Ask Echometer Online Seminar – August 5, 2020

Net Torque Acting on a Pumping Unit Gearbox

TOTAL ASSET MONITOR (TAM)

http://www.echometer.com/Software/Total-Asset-Monitor

"Dynamometer Workshop", Taylor, Fernandez, Rowlan, Podio, Ask Echometer Online Seminar – July 15, 2020

"Advances in Dynamometer Technology", Rowlan, McCoy, Podio SWPSC 2004

"Best Method to Balance Torque Loadings On a Pumping Unit Gearbox", Rowlan, McCoy, Podio, CIPC PAPER 2004-132

"Wireless Motor Power-Current-Voltage Measurements and Analysis", McCoy, Rowlan, Tylor. Becker, Podio, West SWPSC 2015

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API Unit Description

C-320D-256-100

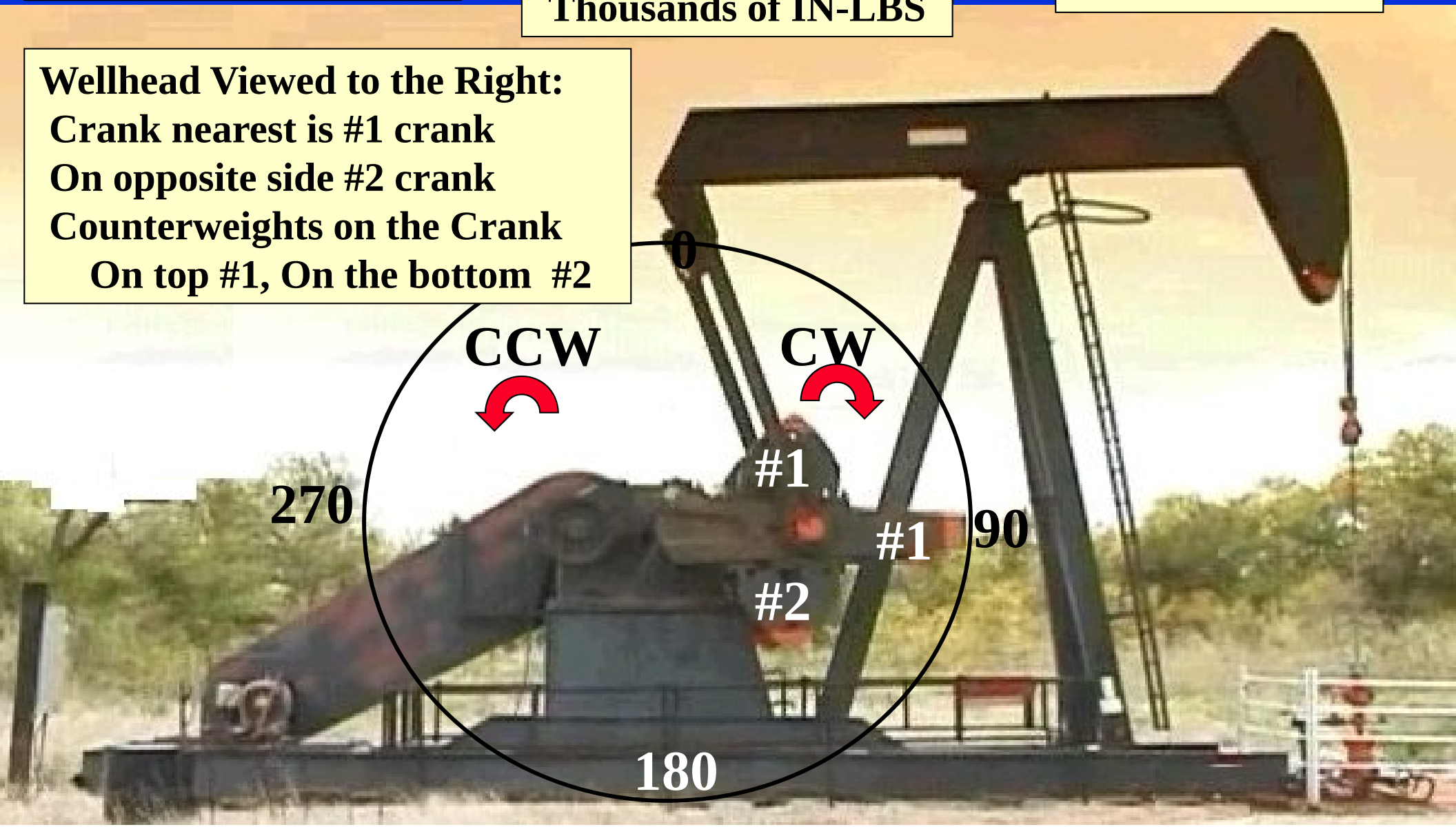
Type:
A - AIR BALANCE
B – BEAM BALANCE
C – CONVENTIONAL
M – MARK II

Peak Torque Rating
Thousands of IN-LBS

Maximum Stroke Length in Inches

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



Rating Usually Stamped on Tag or Gearbox

PUMPING UNIT STRUCTURE

MANUFACTURED BY

LUFKIN INDUSTRIES INC.
LUFKIN, TX. 75901 U.S.A.

