00-004-C
- 42-371-04302-00-005-E
- 42-371-04302-00-006-B
- 42-371-04401-00-001-F
- 42-371-04401-00-002-D
- 42-371-04401-00-003-E
- 42-371-04401-00-004-E

			237.0	
2nd Flow:	120.0		753.0	
Final SI:	30.0	4449.0	4649.55	307.8154

Initial Hydrostatic: 5425.00

Assigned P-Max: 4660.70

Final Hydrostatic: 5425.00

Pressure/Depth: 0.464 psi/ft

Recovery 3750.00ft FREE OIL.

Description: 420.01ft HEAVY OIL AND GAS CUT MUD.

Blow Description: WEAK BLOW INCREASING TO STRONG BLOW IN 2 MINUTES. GAS TO SURFACE IN 6 MINUTES.

Comments: RELATIVELY HIGH PERMEABILITY PRE-FLOW TIME ESTIMATED. INITIAL SHUT-IN STILL BUILDING SLIGHTLY. FINAL SHUT-IN STILL BUILDING TOO RAPIDLY TO EXTRAPOLATE WITH ANY ANY ACCURACY. PRESSURES COMPARE.

Drill Pipe Type:

Length: ft

Weight: lb/ft

Outer Diameter: in

Internal Diameter: in

Drill collar Type: H90

Length: ft

Outer Diameter: 4.50 in

Internal Diameter: in

Cushion Type:

Liquid Cushion:

Gas Cushion:

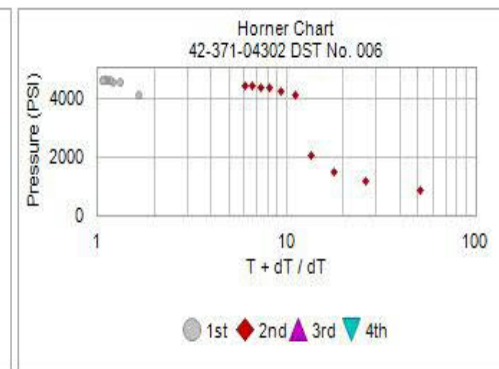
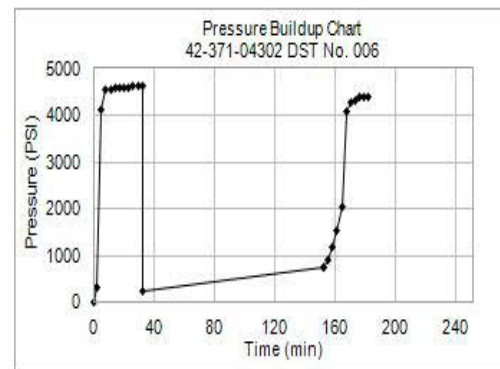
Inhibitor:

Mud Type: GEL CHEM

Mud Weight: 10.40 lb/gal

Salinity: ppm

Chloride Content:



[View Increment data](#) [Export Increment data](#)

aife@cox.net



Incremental Detail

Every Shut-in with a radius of curvature has incremental detail, either from the original DST report or digitized. Increments can be downloaded from the AIFE online server for reservoir calculations.

Increment No.	Time (min)	Pressure (psi)
API No: A423710430200 DST No: 006 Recorder: 004063		
1	0	330.00
2	3	4,126.00
3	6	4,552.00
4	9	4,575.00
5	12	4,594.00
6	15	4,608.00
7	18	4,612.00
8	21	4,624.00
9	24	4,626.00
10	27	4,629.00
11	30	4,631.00
12	0	753.00

13	3	902.00
14	6	1,170.00
15	9	1,520.00
16	12	2,048.00
17	15	4,096.00
18	18	4,280.00
19	21	4,347.00
20	24	4,405.00
21	27	4,428.00
22	30	4,429.00