QRod
Quick Rod Design

Calgary, Alberta

November 28 & 29, 2006

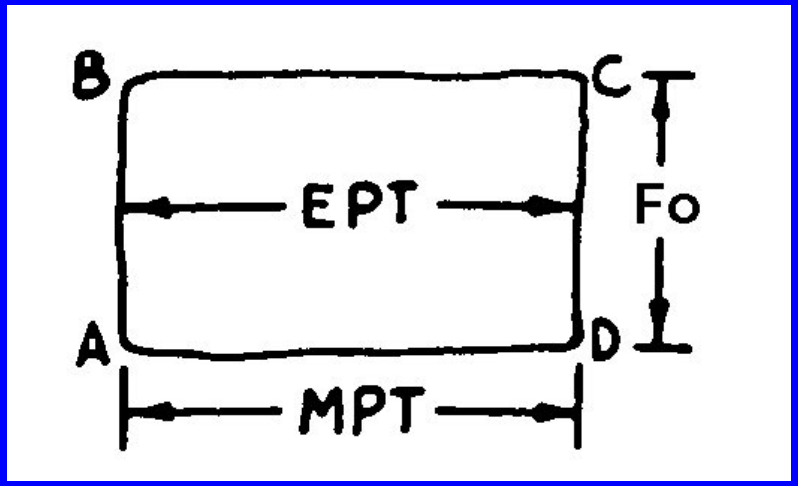
QRod is a Simple User-friendly Practical Beam Pumping Design Program

- Designer Implements State of the Art Beam Pumping Design Technology
- Design and Predict Performance of Sucker Rod Beam Pumping Installations
- Wave Equation Predicts Surface Dynamometer Loads and Polished Rod Position
- Immediately Evaluate Effect of Changing Tubing Anchor, Stroke Length, Stroke Rate, and Pump Diameter

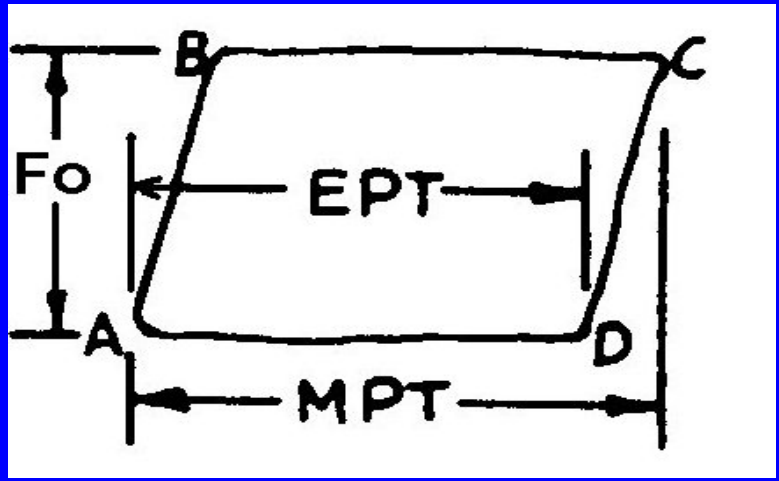
Download free of charge from:
www.echometer.com\software\index.html

QRod Pump Cards: Normal Full Pump

Tubing anchored, EPT=MPT.

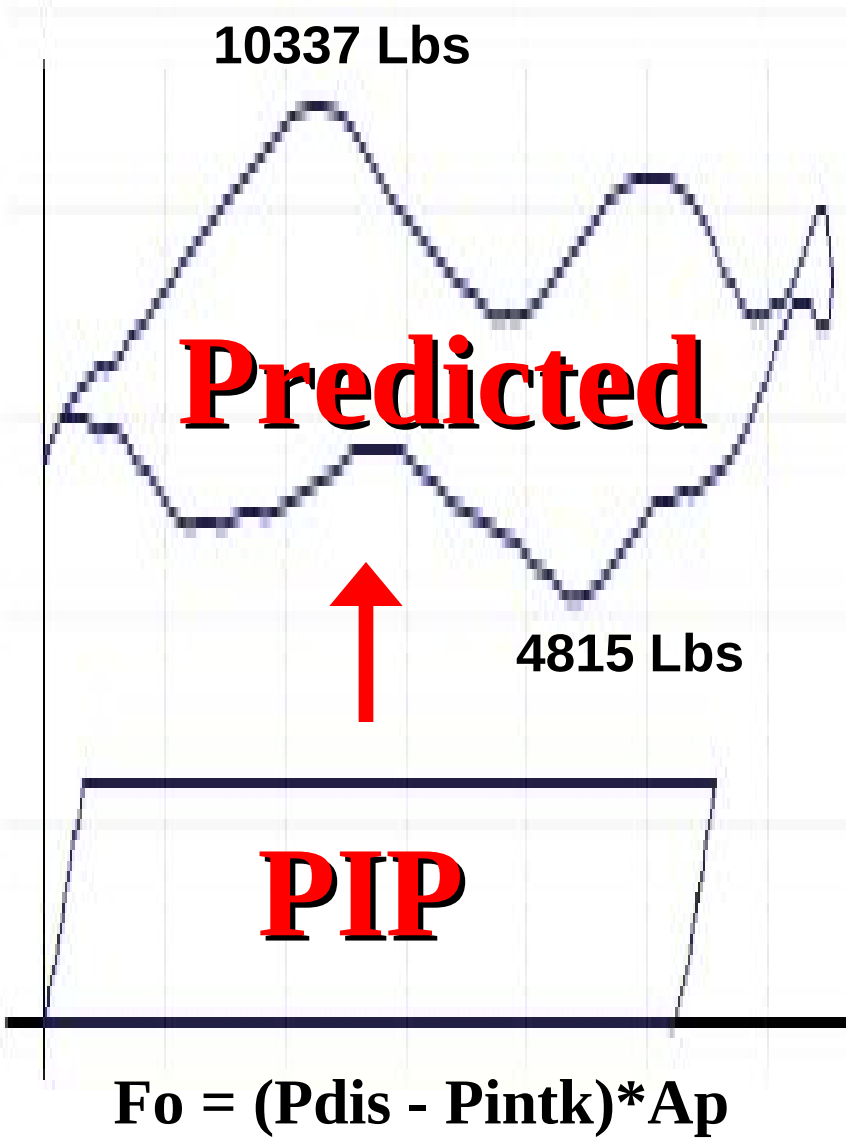


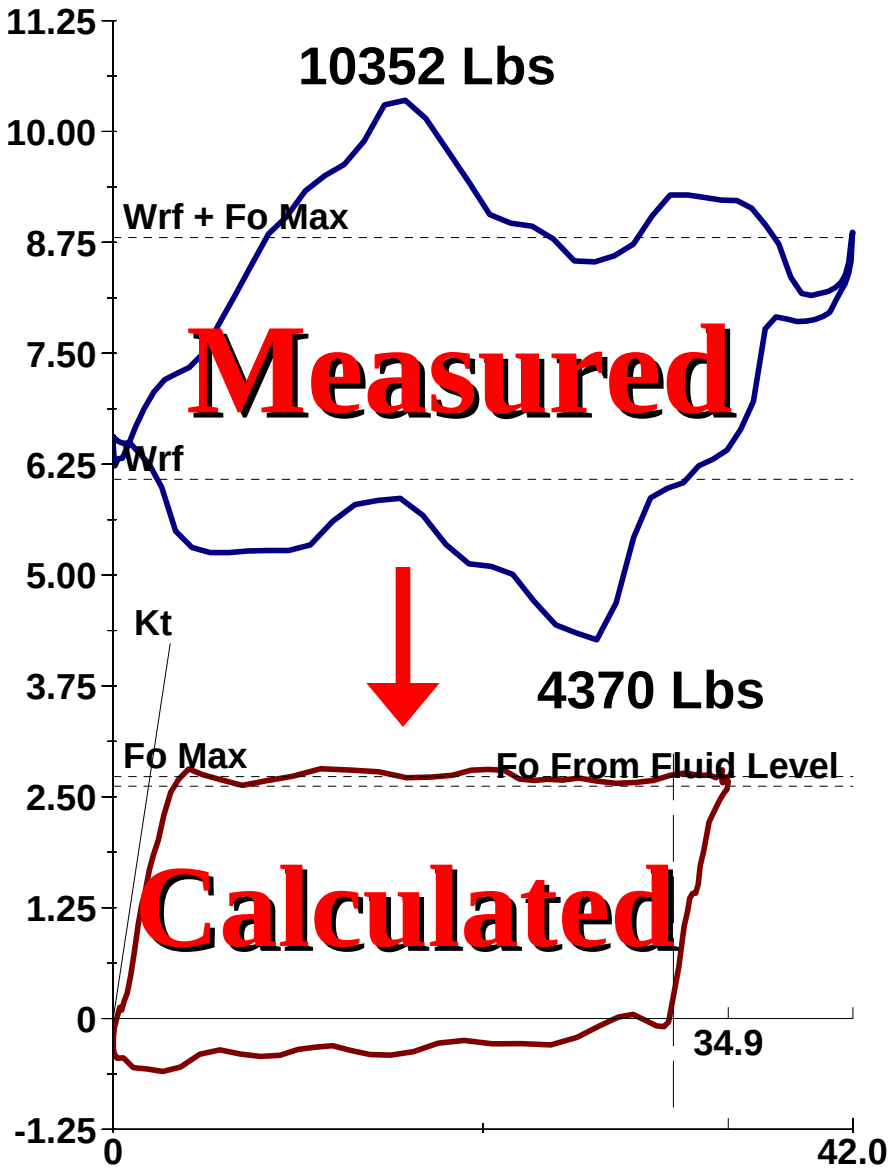
Unanchored tubing, EPT<MPT



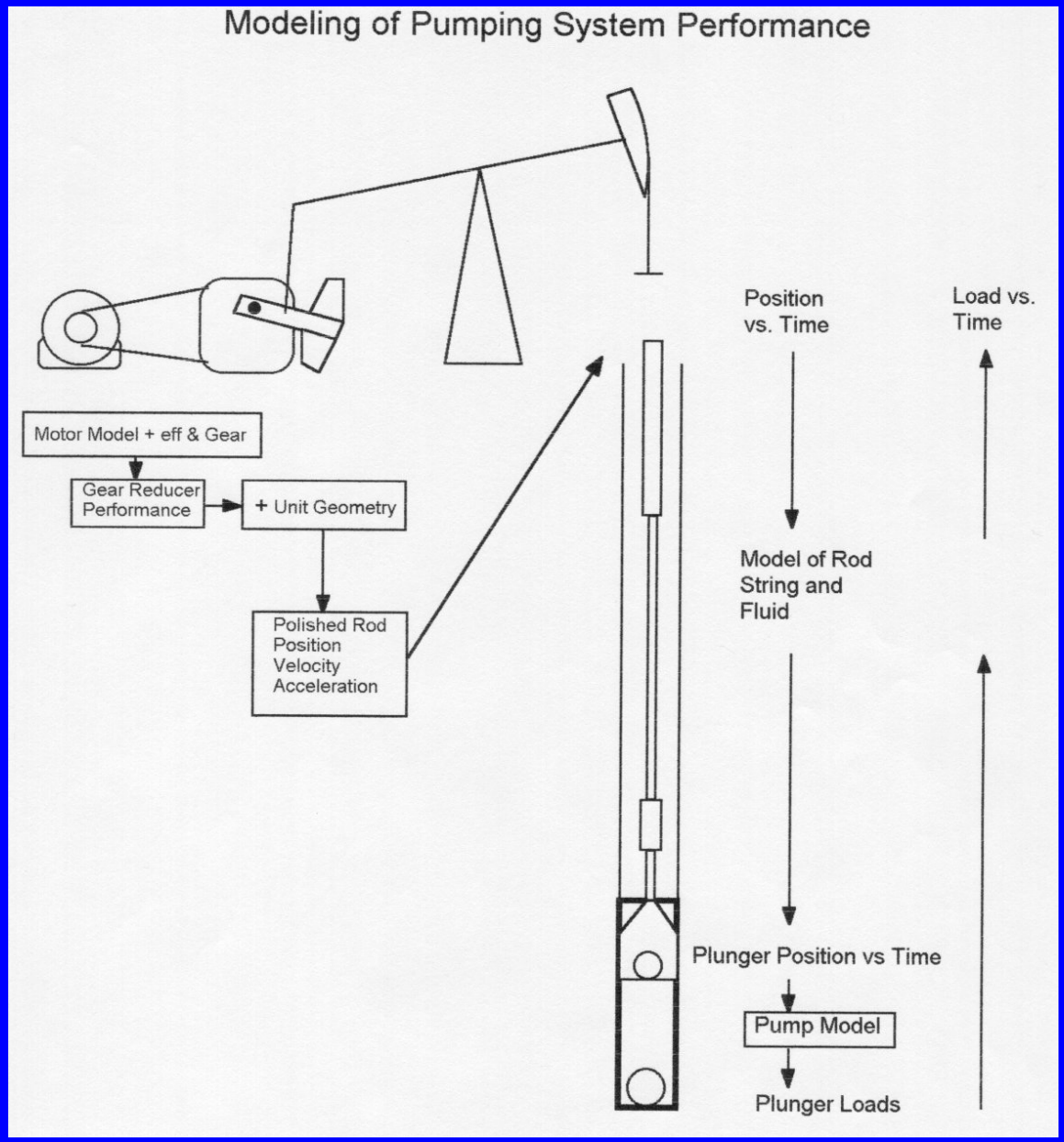
1. **Pumping-Full of Liquid**
2. **No gas in Pump.**
3. **Valves Not Leaking**
4. **Pump functioning properly.**