C-456D-365-120
MODEL NUMBER

M137676G - 103834
SERIAL NO. / ORDER NO.

04-02-01
MFG. DATE

11E-0010.5
API LICENSE NO.

23,980 WITH 4 NO. 0AR0
MAXIMUM COUNTERBALANCE, LBS. C' WTS.

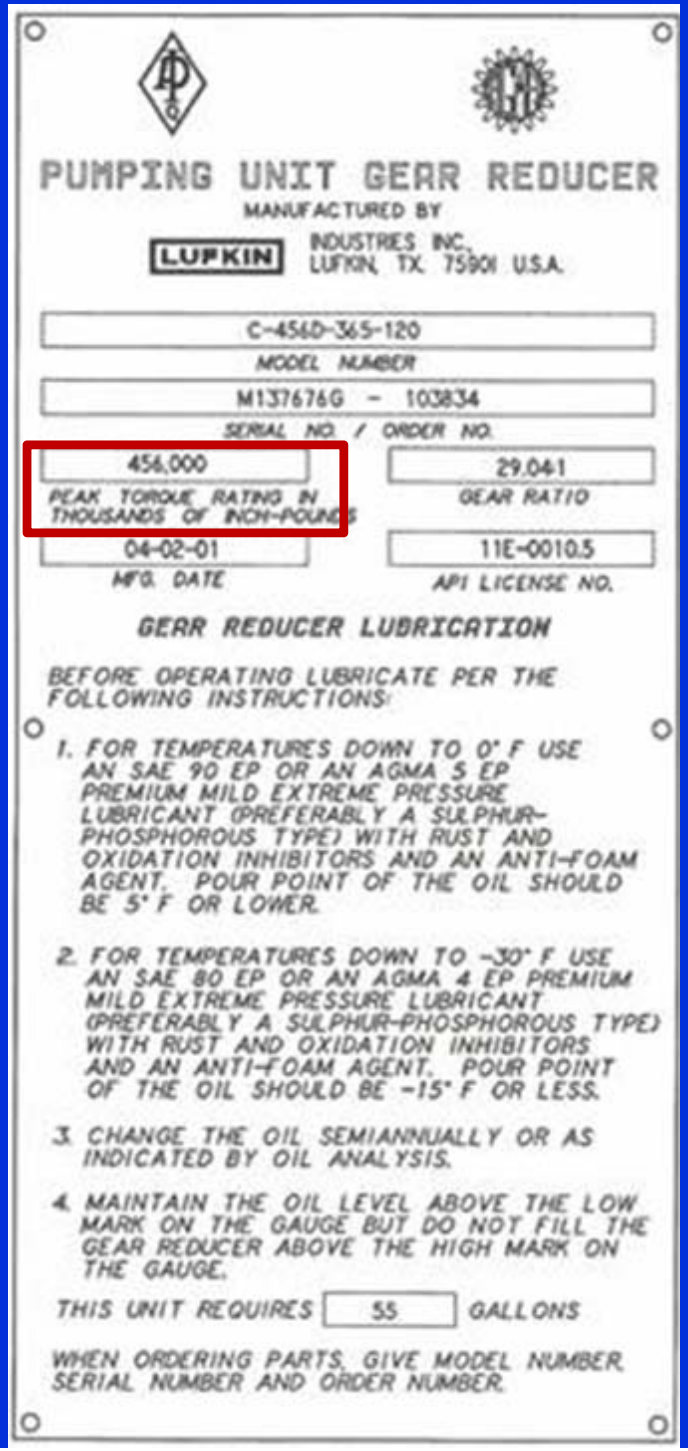
28,725 WITH 4 NO. 0AS
MAXIMUM COUNTERBALANCE, LBS. AUX. WTS.

33,465 WITH 8 NO. 0AS
MAXIMUM COUNTERBALANCE, LBS. AUX. WTS.

COUNTERBALANCE SHOWN IS AT MAX. STROKE AND INCLUDES STRUCTURAL UNBALANCE OF +570 LBS.

WHEN ORDERING PARTS GIVE MODEL NUMBER, SERIAL NUMBER AND ORDER NUMBER.

ALWAYS REFER TO THE OPERATOR'S MANUAL FOR UNIT ERECTION, OPERATION AND MAINTENANCE.



PUMPING UNIT GERR REDUCER

MANUFACTURED BY

LUFKIN INDUSTRIES INC.
LUFKIN, TX. 75901 U.S.A.

C-456D-365-120
MODEL NUMBER

M137676G - 103834
SERIAL NO. / ORDER NO.