Predictive and Diagnostic Models

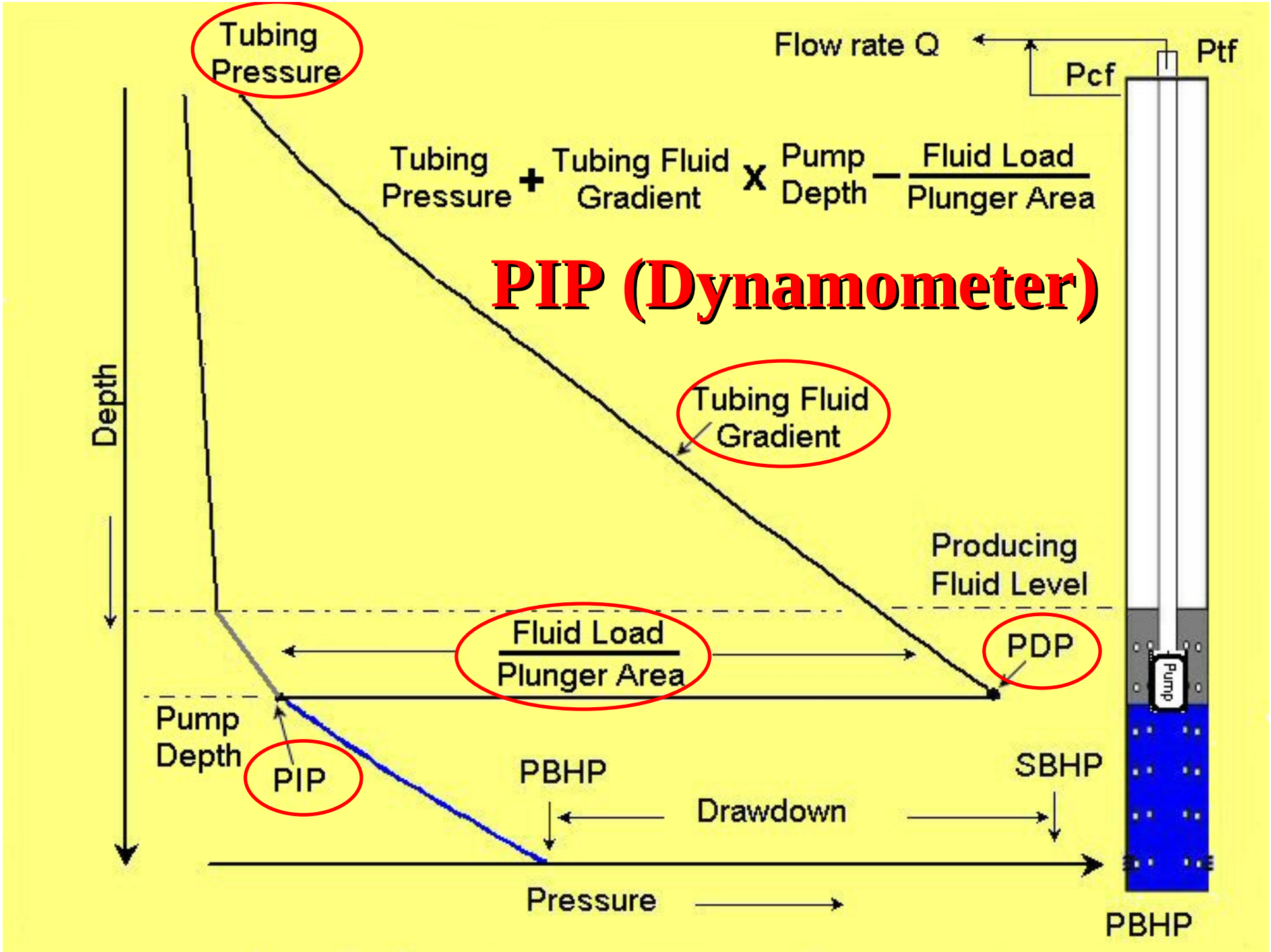




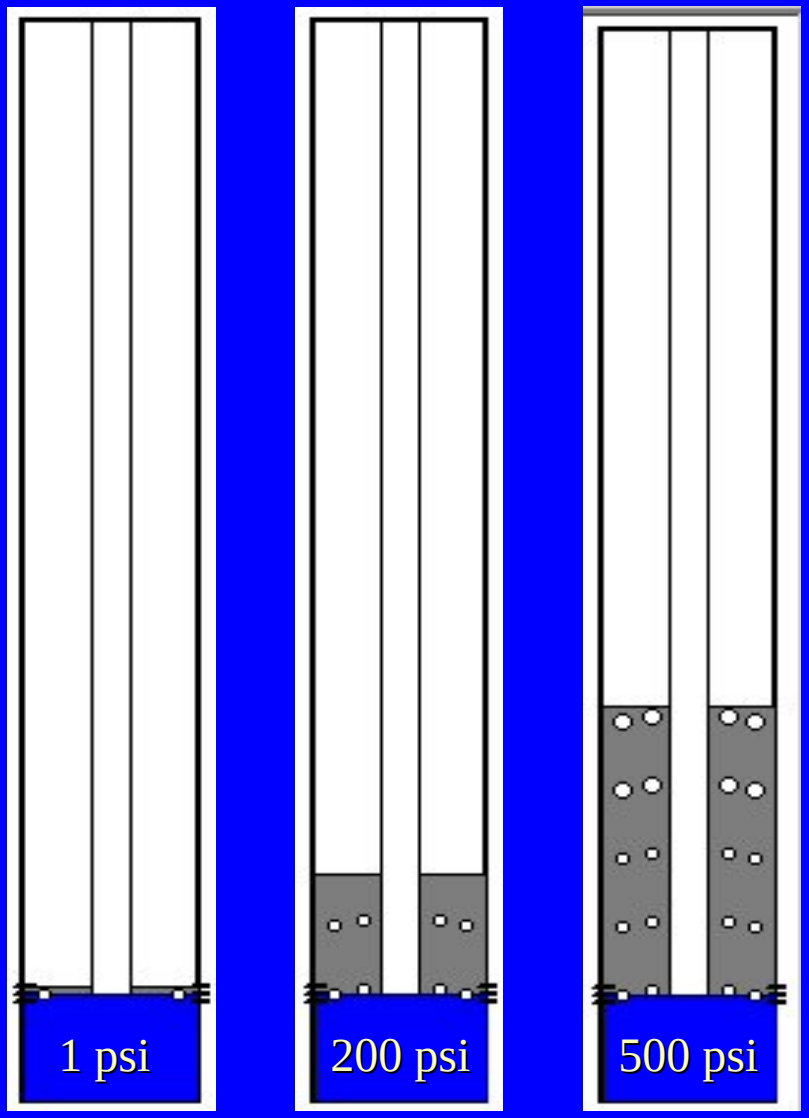
Beam Pumping Simulator



1. Uses the pump intake pressure to determine the load the pump applies to the rods.
2. Mathematically simulates the motion of the surface unit
3. Solves the partial differential equation describing the motion of the rod string
4. Calculates the surface loads, pump velocity and position.
5. Determines gear box torque and proper counter balance


Tubing Pressure
Flow rate Q
Ptf
Pcf
Tubing Pressure + Tubing Fluid Gradient x Pump Depth − Fluid Load / Plunger Area
PIP (Dynamometer)
Depth
Tubing Fluid Gradient
Producing Fluid Level
Fluid Load / Plunger Area
PDP
Pump
Pump Depth
PIP
PBHP
SBHP
Drawdown
Pressure
PBHP

Fluid Load is a Function of Pump Intake Pressure



Example:
2260 Psi Discharge Pressure

PIP (Psig)	1	200	500
Fo (Lbs)	4000	3600	3100
Height Gas Free Oil (Csg)	0	602	1514
Fo/ Fomax	100.0%	90.0%	77.5%
Height Oil /Pump Depth	0.0%	11.8%	29.7%

Pump Intake Pressure helps lift fluid to surface.

Full Pump Card as a Function of Pump Intake Pressure

Echometer QRod 2.4

File Tools Help

Title: My QRod Test Run

Design Inputs

Unit	CWConv	
Pump Depth	5,040	ft
Surface Stroke Length	100	in
Pump Diameter	1.500	in
Tubing Size	2.875" (6.4 lb/ft) 2.441" ID	

☑ Anchored Tubing

Rods

◉ Steel Rods

○ Fiberglass and Steel Rods

Rod Number	76
Rod Grade	D

Results

Rate (100% Pump eff.)	227	bbl/day
Rate (95 % Pump eff.)	215	bbl/day
Rod Taper, %	34.0, 66.0	
Top Rod Loading	78.5	%
Min API Unit Rating	456-173-100	
Min NEMA D Motor Size	20.3	hp
Polished Rod Power	11.3	hp
TVLoad	12,159	lbs
SVLoad	8,163	lbs

Calculate from SPM or Target Rate

◉ Stroke Rate << 9.6 >> SPM

○ Target Rate << 215 >> bbl/day

Calculate

Default Settings

Total Sinker Bar Weight	0	lbs	Damping Factor	0.1	
Fluid Specific Gravity	1	$H_2O = 1$	Unit Efficiency	95	%
Tubing Pressure	80	psi	Pump Efficiency	95	%
Casing Pressure	0	psi			

You may enter Pump Intake Pressure directly, or calculate it from Reservoir Pressure and Productivity Index.

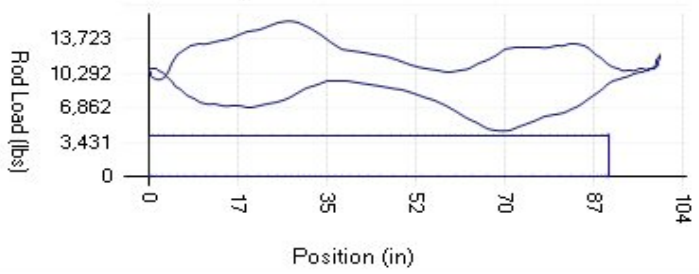
◉ Pump Intake Pressure 1

○ Reservoir Pressure 1000 psi

Productivity Index 2.000 bbl/day/psi

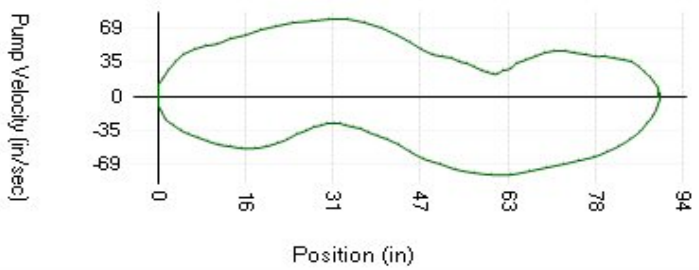
Echometer Company Phone: (940) 767-4334 E-Mail: info@echometer.com

Dynamometer Cards

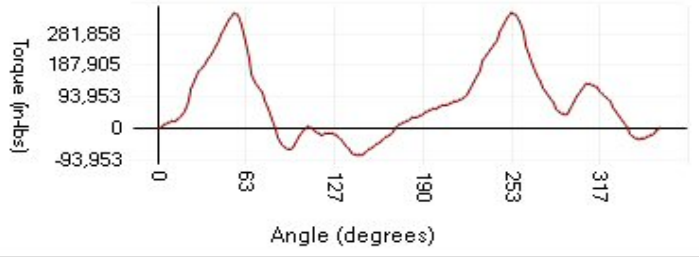


PPRL 15,595 lbs	MPRL 4,606 lbs	Fo 3,996 lbs
Pump Stroke 90.0 in	Static Stretch 16.2 in	Overtravel 6.2 in
Fo/Skr 0.162	Kr 247 lb/in	Kt 887 lb/in

Pump Velocity vs. Position



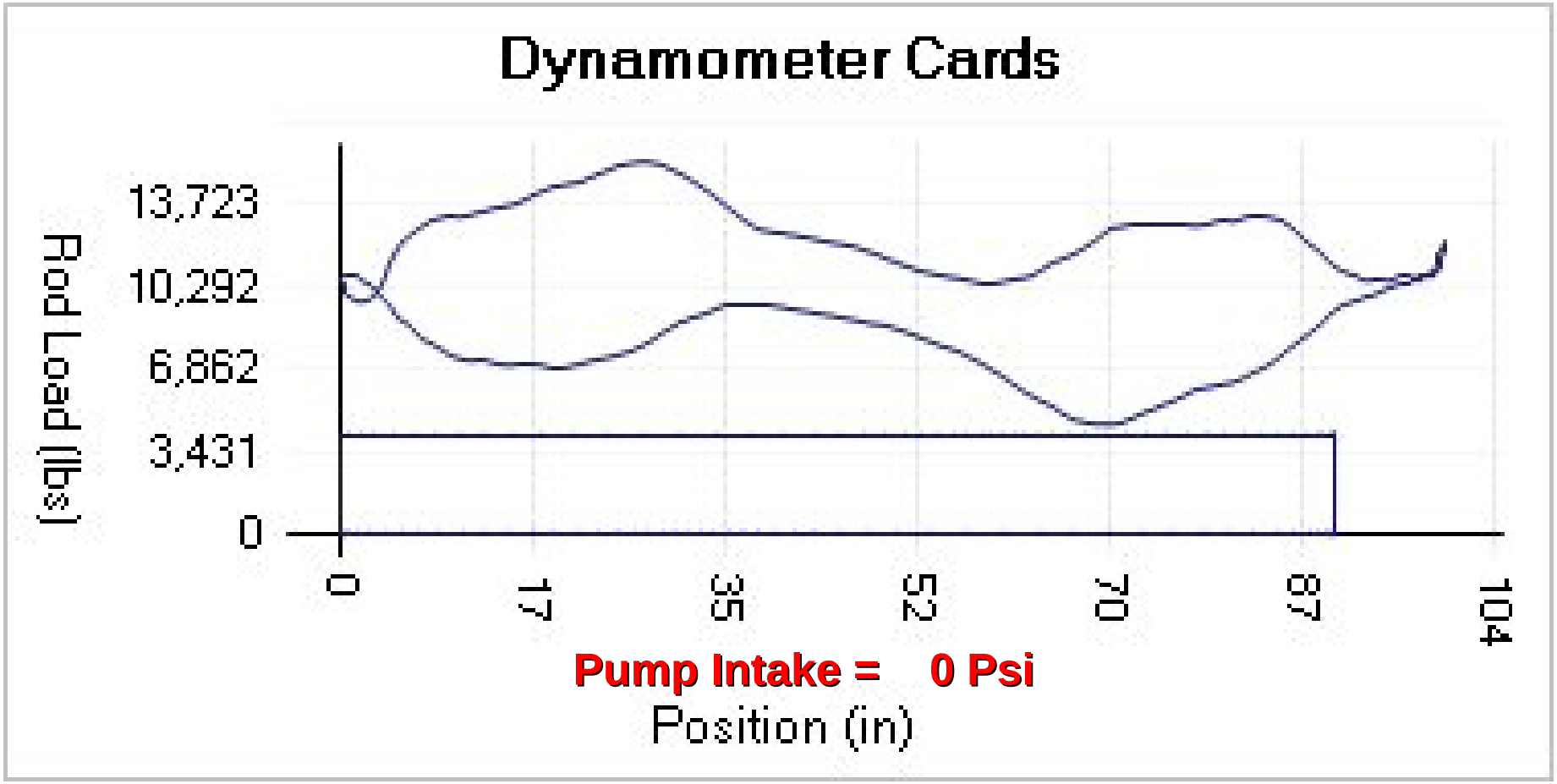
Torque



Peak Gear Box Torque	346	Kin-lbs
Counter Balance Moment	613	Kin-lbs
Counter Balance Effect	12,908	lbs

Full Pump Card as a Function of Pump Intake Pressure

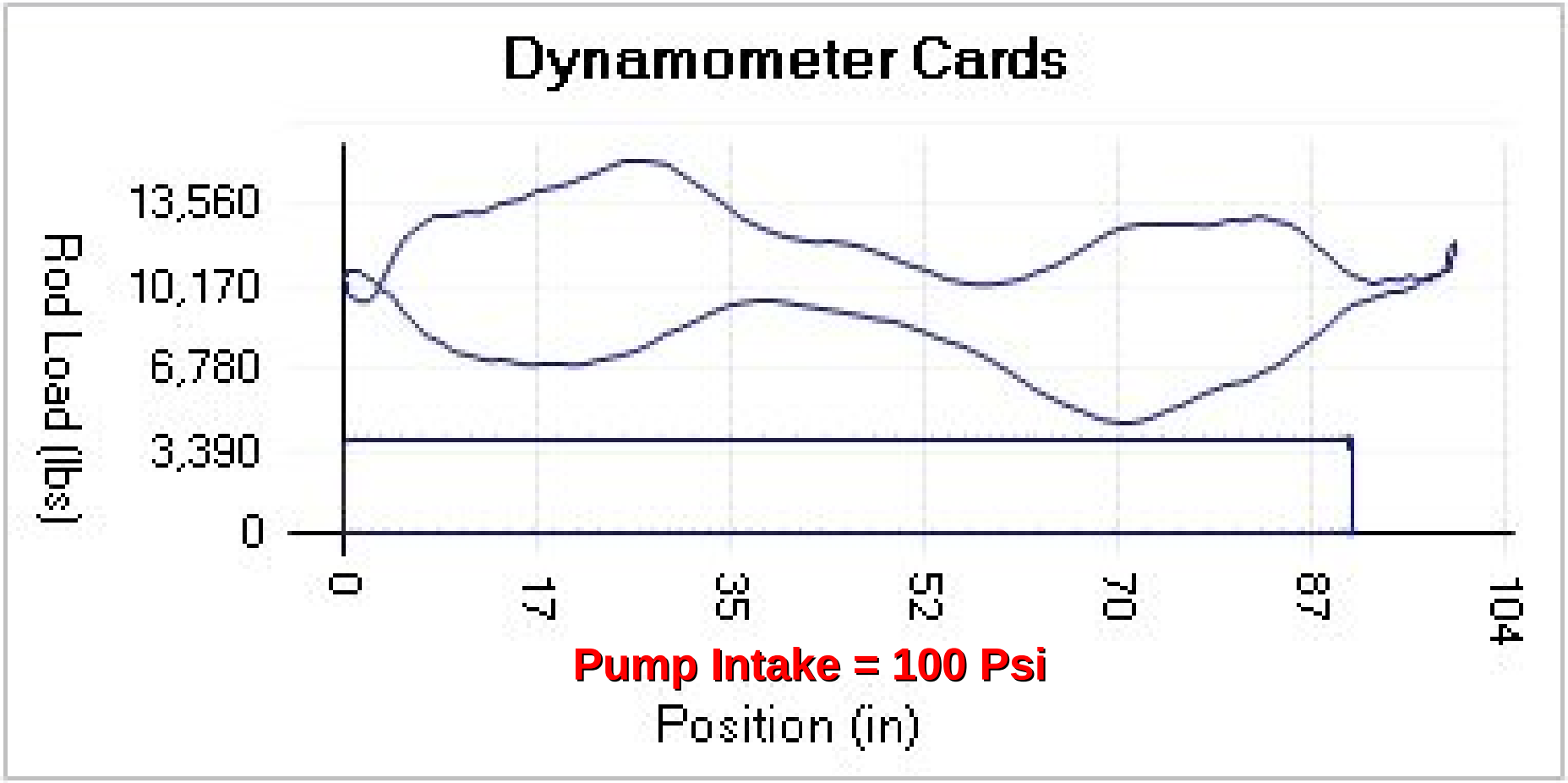
Echometer QRod 2.4



PPRL 15,595 lbs	MPRL 4,606 lbs	Fo 3,996 lbs
Pump Stroke 90.0 in	Static Stretch 16.2 in	Overtravel 6.2 in
Fo/Skr 0.162	Kr 247 lb/in	Kt 887 lb/in

Full Pump Card as a Function of Pump Intake Pressure

Echometer QRod 2.4



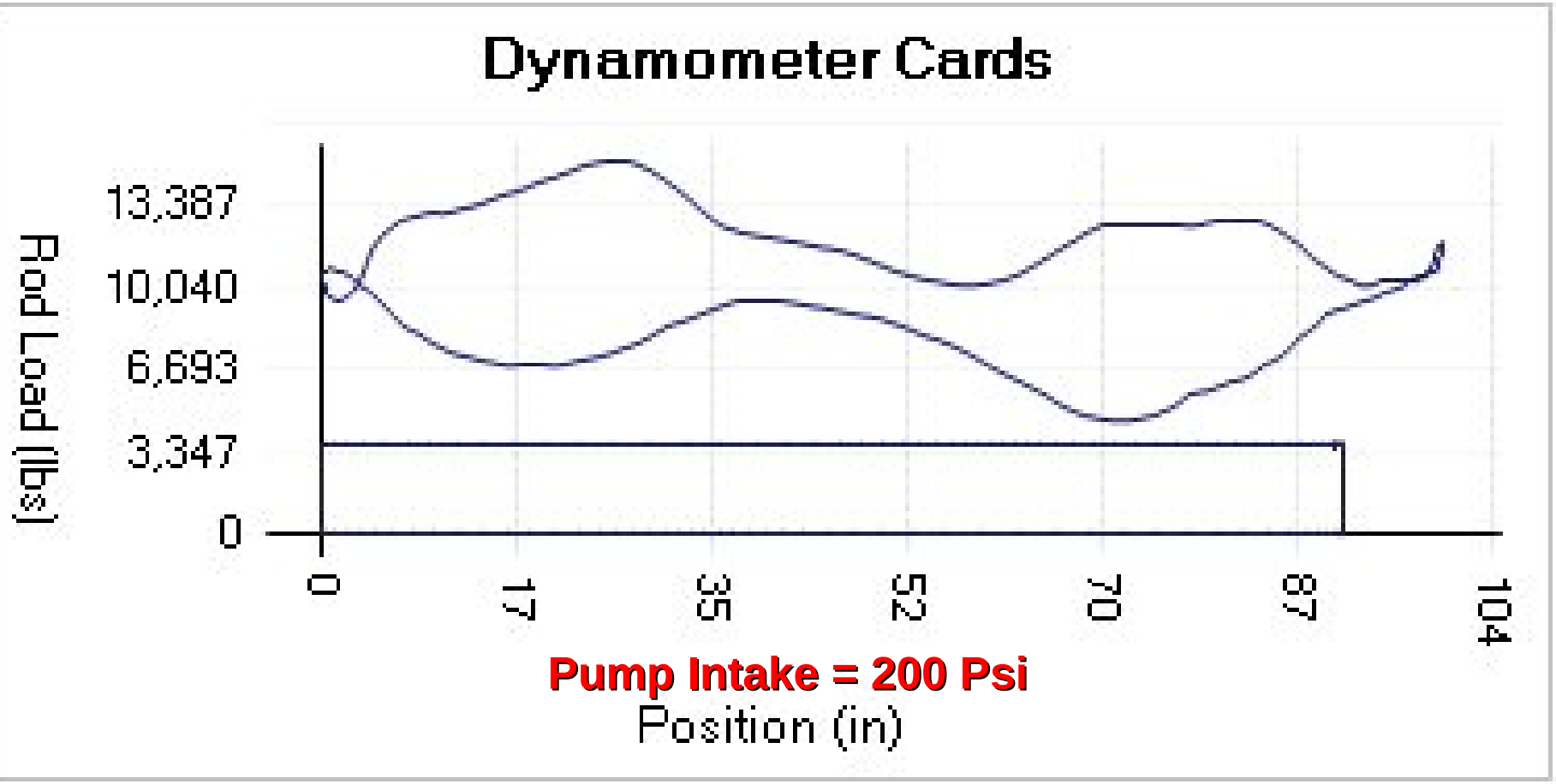
PPRL 15,409 lbs
Pump Stroke 90.5 in
Fo/Skr 0.155

MPRL 4,629 lbs
Static Stretch 15.5 in
Kr 247 lb/in

Fo 3,821 lbs
Overtravel 6.0 in
Kt 887 lb/in

Full Pump Card as a Function of Pump Intake Pressure

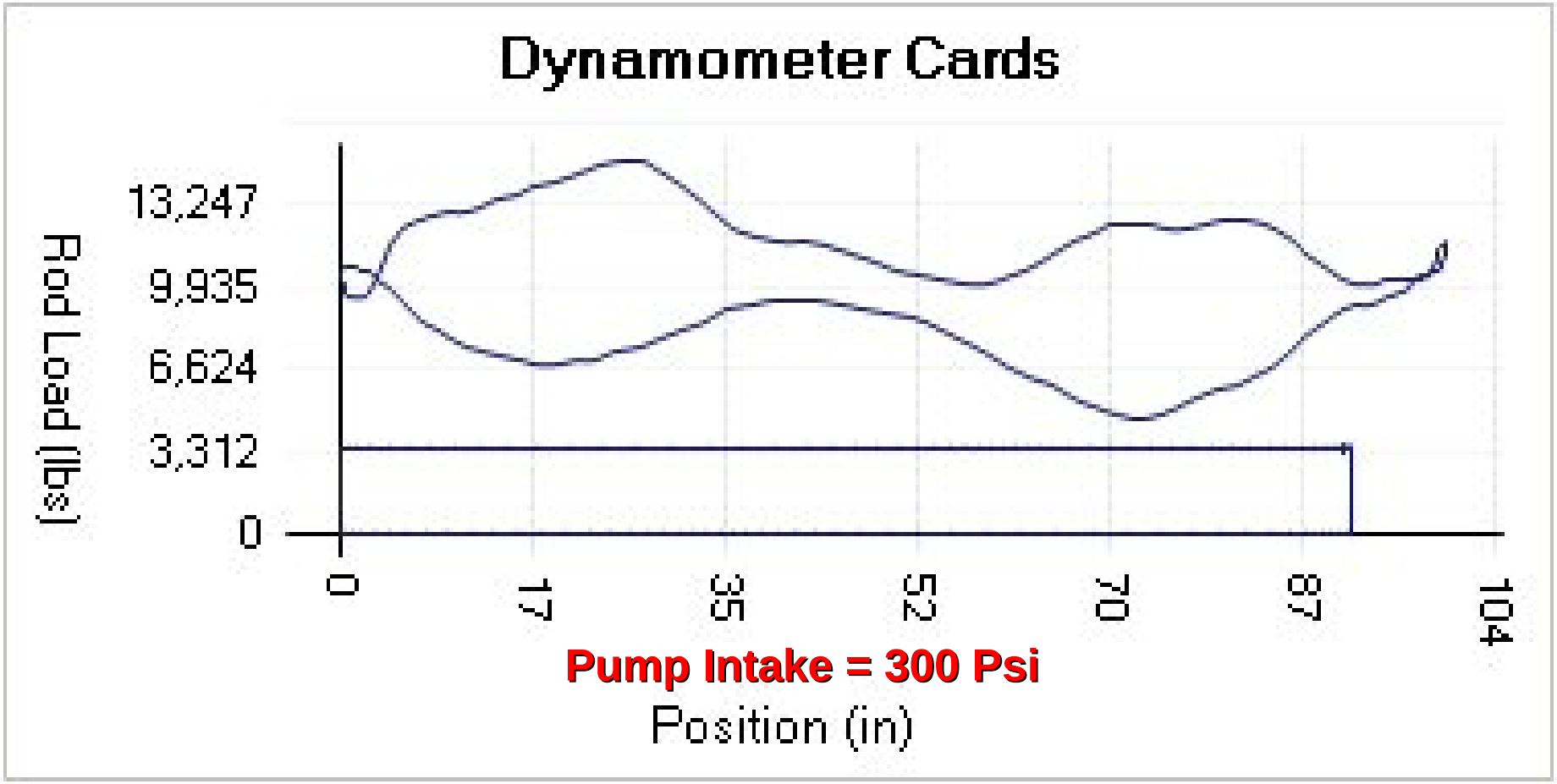
Echometer QRod 2.4



PPRL 15,249 lbs	MPRL 4,661 lbs	Fo 3,644 lbs
Pump Stroke 91.0 in	Static Stretch 14.8 in	Overtravel 5.8 in
Fo/Skr 0.148	Kr 247 lb/in	Kt 887 lb/in

Full Pump Card as a Function of Pump Intake Pressure

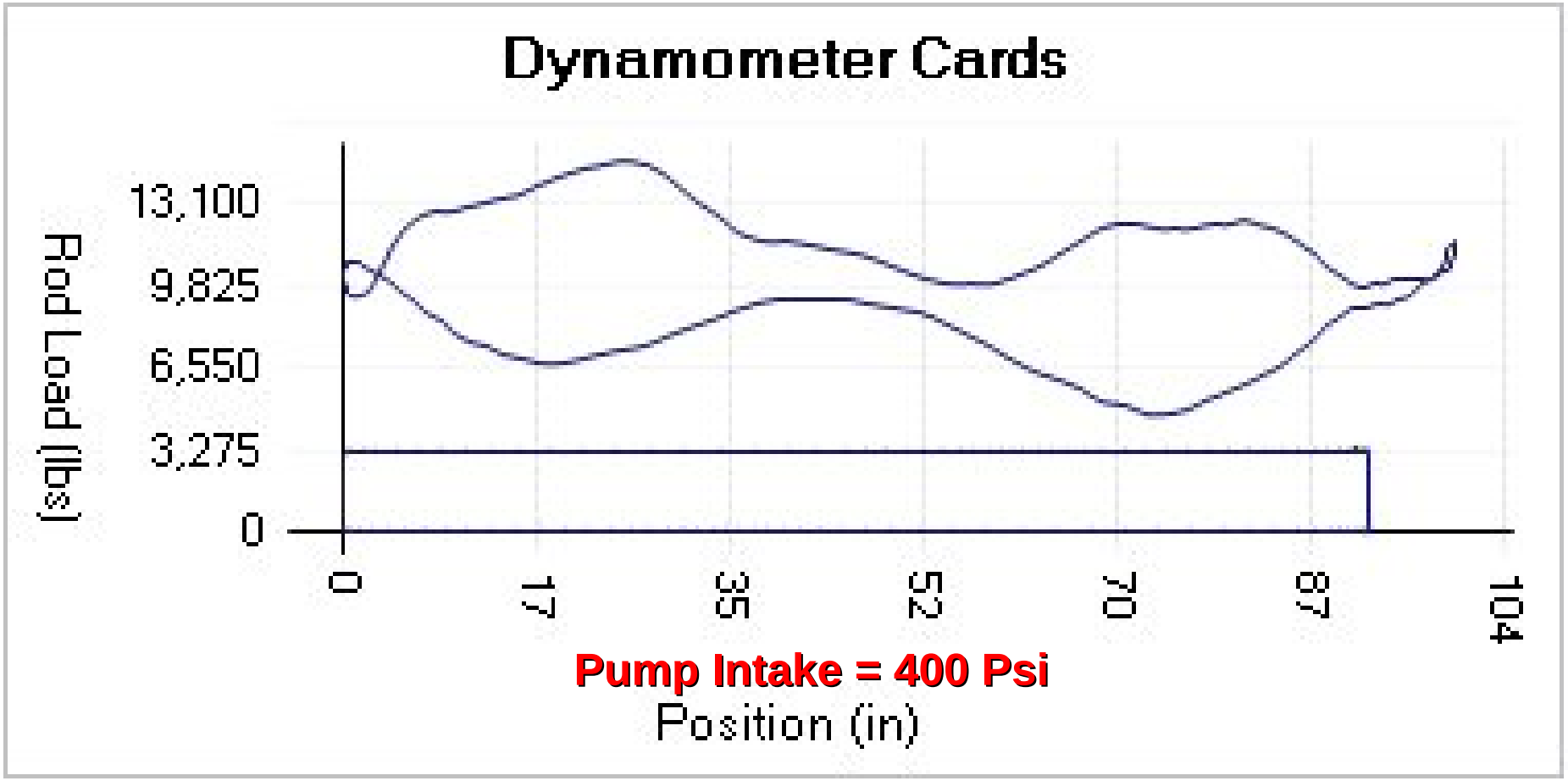
Echometer QRod 2.4



PPRL 15,054 lbs	MPRL 4,710 lbs	Fo 3,468 lbs
Pump Stroke 91.5 in	Static Stretch 14.0 in	Overtravel 5.6 in
Fo/Skr 0.140	Kr 247 lb/in	Kt 887 lb/in

Full Pump Card as a Function of Pump Intake Pressure

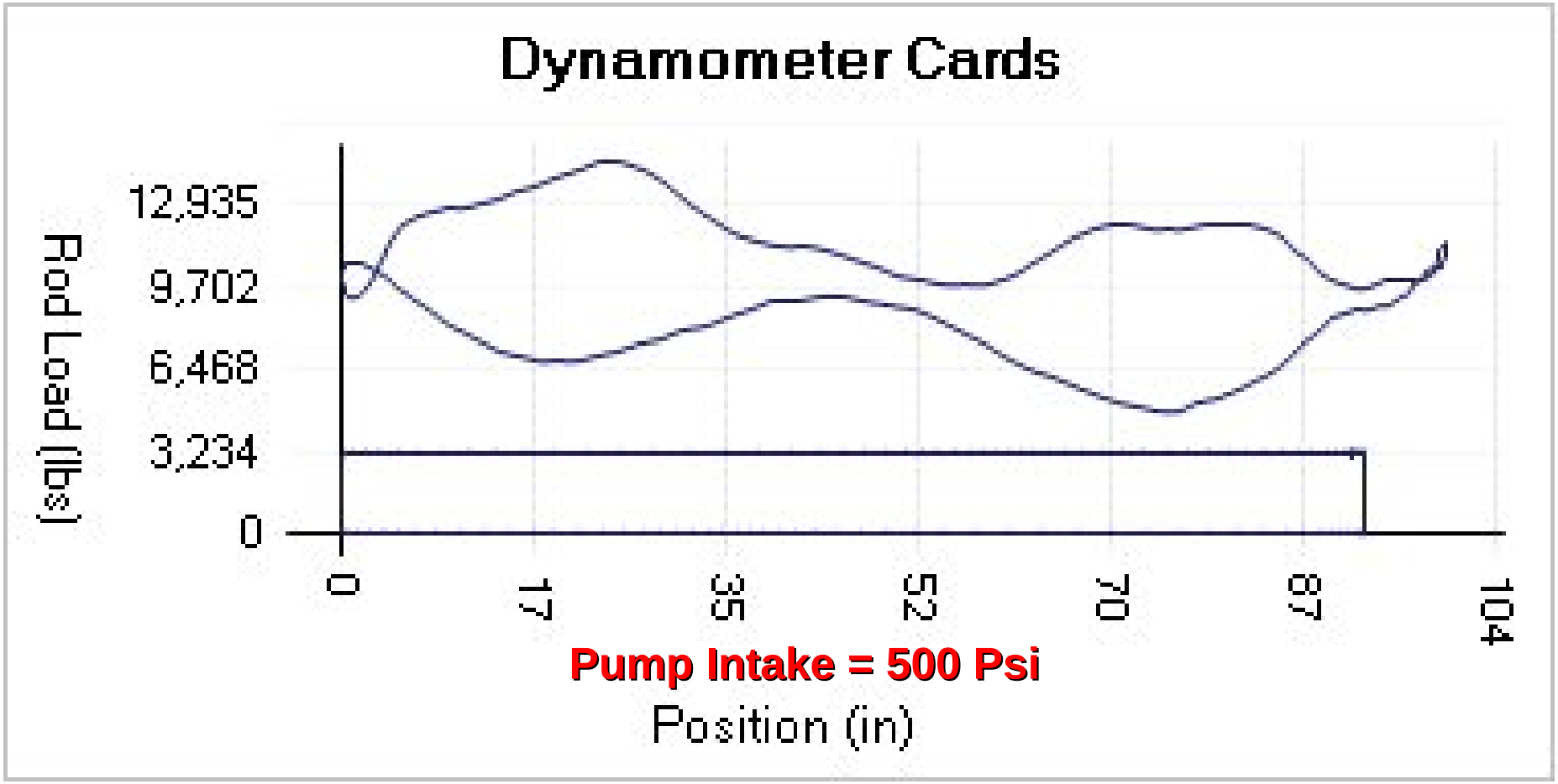
Echometer QRod 2.4



PPRL 14,886 lbs	MPRL 4,772 lbs	Fo 3,291 lbs
Pump Stroke 92.0 in	Static Stretch 13.3 in	Overtravel 5.3 in
Fo/Skr 0.133	Kr 247 lb/in	Kt 887 lb/in

Full Pump Card as a Function of Pump Intake Pressure

Echometer QRod 2.4

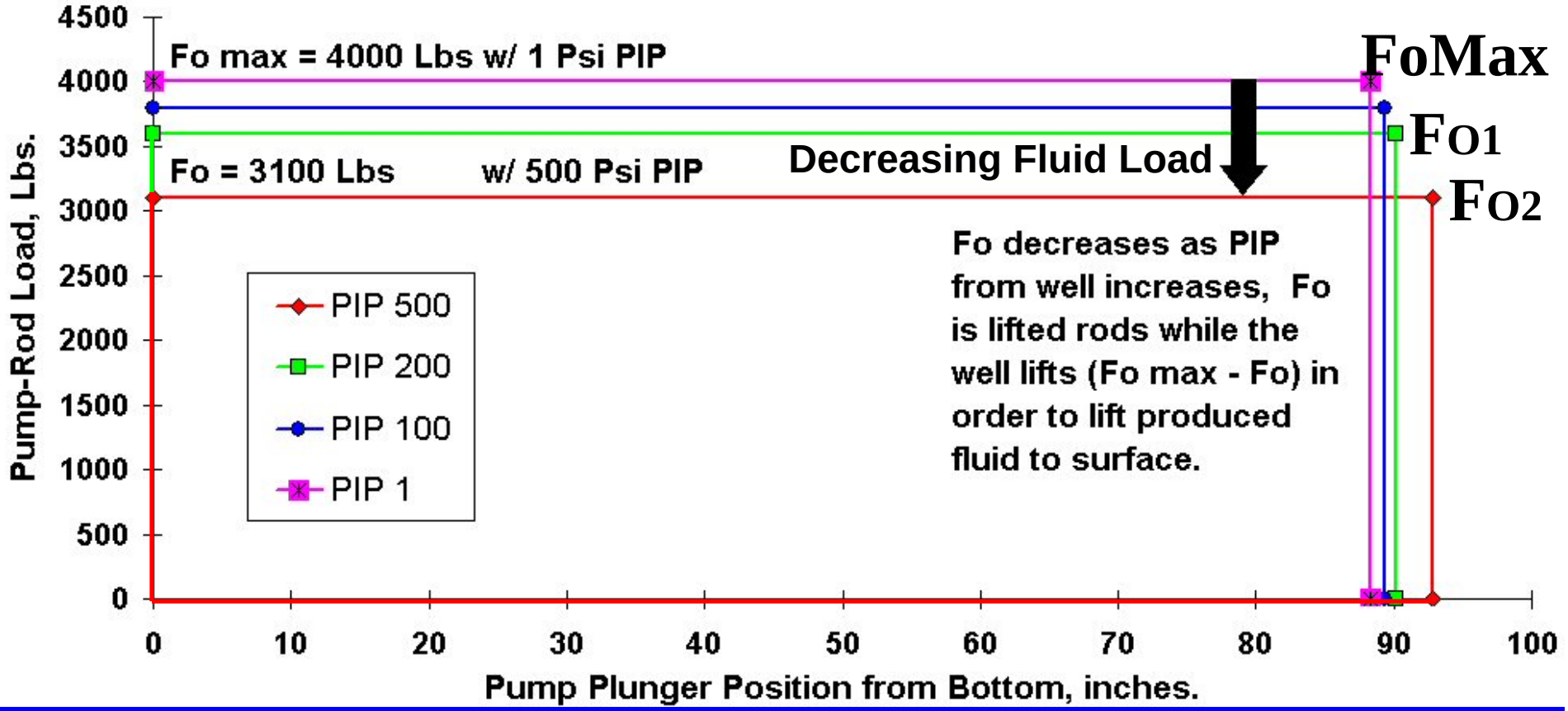


PPRL 14,709 lbs	MPRL 4,841 lbs	Fo 3,114 lbs
Pump Stroke 92.5 in	Static Stretch 12.6 in	Overtravel 5.1 in
Fo/Skr 0.126	Kr 247 lb/in	Kt 887 lb/in

Full Pump Card as a Function of Pump Intake Pressure

100% Liquid Fillage, 2260 Discharge Press., 1.5” Plunger

Fo = (Pdis - Pintk)*Ap



Pump Intake Pressure helps the Rods lift fluid to surface.