456,000
PEAK TORQUE RATING IN THOUSANDS OF INCH-POUNDS

29.041
GEAR RATIO

04-02-01
MFG. DATE

11E-0010.5
API LICENSE NO.

GERR REDUCER LUBRICATION

BEFORE OPERATING LUBRICATE PER THE FOLLOWING INSTRUCTIONS:

1. FOR TEMPERATURES DOWN TO 0° F USE AN SAE 90 EP OR AN AGMA 5 EP PREMIUM MILD EXTREME PRESSURE LUBRICANT (PREFERABLY A SULPHUR-PHOSPHOROUS TYPE) WITH RUST AND OXIDATION INHIBITORS AND AN ANTI-FOAM AGENT. POUR POINT OF THE OIL SHOULD BE 5° F OR LOWER.

2. FOR TEMPERATURES DOWN TO -30° F USE AN SAE 80 EP OR AN AGMA 4 EP PREMIUM MILD EXTREME PRESSURE LUBRICANT (PREFERABLY A SULPHUR-PHOSPHOROUS TYPE) WITH RUST AND OXIDATION INHIBITORS AND AN ANTI-FOAM AGENT. POUR POINT OF THE OIL SHOULD BE -15° F OR LESS.

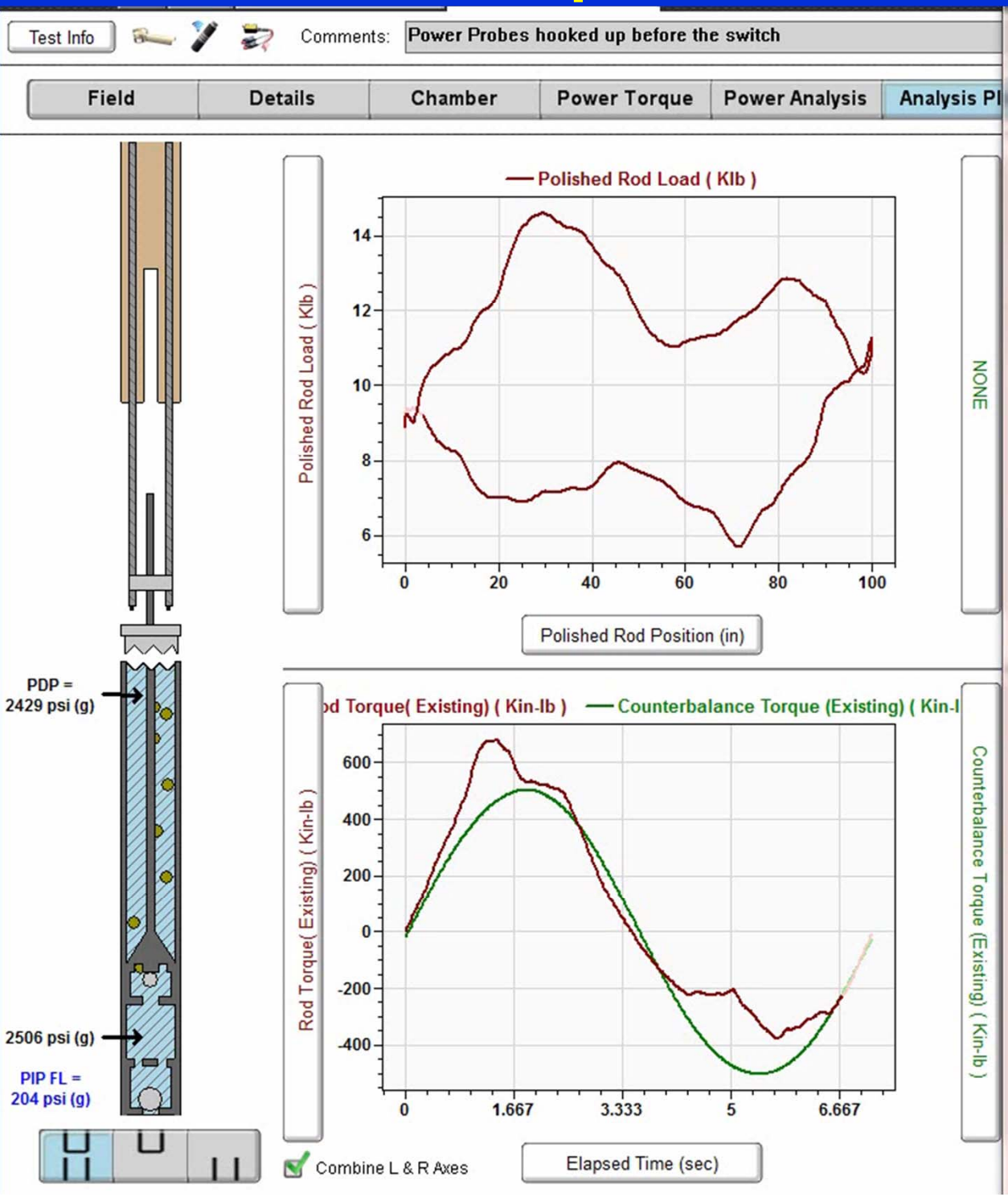
3. CHANGE THE OIL SEMIANNUALLY OR AS INDICATED BY OIL ANALYSIS.