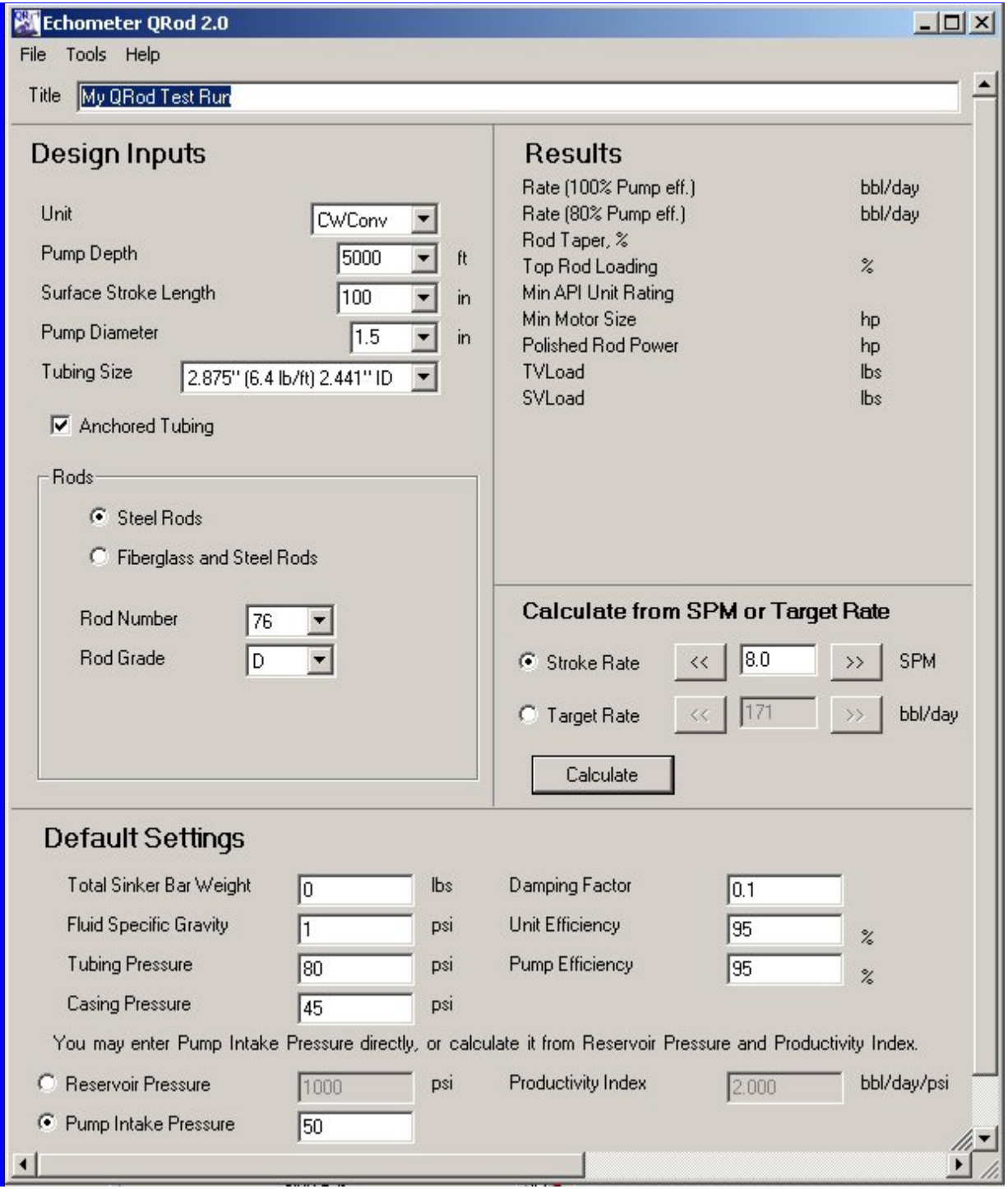
QRod Design

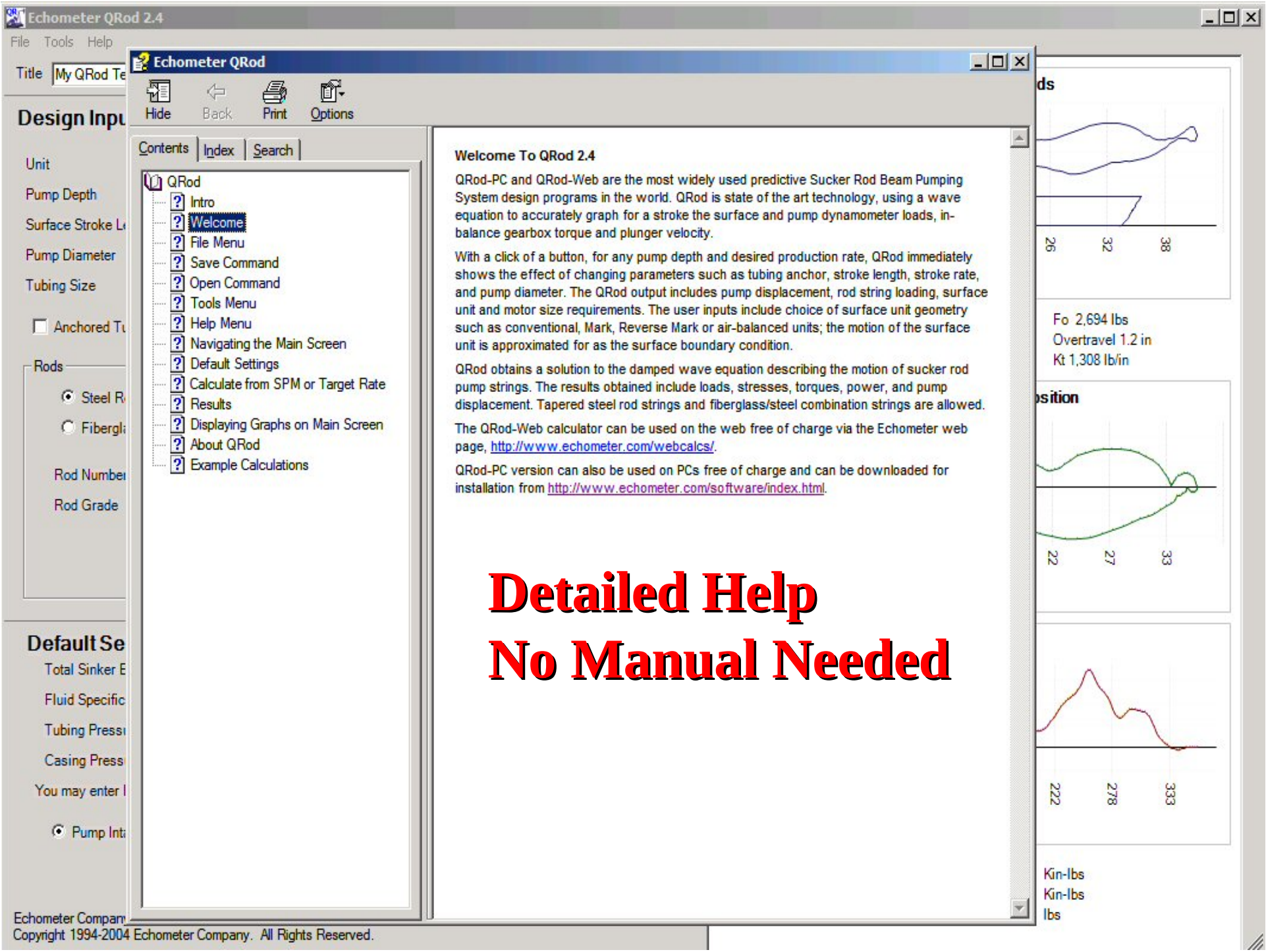
Primary Inputs:

1) ***Pump Inlet Pres.***
2) Pump Depth
3) Target Rate
4) Stroke Length
5) Pump Diameter
6) Stroke Rate

Secondary Inputs:

1) Unit Type
2) Rod String Type
3) Fluid Spec. Grav.
4) Tubing Pressure
5) Damping Factor
6) Anchored




Echometer QRod 2.4
File Tools Help
Title My QRod Te
Design Inpu
Unit
Pump Depth
Surface Stroke L
Pump Diameter
Tubing Size
Anchored Tu
Rods
Steel R
Fibergl
Rod Numbe
Rod Grade
Default Se
Total Sinker E
Fluid Specific
Tubing Press
Casing Press
You may enter
Pump Int
Echometer Compan
Copyright 1994-2004 Echometer Company. All Rights Reserved.
Echometer QRod
Hide
Back
Print
Options
Contents
Index
Search
QRod
Intro
Welcome
File Menu
Save Command
Open Command
Tools Menu
Help Menu
Navigating the Main Screen
Default Settings
Calculate from SPM or Target Rate
Results
Displaying Graphs on Main Screen
About QRod
Example Calculations
Welcome To QRod 2.4
QRod-PC and QRod-Web are the most widely used predictive Sucker Rod Beam Pumping System design programs in the world. QRod is state of the art technology, using a wave equation to accurately graph for a stroke the surface and pump dynamometer loads, in-balance gearbox torque and plunger velocity.
With a click of a button, for any pump depth and desired production rate, QRod immediately shows the effect of changing parameters such as tubing anchor, stroke length, stroke rate, and pump diameter. The QRod output includes pump displacement, rod string loading, surface unit and motor size requirements. The user inputs include choice of surface unit geometry such as conventional, Mark, Reverse Mark or air-balanced units; the motion of the surface unit is approximated for as the surface boundary condition.
QRod obtains a solution to the damped wave equation describing the motion of sucker rod pump strings. The results obtained include loads, stresses, torques, power, and pump displacement. Tapered steel rod strings and fiberglass/steel combination strings are allowed.
The QRod-Web calculator can be used on the web free of charge via the Echometer web page, http://www.echometer.com/webcalcs/.
QRod-PC version can also be used on PCs free of charge and can be downloaded for installation from http://www.echometer.com/software/index.html.
Detailed Help
No Manual Needed
ds
26
32
38
Fo 2,694 lbs
Overtravel 1.2 in
Kt 1,308 lb/in
sition
22
27
33
222
278
333
Kin-lbs
Kin-lbs
lbs

Echometer QRod 2.4

Archivo Útiles Ayuda

Título: Mi Prueba en QRod

Parametros de Entrada

Tipo de Balancín	CWConv	
Profundidad de la Bomba	5,000	ft
Carrera del balancín	100	in
Diámetro del Pistón	1.500	in
Diámetro de la Tubería	2.875" (6.4 lb/ft) 2.441" ID	

☐ Tubería anclada

Varillas

◉ Varillas de acero

○ Varillas fibra de vidrio y acero

Número API: 76

Clase de varillas: D

Resultados

Caudal (100% eficiencia bomba)	180	bbl/day
Caudal (95 % eficiencia bomba.)	171	bbl/day
% varillas para cada secció	34.0, 66.0	
Carga de las varillas en superfici	72.3	%
Capacidad (API) mínima balancín	320-173-100	
Capacidad mínima potencia motor	15.8	hp
Potencia en barra pulida	8.5	hp
Carga válvula viajera	11,977	lbs
Carga válvula fija	8,098	lbs

Spanish

Calcular en base a SPM o Caudal deseado

◉ Velocidad de bombeo < 8.3 > SPM

○ Caudal deseado < 171 > bbl/day

Calcular

Valores de Ajuste Predeterminados

Peso total barras de lastre	0	lbs	Factor de amortiguamento	0.1	
Gravedad específica del fluido	1	$H_2O = 1$	Eficiencia del balancín	95	%
Presión de la tubería	80	psi	Eficiencia de la bomba	95	%
Presión del revestidor	45	psi			

La presión de entrada de la bomba puede introducirse directamente o calcularse a partir de la presión de vacimiento e índice de productividad.

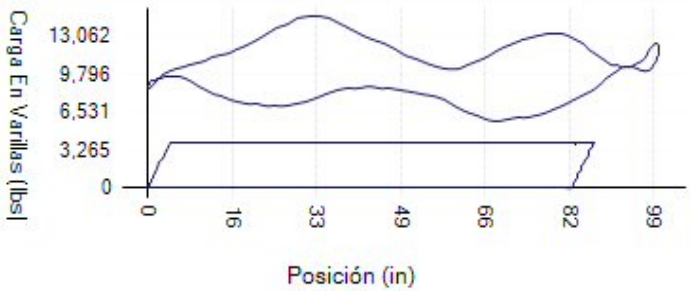
◉ Presión de entrada de la bomba 50

○ Presión de Yacimiento 1000 psi

Indice de Productividad 2.000 bbl/day/psi

Echometer Company Phone: (940) 767-4334 E-Mail: info@echometer.com

Cartas Dinagráficas

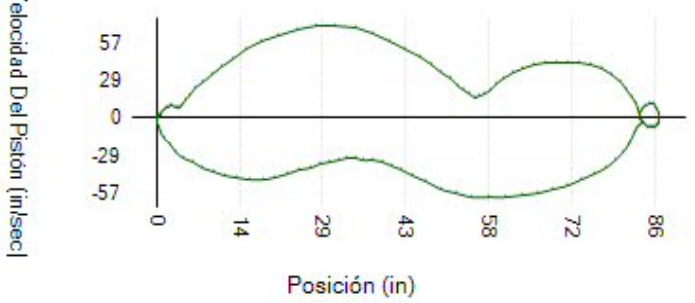


Carga Mínima 14,873 lbs | Carga Máxima 5,817 lbs | Fo 3,879 lbs

Carrera del piston 82.9 in | Elongación 15.6 in | Sobrecarrera 2.8 in

Fo/Skr 0.156 | Kr 249 lb/in | Kt 894 lb/in

Velocidad Del Pistón vs. Posición



Torque

Torque máximo	291	Kin-lbs
Momento de Contrapesas	621	Kin-lbs
Efecto de Contrapesas	13,087	lbs

One Page Report

Programa QRod
Título: Mi Prueba en QRod

Resultados

Caudal (100% eficiencia bomba)	180 bbl/day
Caudal (95 eficiencia bomba)	171 bbl/day
% varillas para cada sección	34.0, 66.0
Carga de las varillas en superficie	72.3 %
Capacidad (API) mínima balancín	320-173-100
Capacidad mínima potencia motor	15.8 hp
Potencia en barra pulida	8.5 hp
Carga válvula viajera	11,977 lbs
Carga válvula fija	8,098 lbs

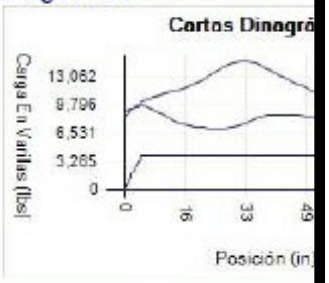
Parametros de Entrada

Tipo de Balancín	CWConv
Profundidad de la Bomba	5,000 ft
Caudal deseado	171 bbl/day
Velocidad de bombeo	8.3 SPM
Carrera del balancín	100 in
Diámetro del Pistón	1.500 in
Diámetro de la tubería	2.875" (6.4 lb/ft) 2.441" ID in
Tubería anclada	No
Tipo de varillas	Varillas de acero
Número API de las varillas	76
Clase de varillas	D