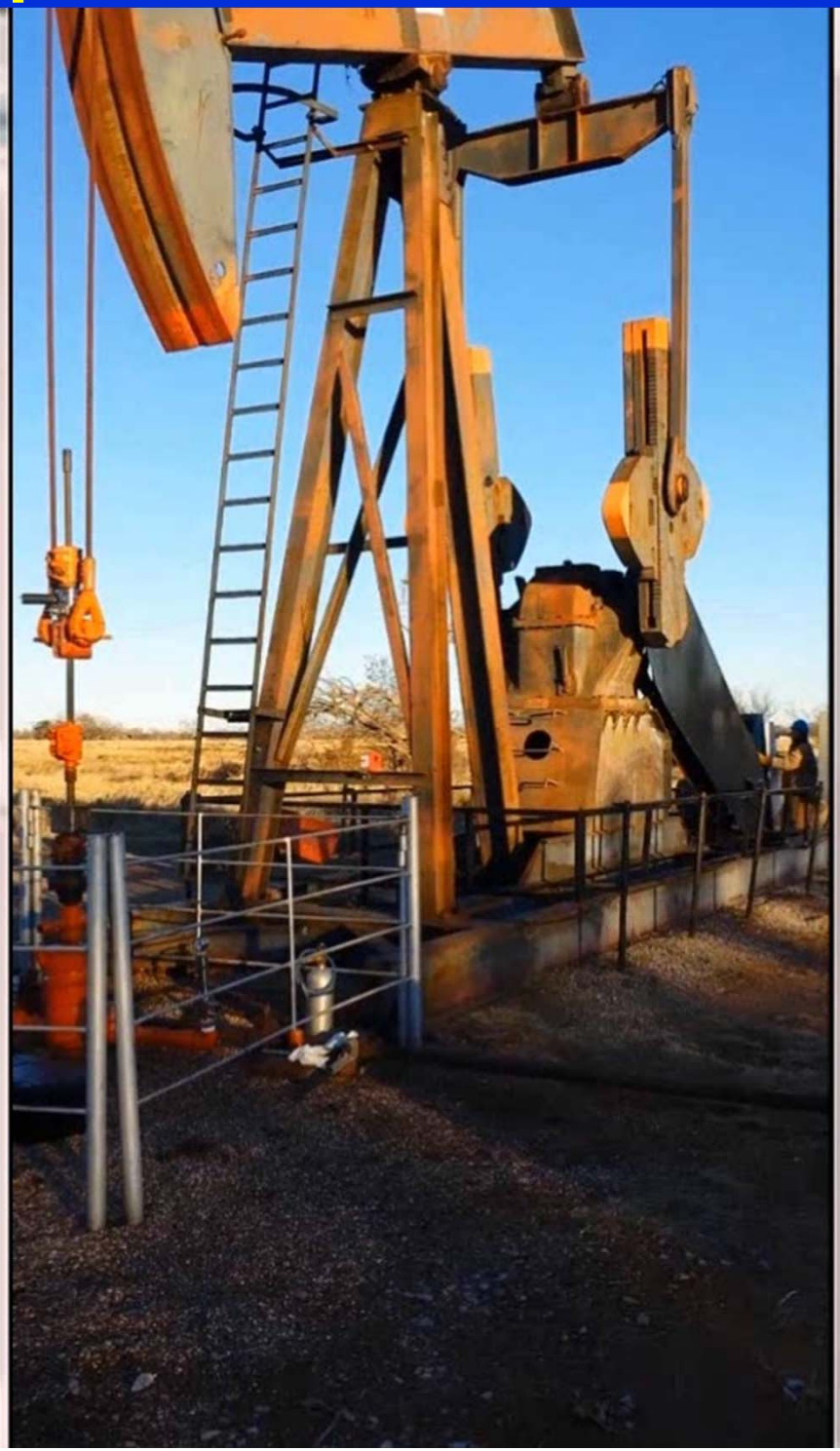
4. MAINTAIN THE OIL LEVEL ABOVE THE LOW MARK ON THE GAUGE BUT DO NOT FILL THE GEAR REDUCER ABOVE THE HIGH MARK ON THE GAUGE.