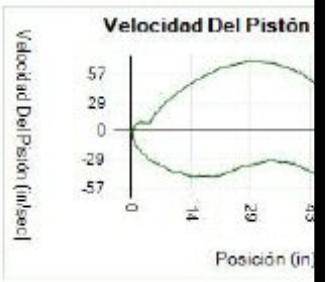
Valores de Ajuste Predeterminados

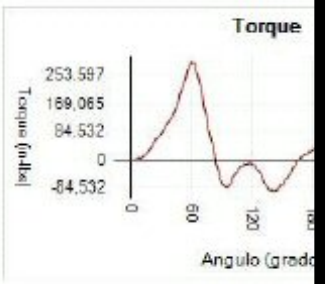
Peso total barras de lastre	0 lb
Gravedad específica del fluido	1
Presión de la tubería	80 psi
Presión del revestidor	45 psi
Factor de amortiguamento	0.1
Eficiencia del balancín	95
Eficiencia de la bomba	95
Presión de entrada de la bomba	50 psi

Diagramas



Carga Máxima	14,873 lbs	Carga Mínima	5, lb
Carrera del piston	82.9 in	Elongación	15
Fo/Skr	0.156	Kr	24





Torque máximo	
Momento de Contrapesas	
Efecto de Contrapesas	

en Venezuela: varilla = cabilla

QRod Version 2.3

Echometer Company

QRod Application
Title: My QRod Test Run

Results

Rate (100 % Pump Eff.)	180 bbl/day
Rate (95 Pump Eff.)	171 bbl/day
Rod Taper, %	34.0, 66.0
Top Rod Loading	72.3 %
Min API Unit Rating	320-173-100
Min Motor Size	15.8 hp
Polished Rod Power	8.5 hp
TVLoad	11,977 lbs
SVLoad	8,098 lbs

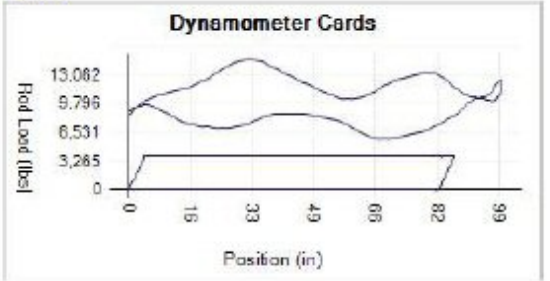
Design Inputs

Unit Type	CWConv
Pump Depth	5,000 ft
Target Rate	171 bbl/day
Stroke Rate	8.3 SPM
Surface Stroke Length	100 in
Pump diameter	1.500 in
Tubing Size	2.875" (6.4 lb/ft) 2.441" ID in
Anchored Tubing	No
Rod Type	Steel Rods
Rod Number	76
Rod Grade	D

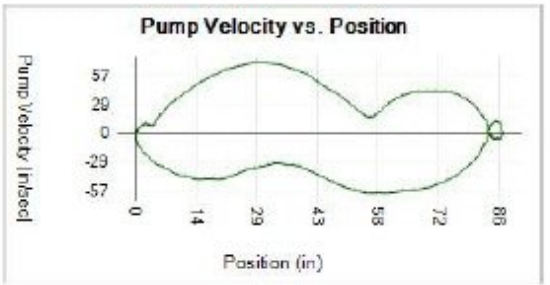
Default Settings

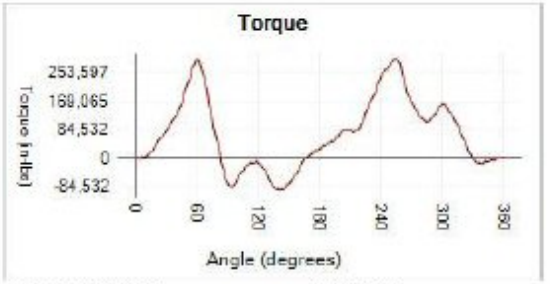
Total Sinker Bar Weight	0 lb
Fluid Specific Gravity	1
Tubing Pressure	80 psi
Casing Pressure	45 psi
Damping Factor	0.1
Unit Efficiency	95
Pump Efficiency	95
Pump Intake Pressure	50 psi

Plots



PPRL	14,873 lbs	MPRL	5,817 lbs	Fo	3,879 lbs
Pump Stroke Length	82.9 in	Static Stretch	15.6 in	Overtravel	2.8 in
Fo/Skr	0.156	Kr	249 lb/in	Kl	894 lb/in





Peak GearBox Torque	291 Kin-lbs
Counter Balance Moment	621 Kin-lbs
Counter Balance Effect	13,087 lbs

QRod Version 2.3

Echometer Company
5001 Ditto Lane
Wichita Falls, Texas 76302
U.S.A.

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Fax: (940) 723-7507
E-Mail: info@echometer.com

PUMPING PERFORMANCE GUIDE

From Predictive Dynamometer Design Programs:

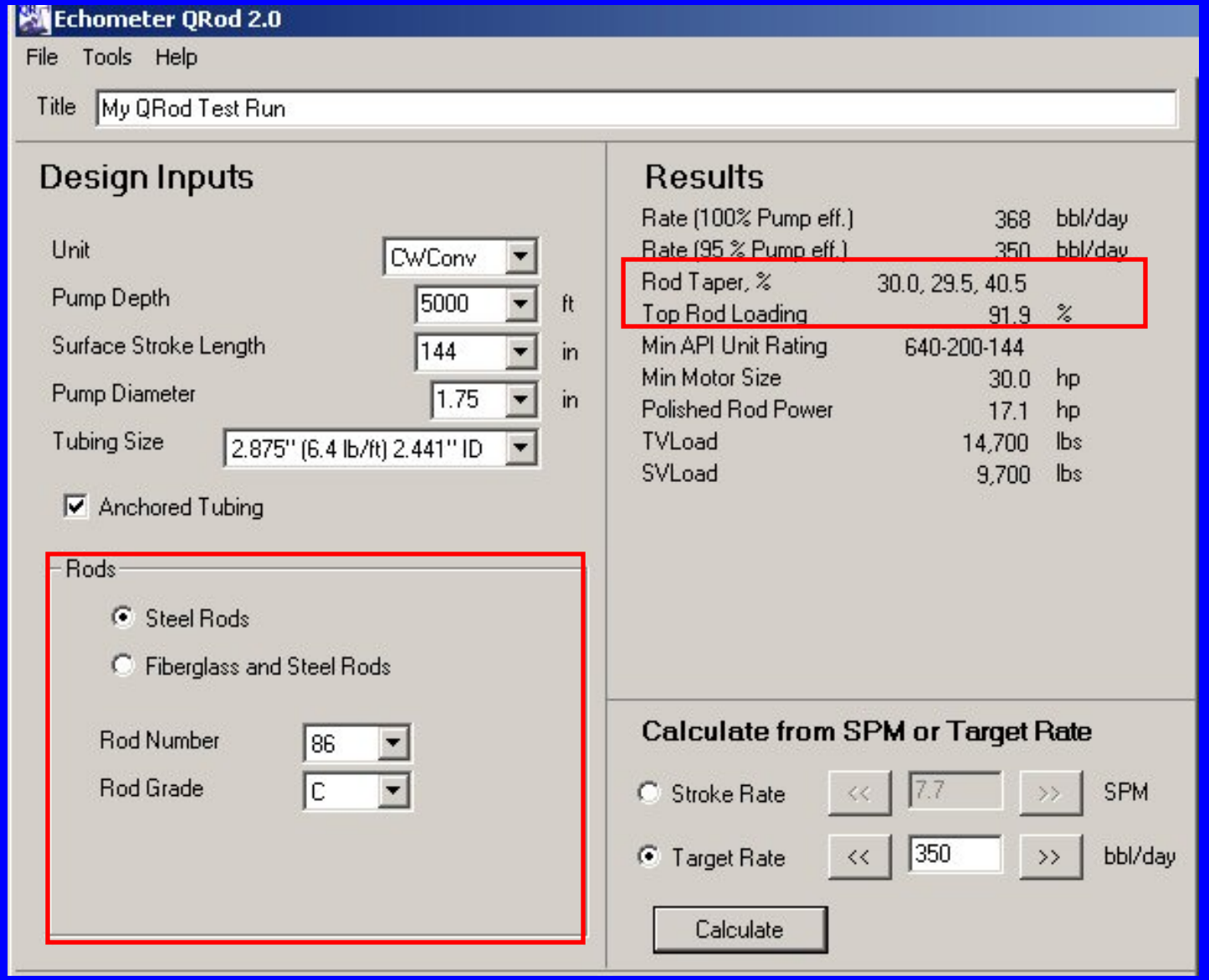
1. Is the pumping system operating as expected?
2. Is the predicted dynamometer in agreement with accurately measured horseshoe dynamometer data?
3. If not, the design program may have incorrect data, or the software is not properly predicting well performance.
4. Can the performance be improved by a change in pump size, polished rod stroke length, SPM or other factors?

Design a pumping system to pump 350 BPD from a depth of 5000 ft with a .95 fluid specific gravity

API RP11L method determines percentage of each rod size and depends on the pump diameter; resulting in a balanced design with approximately equal stresses at the top of each rod section.

86 - 3 taper rod string 30.0% of 1 inch, 29.5% of 7/8 inch and 40.5% of ¾ inch rods.

Loading on the top rod is 91.9% of the allowable for grade "C" rods and calculated using the modified Goodman diagram method.



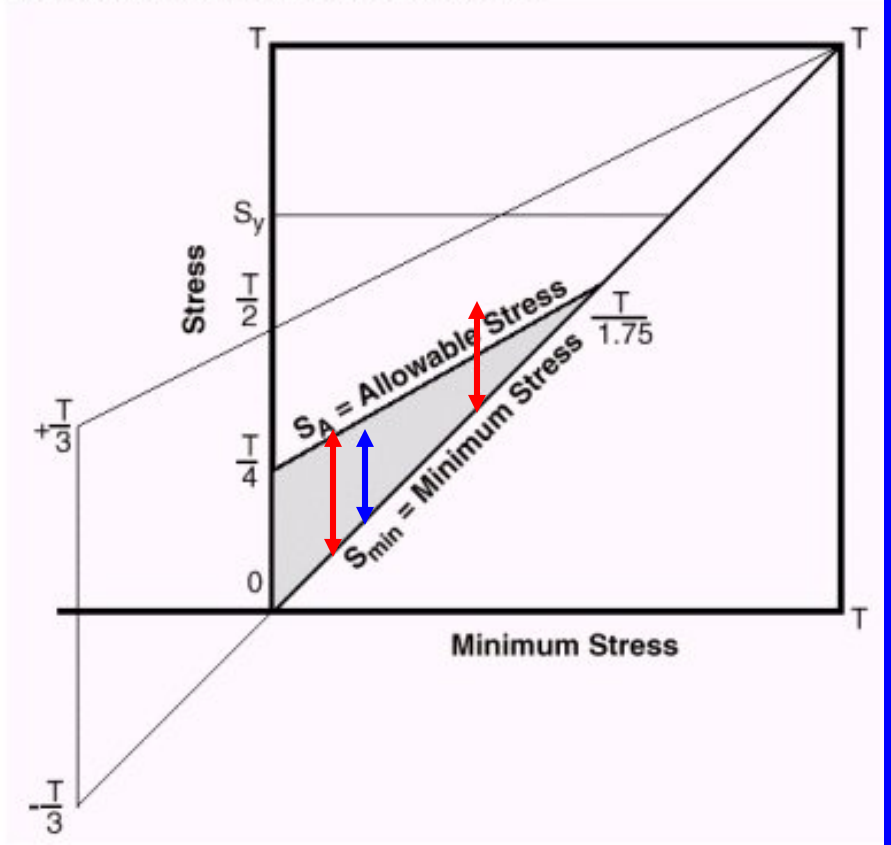
Rod String Design:

Rod at the top of each Rod String Taper:

1) **Supports the pump forces applied at the bottom of the rod string,**
2) **Plus the weight of the all the rods connecting the pump to the top rod in each taper.**

- **Rod string is designed for a long operational life**
- **Planned failure mode due to fatigue – 10 million cycles**
- **Wear out the rods**
- **DO NOT tensile fail due maximum load near the peak tensile strength of the rod.**
- **Design the string so the unit stresses are equal in the top rod of each of the different-sized sections of the string. Provides good safety margin as far as corrosion pitting is concerned.**

Modified Goodman Diagram



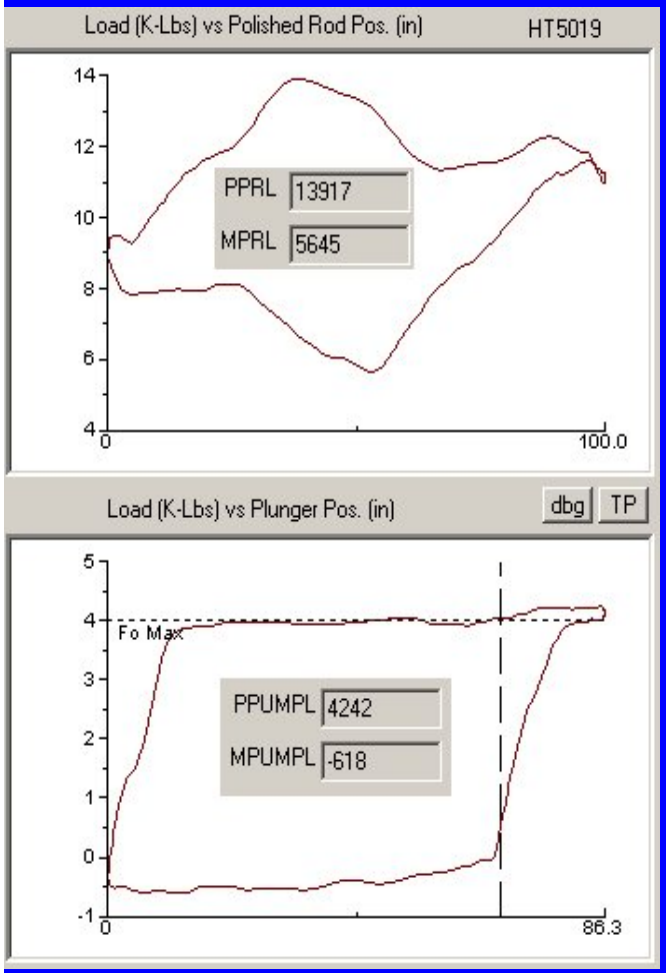
Maximum allowable working stresses should not be higher than about 30,000 to 40,000 psi, although some sucker rods, such as the "high tensile strength" rods are rated at 40,000 to 50,000 psi maximum.

Operation of rods in corrosive environments requires that the maximum allowable stress be decreased.

Max. Allowable Stress,
Sa = (0.25T + 0.5625*Smin)*SF
Allowable Stress Range, Sr = Sa - Smin

Stress Limit For New Rods Based On API-Goodman Guide	Service Factor 1.0 T/4	T/1.75	Peak Tensile(T)
New Grade C Rod (Psi)	23,750	54,286	95,000
New Grade K Rod (Psi)	21,250	48,571	85,000
New Grade D Rod (Psi)	28,750	65,714	115,000
New Grade H Rod (Psi)	50,000	50,000	140,000

Rod Loading – Allowable Stress



Top Rod Loading As % of Goodman for Given Grades

Service Factor	C	D	K	H
1.0	83.3	68.0	87.2	46.3
0.85	94.8	77.9	99.1	54.5
0.60	123.2	102.7	128.4	77.1

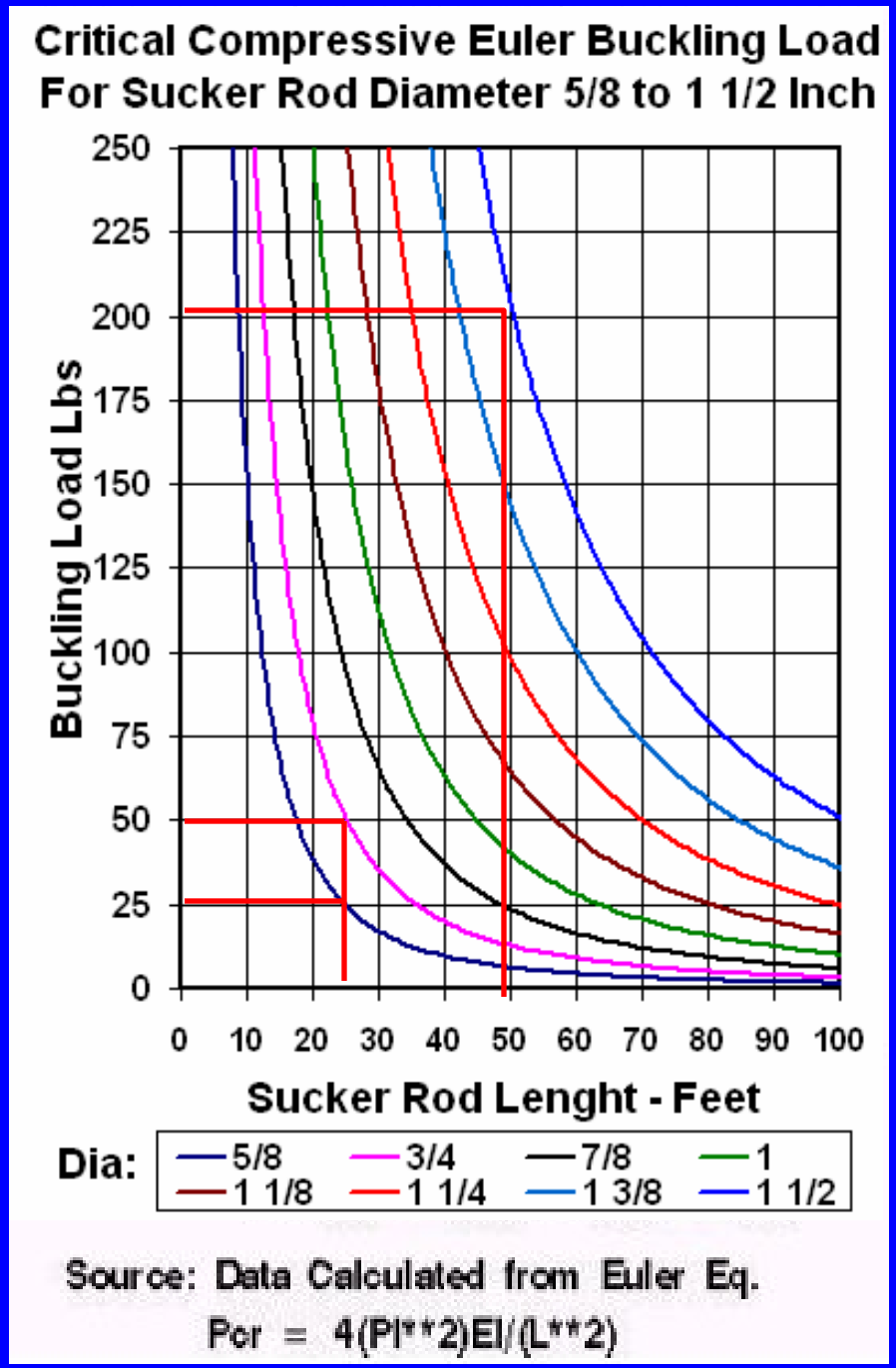
Beam Loading: 54.4 %

Rod Loading At Top of Tapers As % of Goodman

		Top Taper	Taper 2	Taper 3	Taper 4	Taper 5	Taper 6
Rod Type		D	D	D			
Diameter	in	0.875	0.75	0.875			
Service Factor	1.0	68.0	72.2	27.1			
	0.85	77.9	82.6	31.9			
	0.60	102.7	108.6	45.4			
Rod Stress psi	Max	23144	24826	7752			
	Min	9388	9986	-301			

Rod Loads/Stresses:

1. Loads on the top rod in a taper are the highest
2. Load decreases as the suspended rod weight decreases as you move closer to the pump.
3. Largest diameter rods are located at the top of the string
4. Diameter rod string decreases with the length of each taper
5. Results in stresses on the top rod in each taper being equal.