THIS UNIT REQUIRES 55 GALLONS

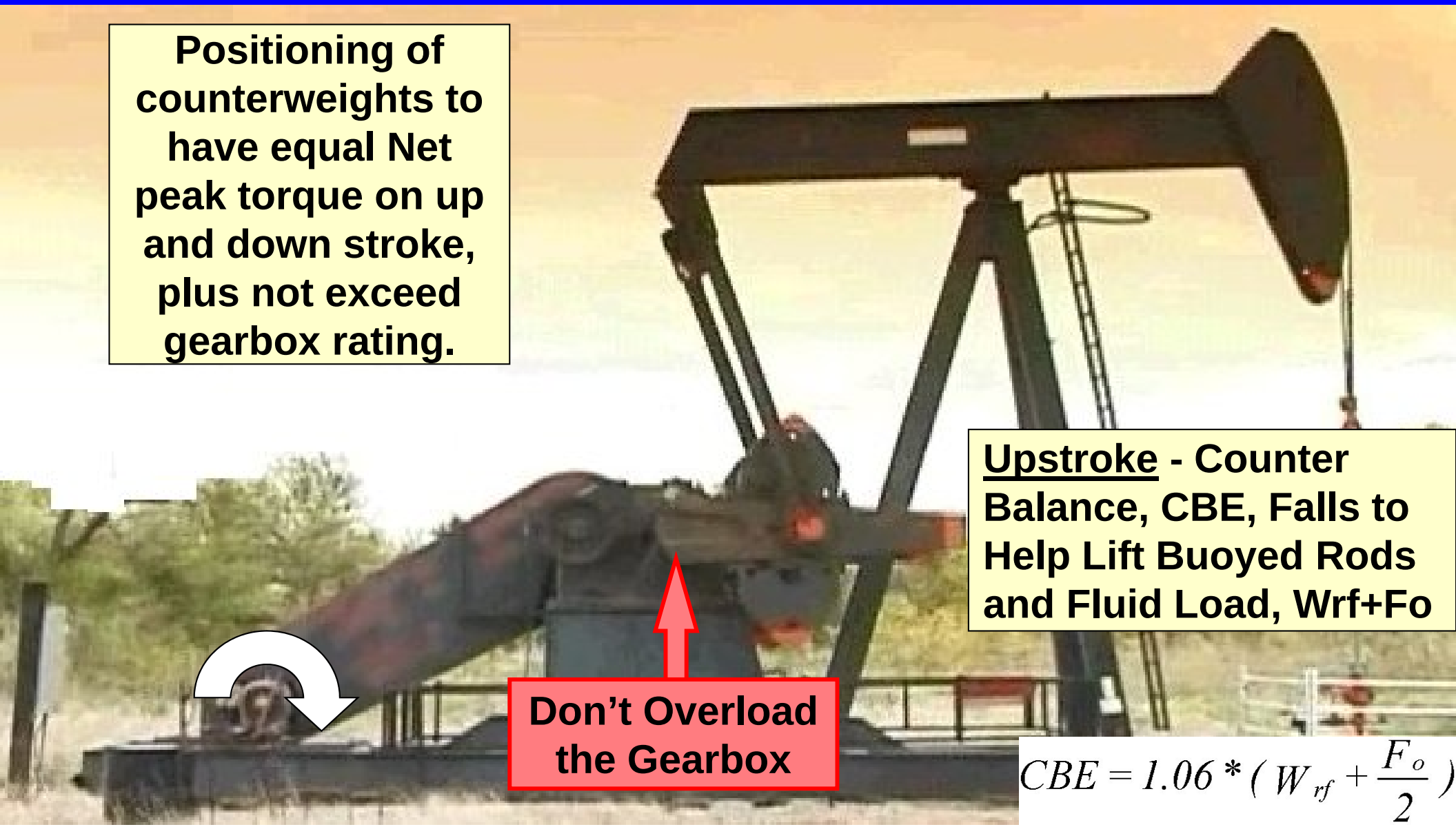
WHEN ORDERING PARTS, GIVE MODEL NUMBER, SERIAL NUMBER AND ORDER NUMBER.

Net Gearbox Torque = Rod Torque - Counterbalance





Counter Balance Effect at the Polished Rod is *Approximately* Equal to Buoyant Weight of Rods + 1/2 Fluid Load Weight



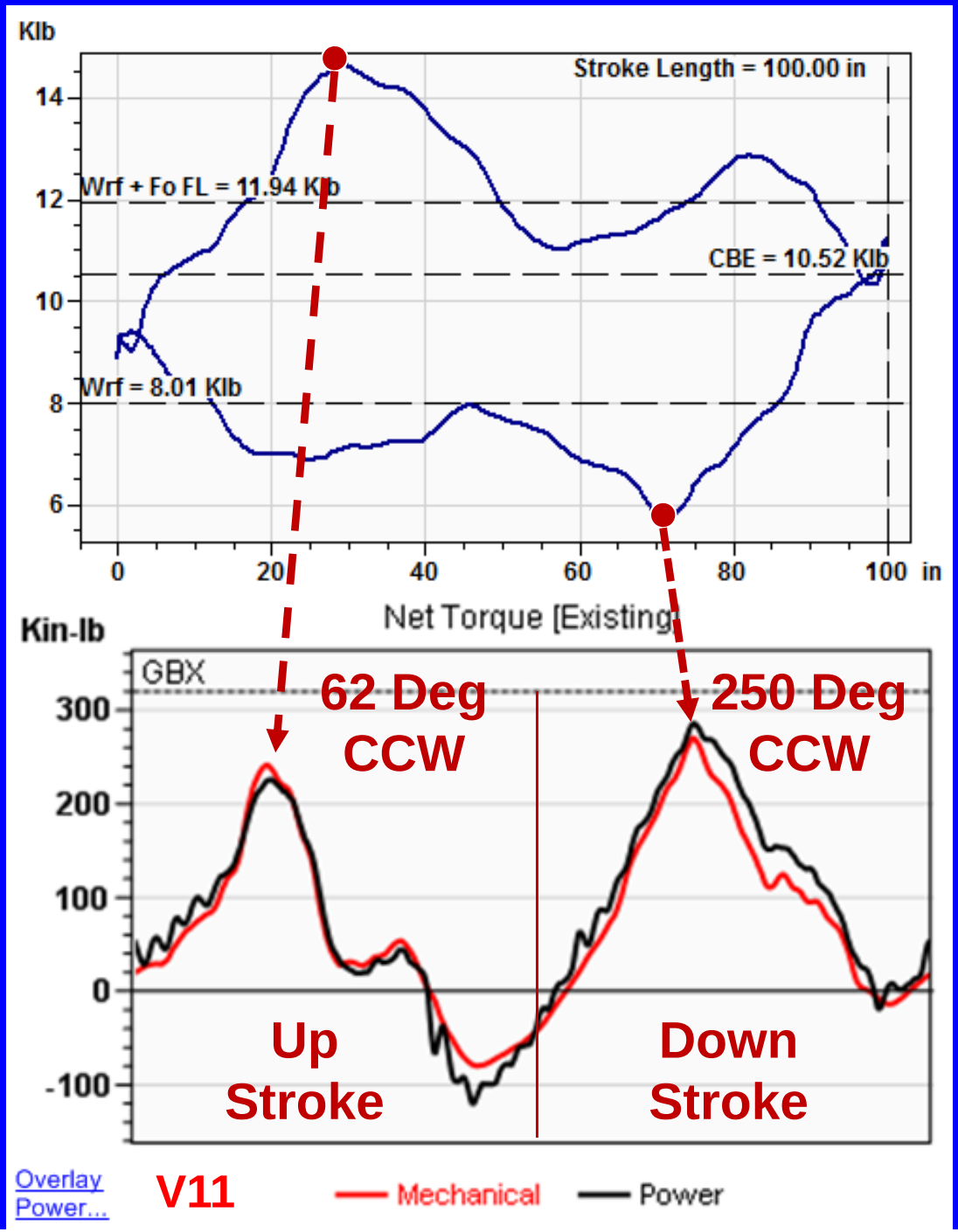
Positioning of counterweights to have equal Net peak torque on up and down stroke, plus not exceed gearbox rating.

<u>Upstroke</u> - Counter Balance, CBE, Falls to Help Lift Buoyed Rods and Fluid Load, Wrf+Fo