Rod Buckling:

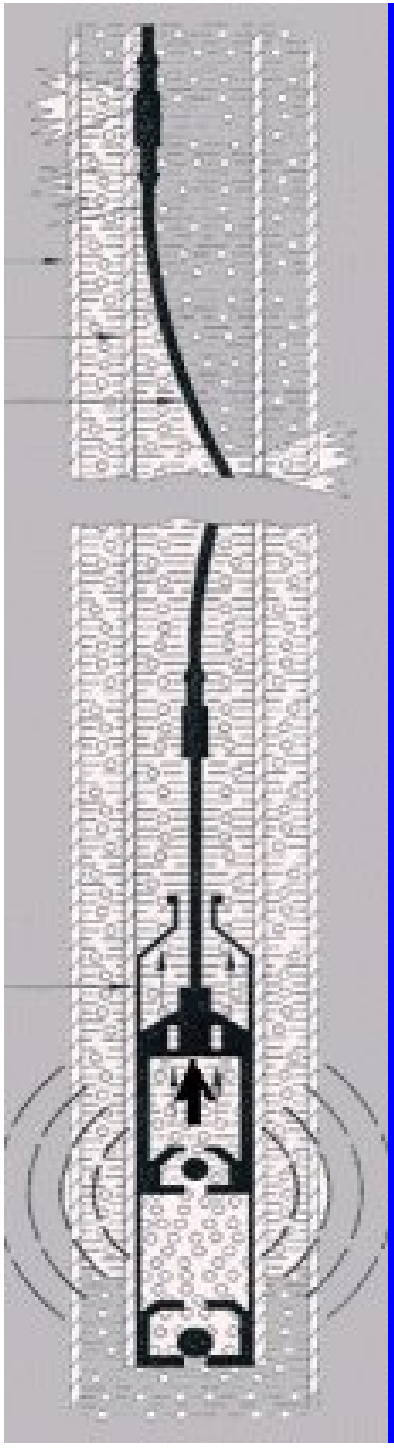
- ***Use Effective Load***

- Rod strings behave as a slender Euler column.

- Buckling occurs under small compressive loading.

Notice:

- 25 Lbs. Buckles > 25 feet of 5/8 Inch Dia. Rod
- 50 Lbs. Buckles > 25 feet of 3/4 Inch Dia. Rod
- 200 Lbs. Buckles > 50 feet of 1 ½ Inch Dia. Rod



Weight Bars/Sinkerbars

1. During the pumping cycle Upstroke:
   - traveling valve shut
   - rod string will be under tension
   - buoyed rods and fluids loads are lifted.

2. During the pumping cycle Down stroke:
   - traveling valve is opened and the standing valve is shut,
   - rods are suspended in fluid and still under tension.

3. But any upward force applied to the rod string from the plunger/pump assembly
   - Due to fluid flow in the traveling valve, barrel/plunger friction, compressing gas, etc…
   - Results in compressive (negative) loads
   - Causes rod buckling at the bottom of the rod string above the pump.

Weight Bars/Sinkerbars

Sinkerbar.XLS

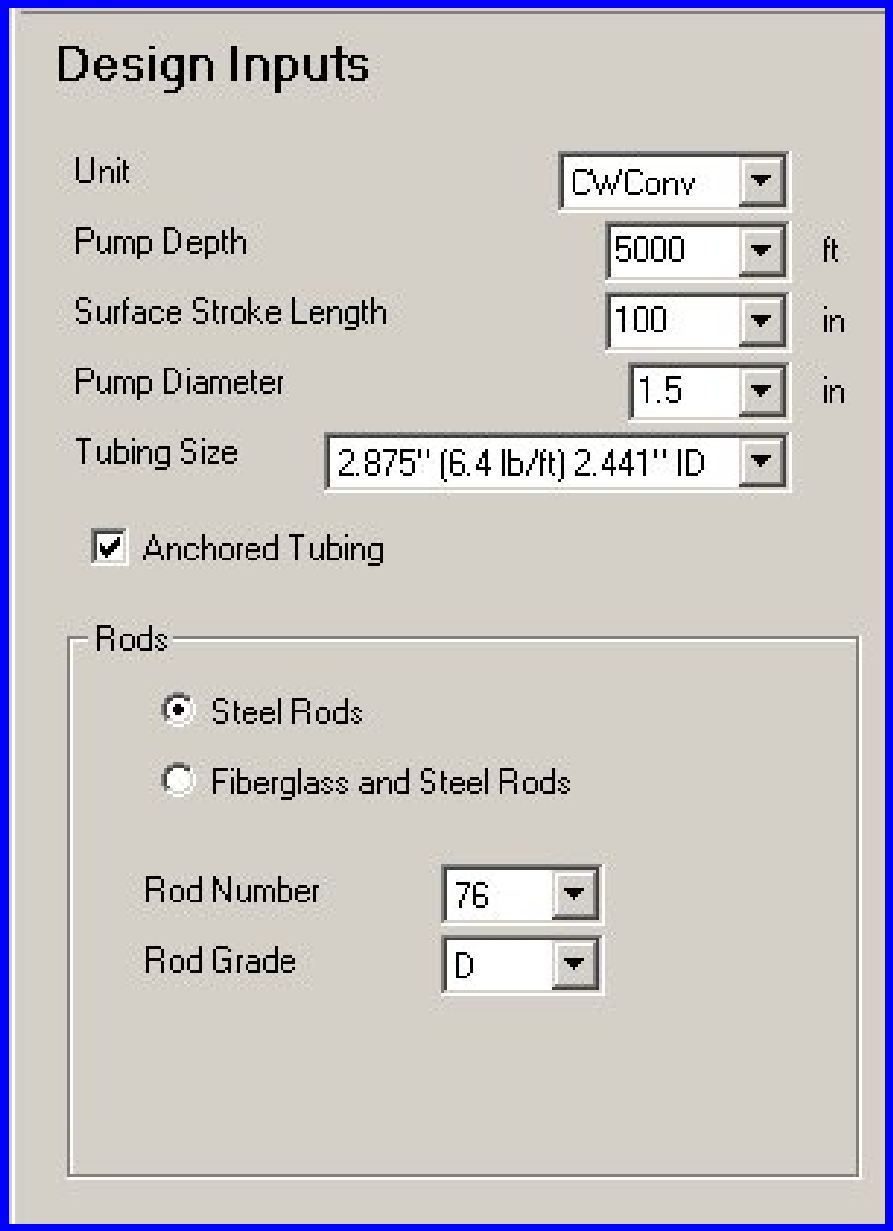
Sinker Bar Design Inputs

PLUNGER DIA. (Inches)	1.5
PUMP DEPTH (Feet)	5000
MAXIMUM TUBING SPECIFIC GRAVITY (Water=1)	1
Sinker Bar Diameter (Inch)	1.5

Sinker Bar Design Calculations

SPEC.GRAV.:1.0000
USED PLNGR DIA: 1.5000 (In.) 38.1000 (mm)
SB FACTOR: 0.415
REQ.SB.WT.: 898.4 (Lbs.)
SB. DIA.: 1.50 (In.) 38.10 (mm)
SB. LENGTH: 175.0 (Ft.) 53.3 (Meters)

Unit Type Selection



CWConv - selects the conventional unit with clockwise rotation of the crank**.**

CCWConv - selects the conventional unit with counter-clockwise rotation of the crank.

MarkII - selects the MarkII unit with counter-clockwise rotation of the crank.

AirBal - selects the air-balanced unit with clockwise rotation of the crank.

Type:
A - AIR BALANCE
B – BEAM BALANCE
C – CONVENTIONAL
M – MARK II

Pumping Unit Description

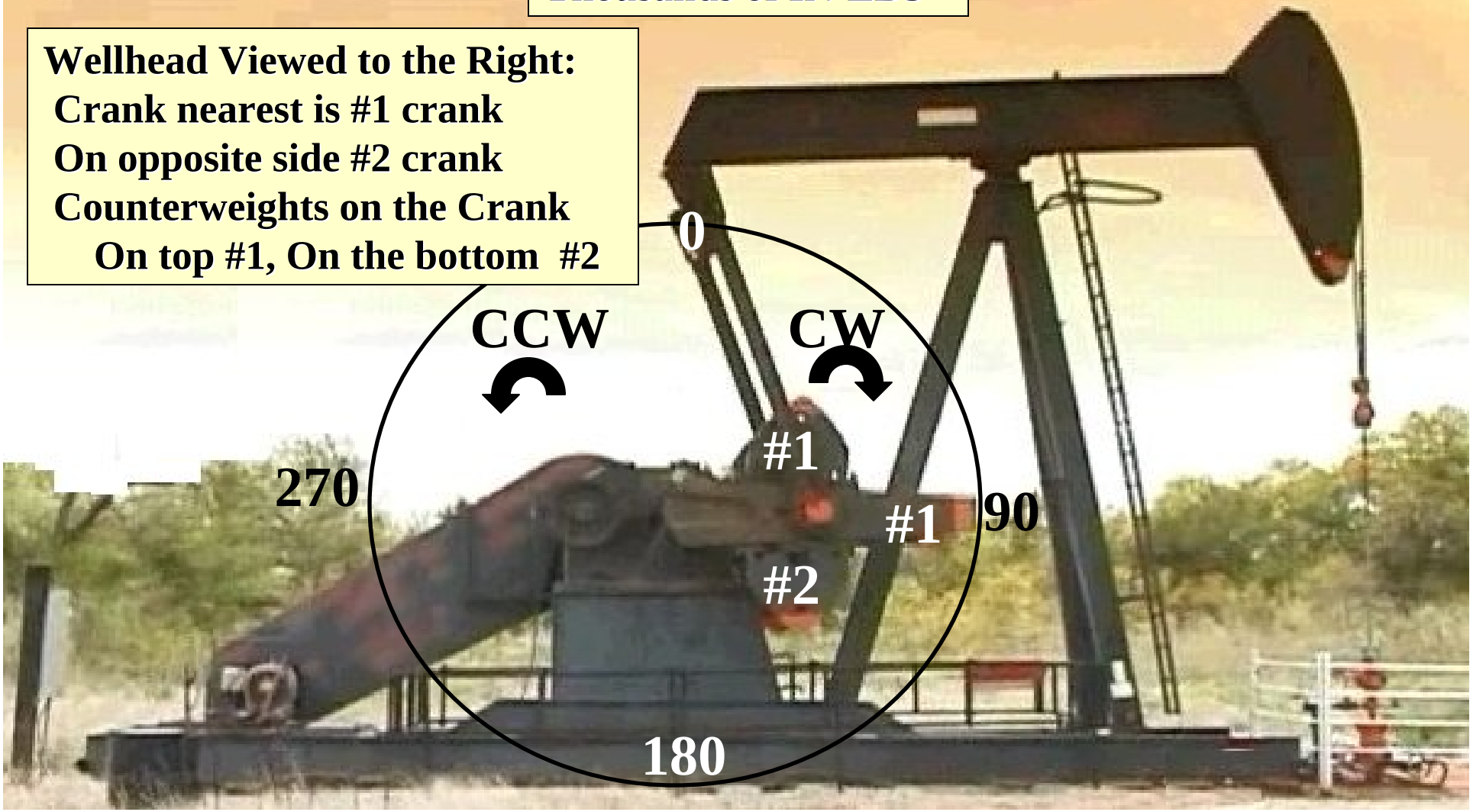
C-320D-256-100

Maximum Stroke Length in Inches

Peak Torque Rating in Thousands of IN-LBS

Structure Rating in 100s of LBS

Wellhead Viewed to the Right:
Crank nearest is #1 crank
On opposite side #2 crank
Counterweights on the Crank
On top #1, On the bottom #2



Echometer QRod 2.0

File Tools Help

Title: My QRod Test Run

Design Inputs

Unit	CWConv	
Pump Depth	5000	ft
Surface Stroke Length	144	in
Pump Diameter	1.75	in
Tubing Size	2.875" (6.4 lb/ft) 2.441" ID	

☑ Anchored Tubing

Rods

◉ Steel Rods

○ Fiberglass and Steel Rods

Rod Number: 86

Rod Grade: C

Results

Rate (100% Pump eff.)	368	bbl/day
Rate (95 % Pump eff.)	350	bbl/day
Rod Taper, %	30.0, 29.5, 40.5	
Top Rod Loading	91.9	%
Min API Unit Rating	640-200-144	
Min Motor Size	30.0	hp
Polished Rod Power	17.1	hp
TVLoad	14,700	lbs
SVLoad	9,700	lbs

Calculate from SPM or Target Rate

○ Stroke Rate << 7.7 >> SPM

◉ Target Rate << 350 >> bbl/day

Calculate

Default Settings

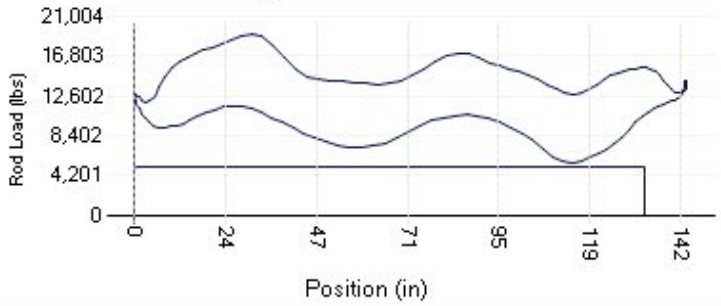
Total Sinker Bar Weight	0	lbs	Damping Factor	0.1	
Fluid Specific Gravity	0.95	psi	Unit Efficiency	95	%
Tubing Pressure	80	psi	Pump Efficiency	95	%
Casing Pressure	45	psi			

You may enter Pump Intake Pressure directly, or calculate it from Reservoir Pressure and Productivity Index.