Don't Overload the Gearbox

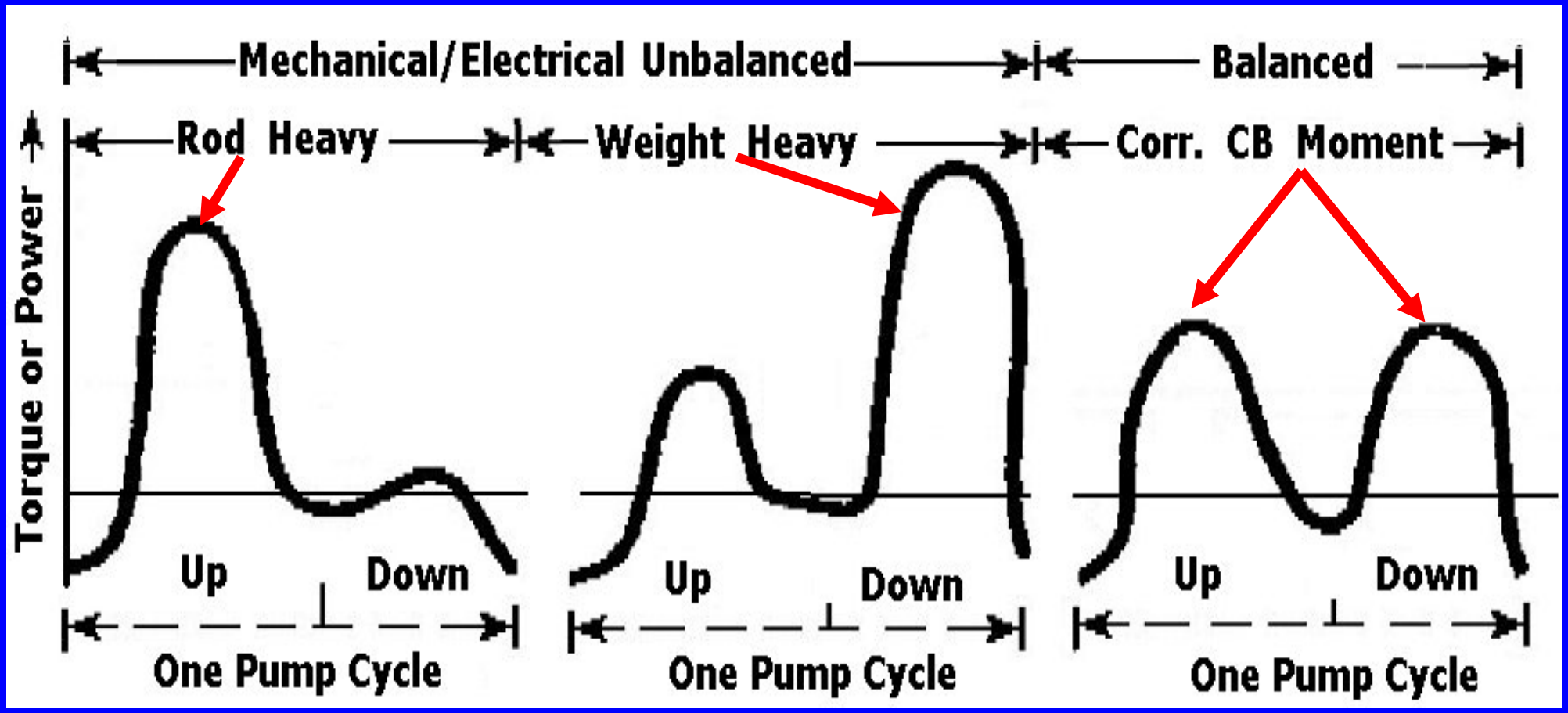
$$CBE = 1.06 * \left(W_{rf} + \frac{F_o}{2} \right)$$

Net Gearbox Torque



More Uniform Torque Loading Throughout Stroke

Mechanical/Torque (in-lbs) or Electrical/Power (kW) Signatures for a Unbalanced or Balanced Pumping Unit:



Three Methods Available to Determine Net Gearbox Torque Loading

1. Use Input Motor Power, motor and drive efficiencies and the pumping unit speed

2. Use surface dynamometer card and torque factors together with counterbalance moments determined from static counter balance effect, CBE, test.

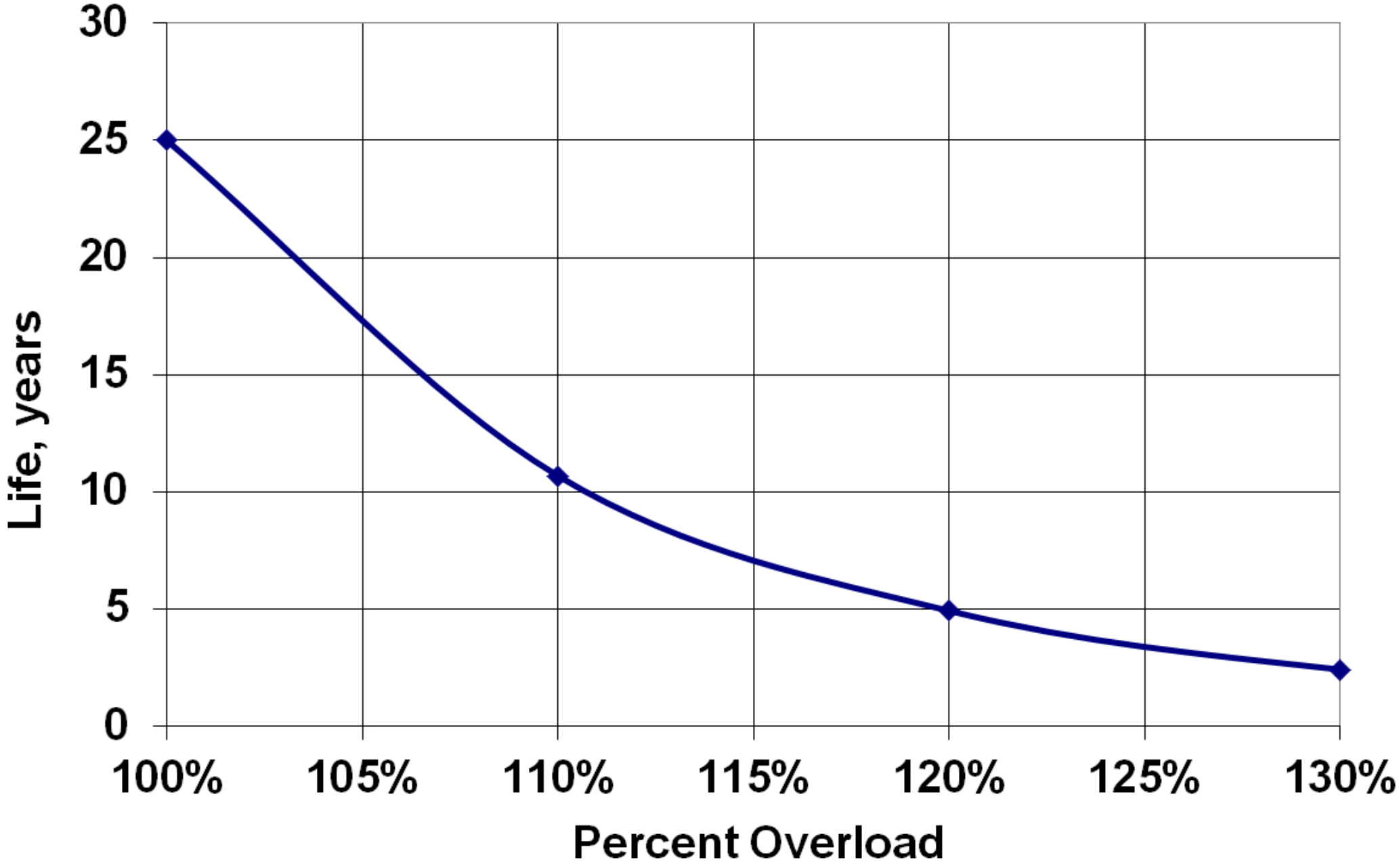
3. Use surface dynamometer card and torque factors together with counterbalance moments from the crank and weights