○ Reservoir Pressure	1000	psi	Productivity Index	2.000 bbl/day/psi
◉ Pump Intake Pressure	50			

Echometer Company Phone: (940) 767-4334 E-Mail: info@echometer.com

Dynamometer Cards

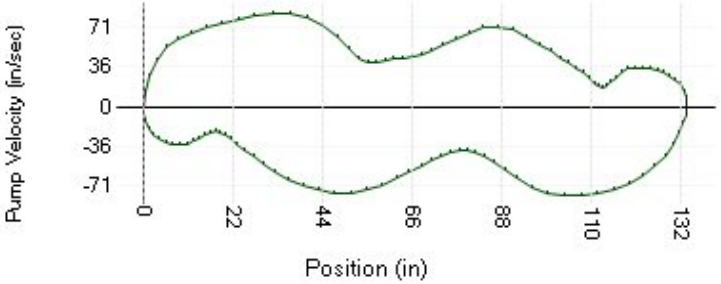


PPRL 19,100 lbs MPRL 5,500 lbs

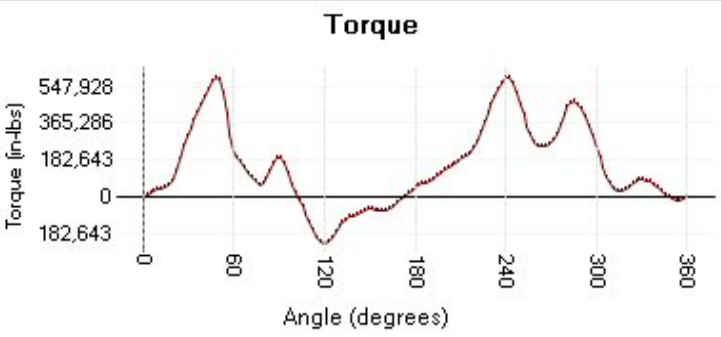
Pump Stroke Length 133.2 in Fo 5,000 lbs

Fo/Skr 0.122 Kr 286 lb/in Kt 894 lb/in

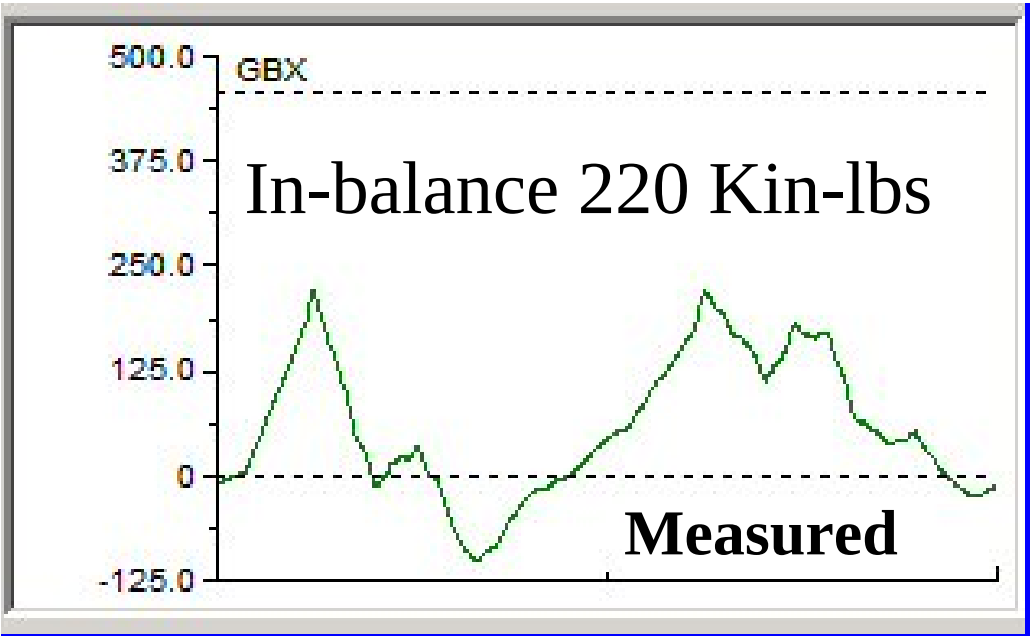
Pump Velocity vs. Position



Torque

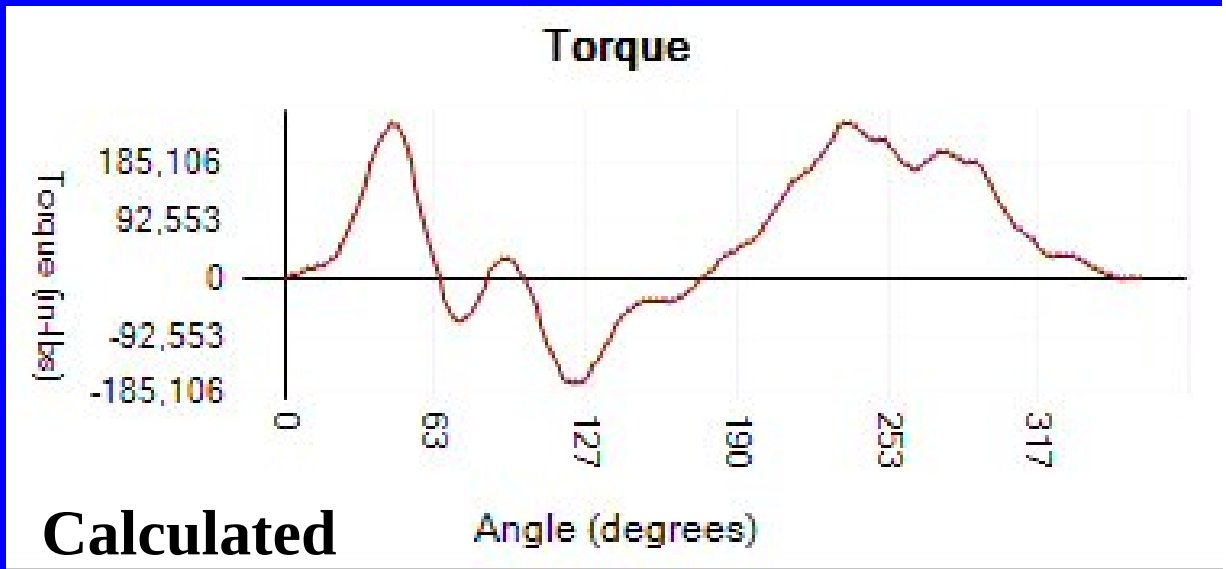


Peak Gear Box Torque	596	Kin-lbs
Counter Balance Moment	1,155	Kin-lbs
Counter Balance Effect	16,900	lbs



TTU Test Well 9.72 SPM Clock-Wise Rotation

Compare Calculated and Measured Torque



Calculated

Peak Gear Box Torque	251	Kin-lbs
Counter Balance Moment	552	Kin-lbs
Counter Balance Effect	11,009	lbs

MOTOR CHARACTERISTICS

NEMA	MOTOR CHARACTERISTICS
B	4% - 5% Slip, 180% Starting Torque, Lower Cost and High AMPs
C	6% - 7% Slip, 200% Starting Torque, High Starting AMPs
D	8% - 13% Slip, 275% Starting Torque, More Efficient under Cyclic loads.

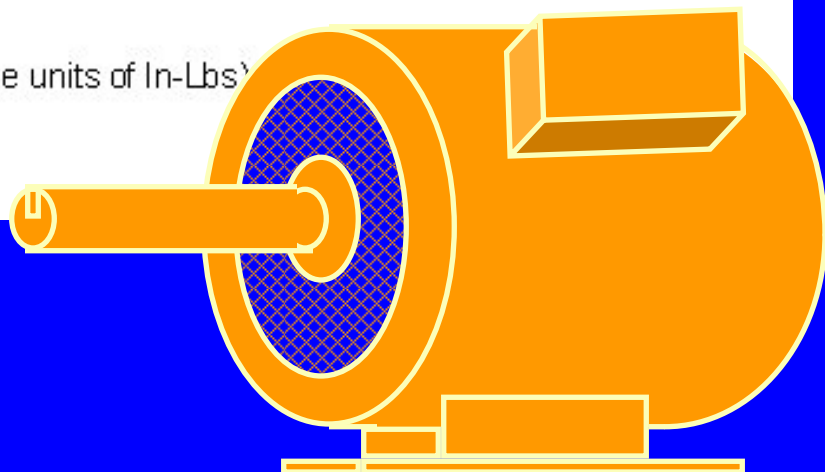
Output HP = Torque x RPM / Constant

kW Input = (HP Output) x 0. 746 / Efficiency

Motor Slip (%) = (Synch. RPM - Running RPM) / Synch. RPM

Where:

Torque	= Motor Torque (Ft-Lbs or In-Lbs)
rpm	= Motor Speed (revolutions per minute)
Constant	= 5,250 (torque units of Ft-Lbs) or 63,000 (torque units of In-Lbs)
HP	= Output motor horsepower
kW	= HP * 0.746
Synch speed	= RPM of motor under no load



Size Motor Horsepower

Computer: HP = CLF * PRHP / Unit Effcy

QRod uses:

CLF = *RMS Torque/ Average Torque*

RMS Power/ Average Power is OK.

(don't use CLF based on motor current)

OR:

Gault: HP = 2. * PRHP

Unit Efficiency: 95 % for "Large" Units
80 % for "Small" Units

Echometer QRod 2.0

File Tools Help

Title: My QRod Test Run

Design Inputs

Unit	CWConv	
Pump Depth	5000	ft
Surface Stroke Length	144	in
Pump Diameter	1.75	in
Tubing Size	2.875" (6.4 lb/ft) 2.441" ID	

☑ Anchored Tubing

Rods

◉ Steel Rods

○ Fiberglass and Steel Rods

Rod Number: 86

Rod Grade: C

Results

Rate (100% Pump eff.)	368	bbl/day
Rate (95 % Pump eff.)	350	bbl/day
Rod Taper, %	30.0, 29.5, 40.5	
Top Rod Loading	91.9	%
Min API Unit Rating	640-200-144	
Min Motor Size	30.0	hp
Polished Rod Power	17.1	hp
TVLoad	14,700	lbs
SVLoad	9,700	lbs

Calculate from SPM or Target Rate

○ Stroke Rate << 7.7 >> SPM

◉ Target Rate << 350 >> bbl/day

Calculate

Default Settings

Total Sinker Bar Weight	0	lbs	Damping Factor	0.1	
Fluid Specific Gravity	0.95	psi	Unit Efficiency	95	%
Tubing Pressure	80	psi	Pump Efficiency	95	%
Casing Pressure	45	psi			

You may enter Pump Intake Pressure directly, or calculate it from Reservoir Pressure and Productivity Index.

○ Reservoir Pressure	1000	psi	Productivity Index	2.000 bbl/day/psi
◉ Pump Intake Pressure	50			

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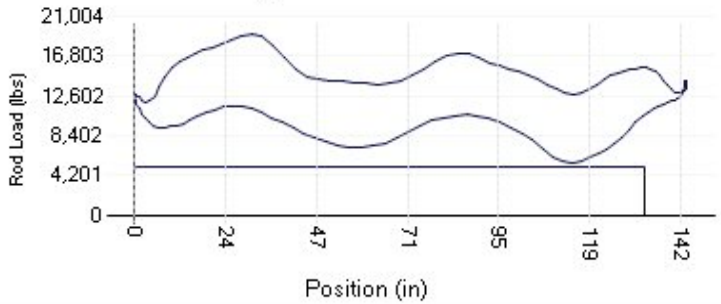
Dynamometer Cards

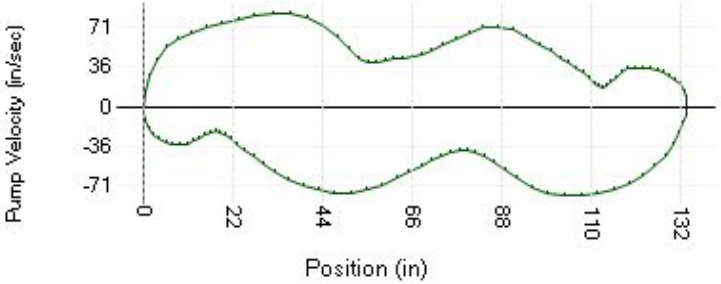


PPRL 19,100 lbs MPRL 5,500 lbs

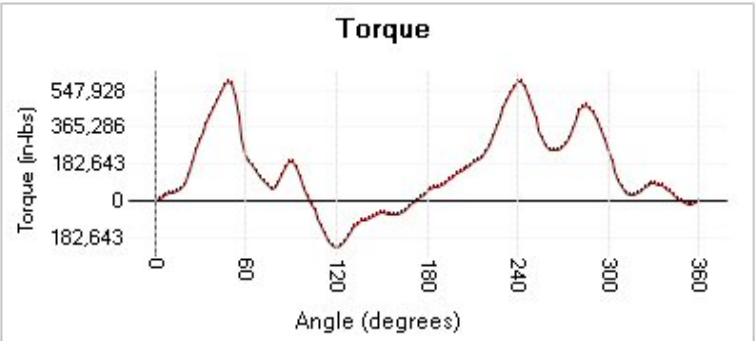
Pump Stroke Length 133.2 in Fo 5,000 lbs

Fo/Skr 0.122 Kr 286 lb/in Kt 894 lb/in

Pump Velocity vs. Position



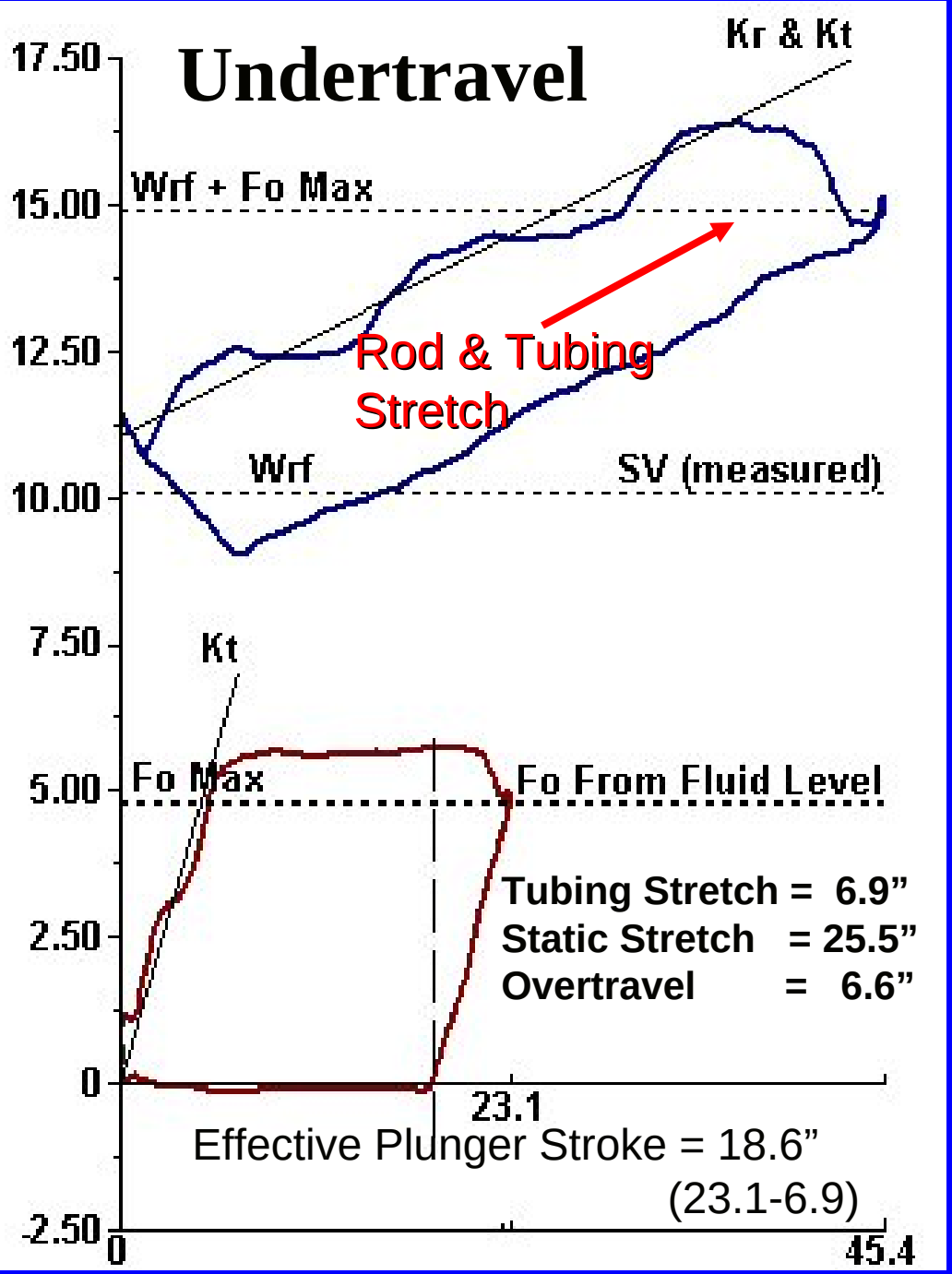
Torque

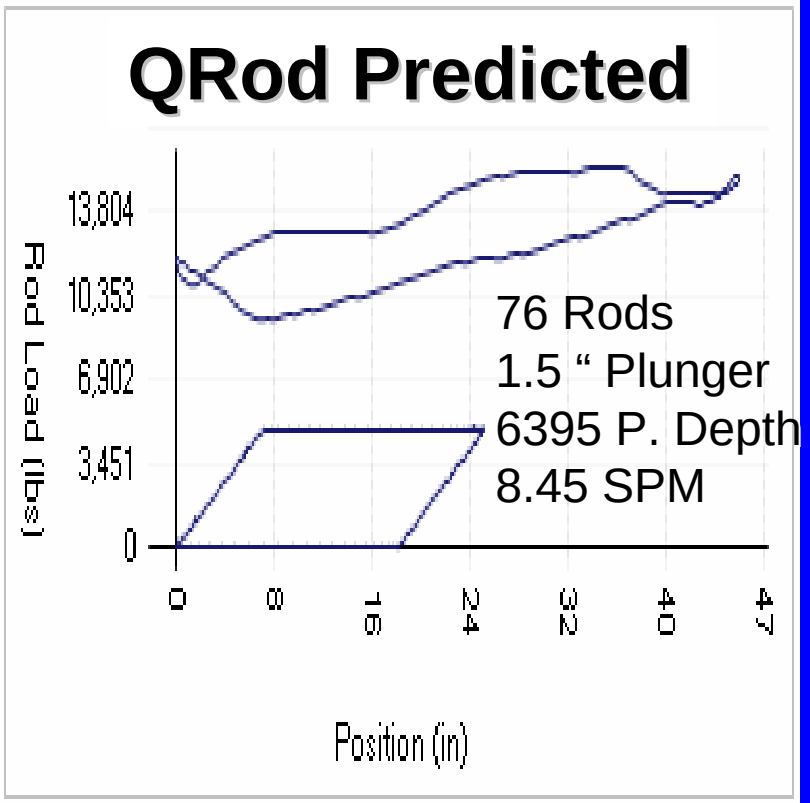


Peak Gear Box Torque	596	Kin-lbs
Counter Balance Moment	1,155	Kin-lbs
Counter Balance Effect	16,900	lbs

Plunger too Large for Rods

Severe under travel occurs when the sub surface pump diameter is too large for the sucker rod string.

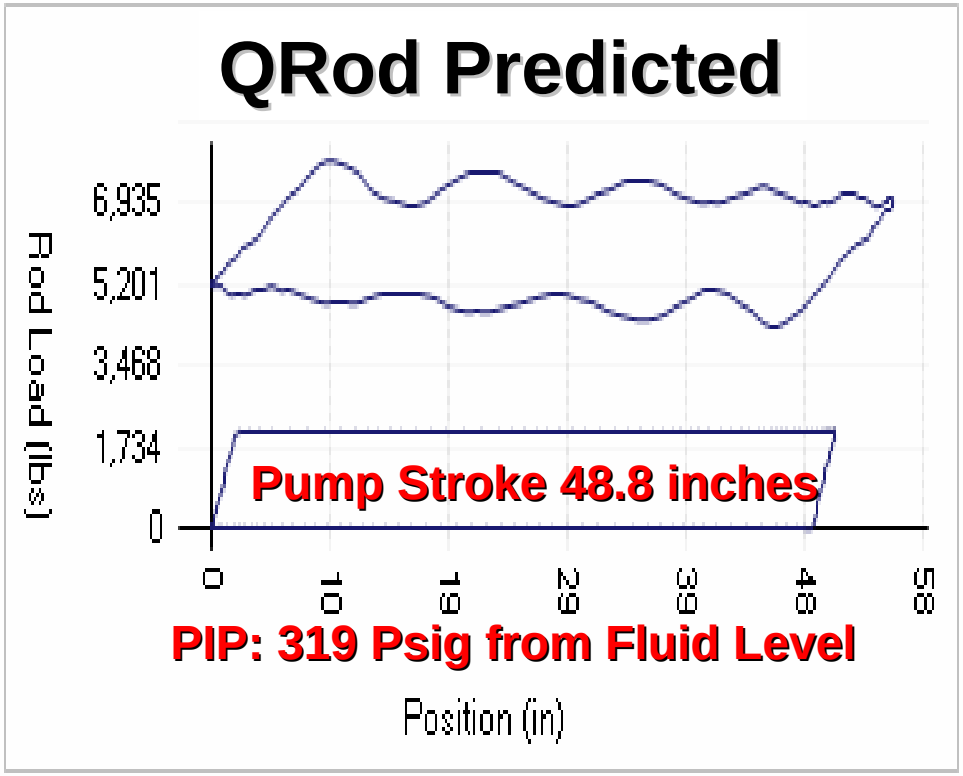




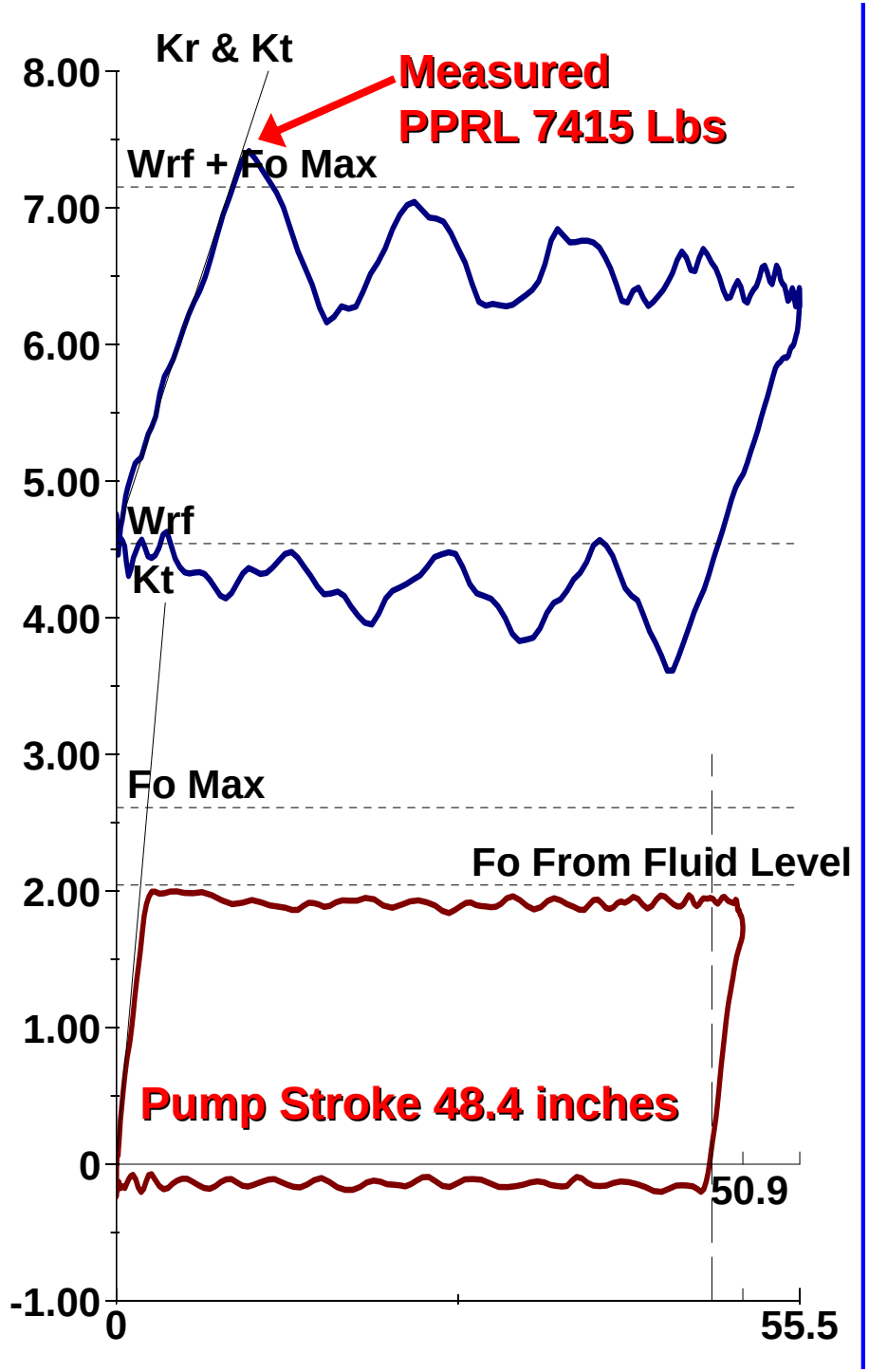
PPRL 15,690 lbs	MPRL 9,464 lbs	Fo 4,815 lbs
Pump Stroke 18.0 in	Static Stretch 24.7 in	Overtravel 4.2 in
Fo/Skr 0.545	Kr 195 lb/in	Kt 699 lb/in

Tubing Unanchored?

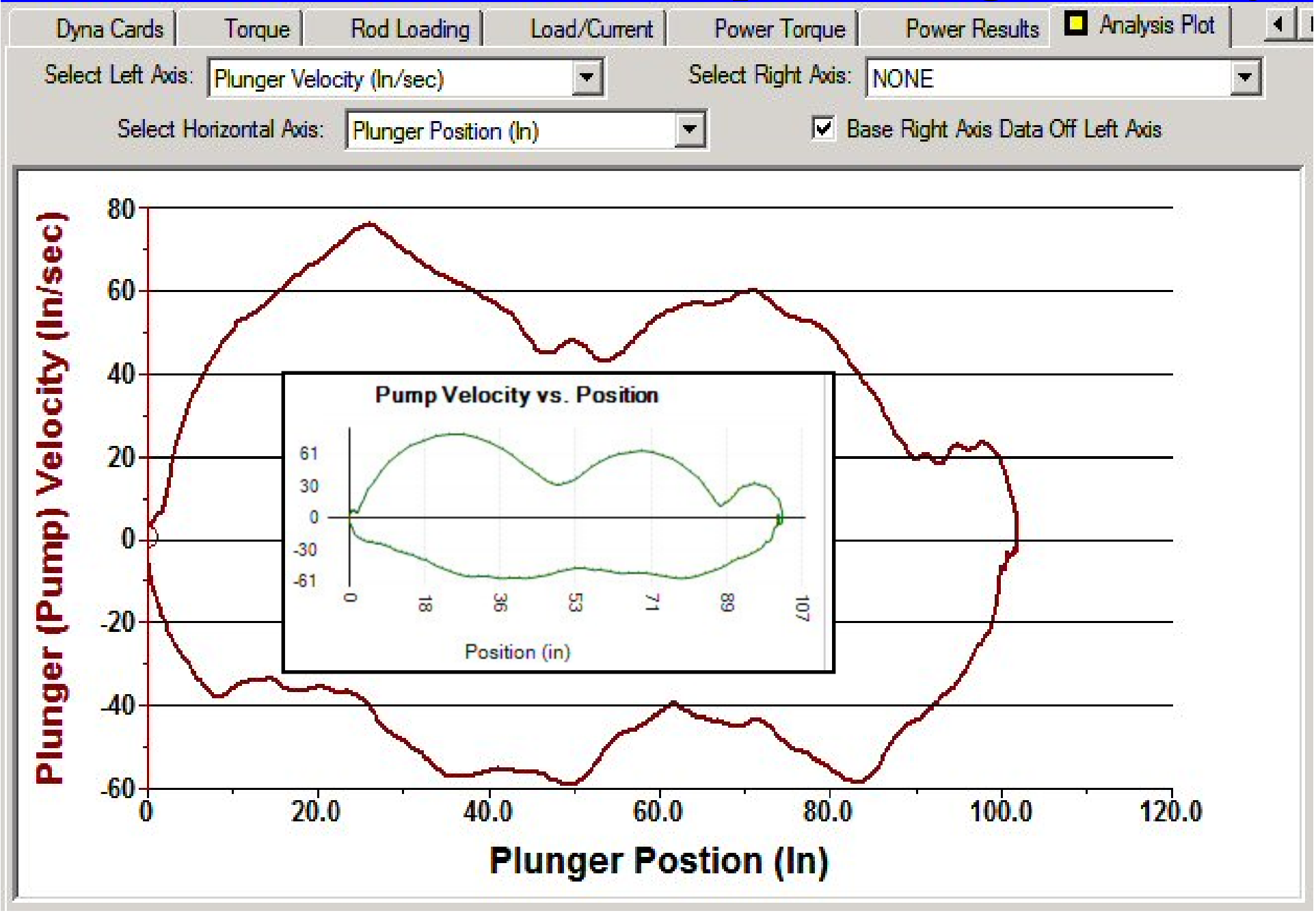
Pump Intake pressure is 319 and pump is full of fluid. Tubing Anchor depth is 2914, but anchor appears to not be set.



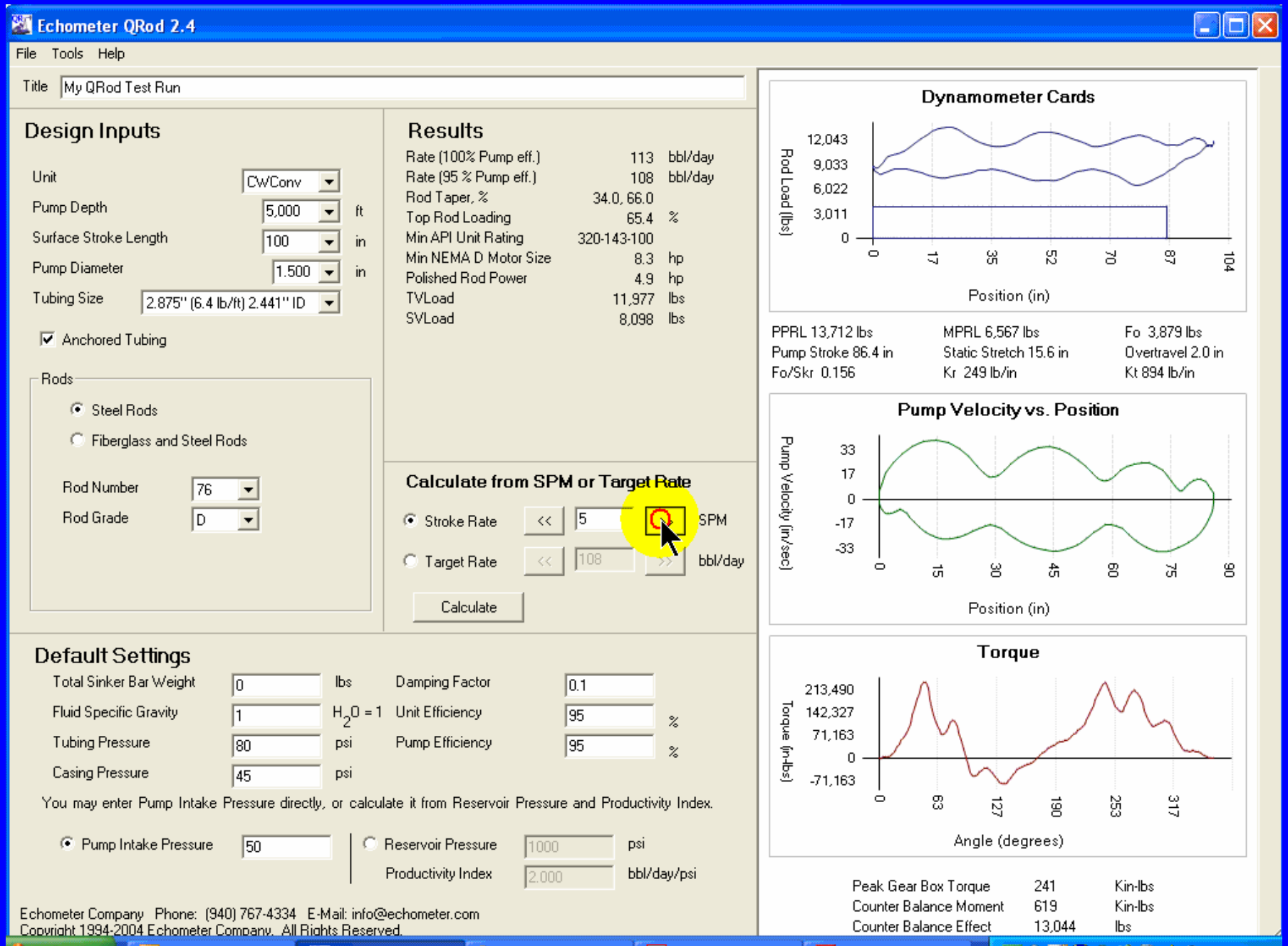
PPRL 7,881 lbs	MPRL 4,303 lbs	Fo 2,044 lbs
Pump Stroke 48.8 in	Static Stretch 5.1 in	Overtravel 0.4 in
Fo/Skr 0.092	Kr 399 lb/in	Kt 1,032 lb/in



TTU Well 9.72 SPM – Compare Plunger Velocity



Questions?


Echometer QRod 2.4
File Tools Help
Title My QRod Test Run
Design Inputs
Unit CWConv
Pump Depth 5,000 ft
Surface Stroke Length 100 in
Pump Diameter 1.500 in
Tubing Size 2.875" (6.4 lb/ft) 2.441" ID
Anchored Tubing
Rods
Steel Rods
Fiberglass and Steel Rods
Rod Number 76
Rod Grade D
Results
Rate (100% Pump eff.) 113 bbl/day
Rate (95 % Pump eff.) 108 bbl/day
Rod Taper, % 34.0, 66.0
Top Rod Loading 65.4 %
Min API Unit Rating 320-143-100
Min NEMA D Motor Size 8.3 hp
Polished Rod Power 4.9 hp
TVLoad 11,977 lbs
SVLoad 8,098 lbs
Calculate from SPM or Target Rate
Stroke Rate 5 SPM
Target Rate 108 bbl/day
Calculate
Default Settings
Total Sinker Bar Weight 0 lbs
Fluid Specific Gravity 1 H2O = 1
Tubing Pressure 80 psi
Casing Pressure 45 psi
Damping Factor 0.1
Unit Efficiency 95 %
Pump Efficiency 95 %
You may enter Pump Intake Pressure directly, or calculate it from Reservoir Pressure and Productivity Index.
Pump Intake Pressure 50
Reservoir Pressure 1000 psi
Productivity Index 2.000 bbl/day/psi
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Dynamometer Cards
Rod Load (lbs)
12,043
9,033
6,022
3,011
0
0 17 35 52 70 87 104
Position (in)
PPRL 13,712 lbs
MPRL 6,567 lbs
Fo 3,879 lbs
Pump Stroke 86.4 in
Static Stretch 15.6 in
Overtravel 2.0 in
Fo/Skr 0.156
Kr 249 lb/in
Kt 894 lb/in
Pump Velocity vs. Position
Pump Velocity (in/sec)
33
17
0
-17
-33
0 15 30 45 60 75 90
Position (in)
Torque
Torque (in-lbs)
213,490
142,327
71,163
0
-71,163
0 63 127 190 253 317
Angle (degrees)
Peak Gear Box Torque 241 Kin-lbs
Counter Balance Moment 619 Kin-lbs
Counter Balance Effect 13,044 lbs

Questions ?