Three Methods to Determine Gearbox Loading

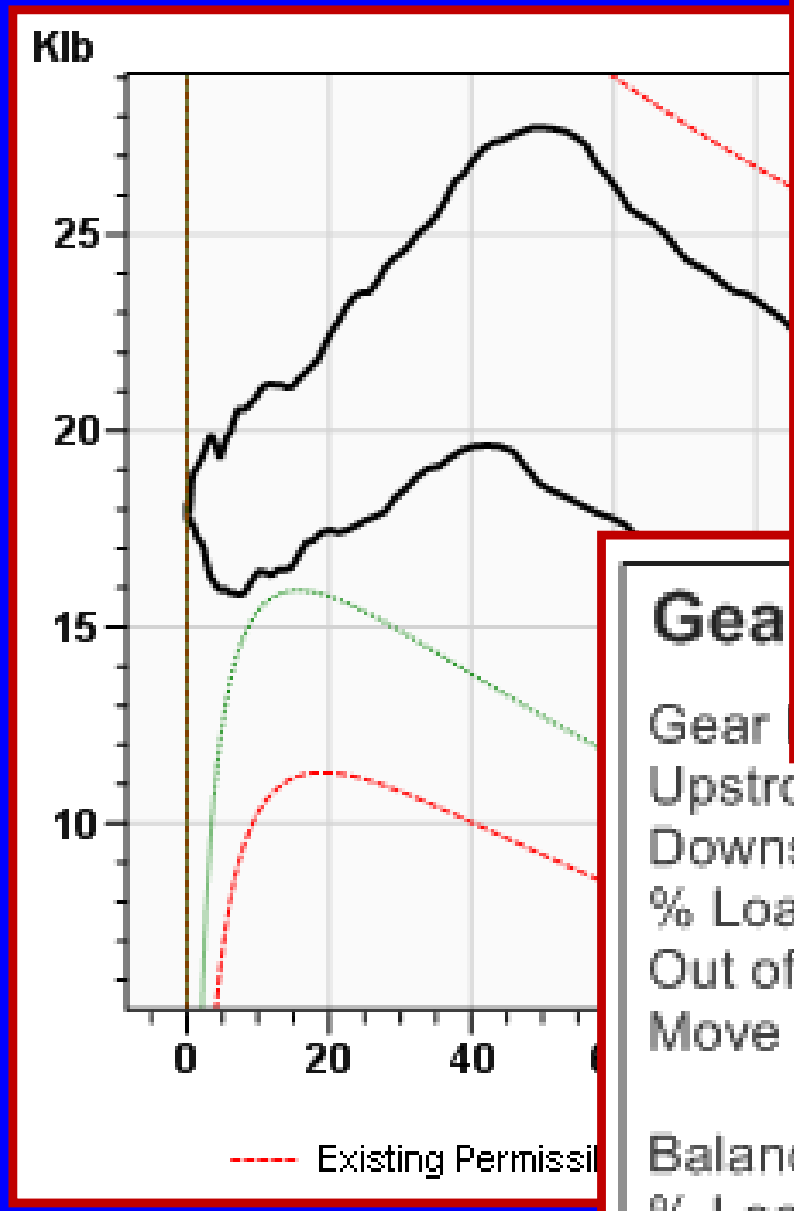
Many Variables Effect Gear Life

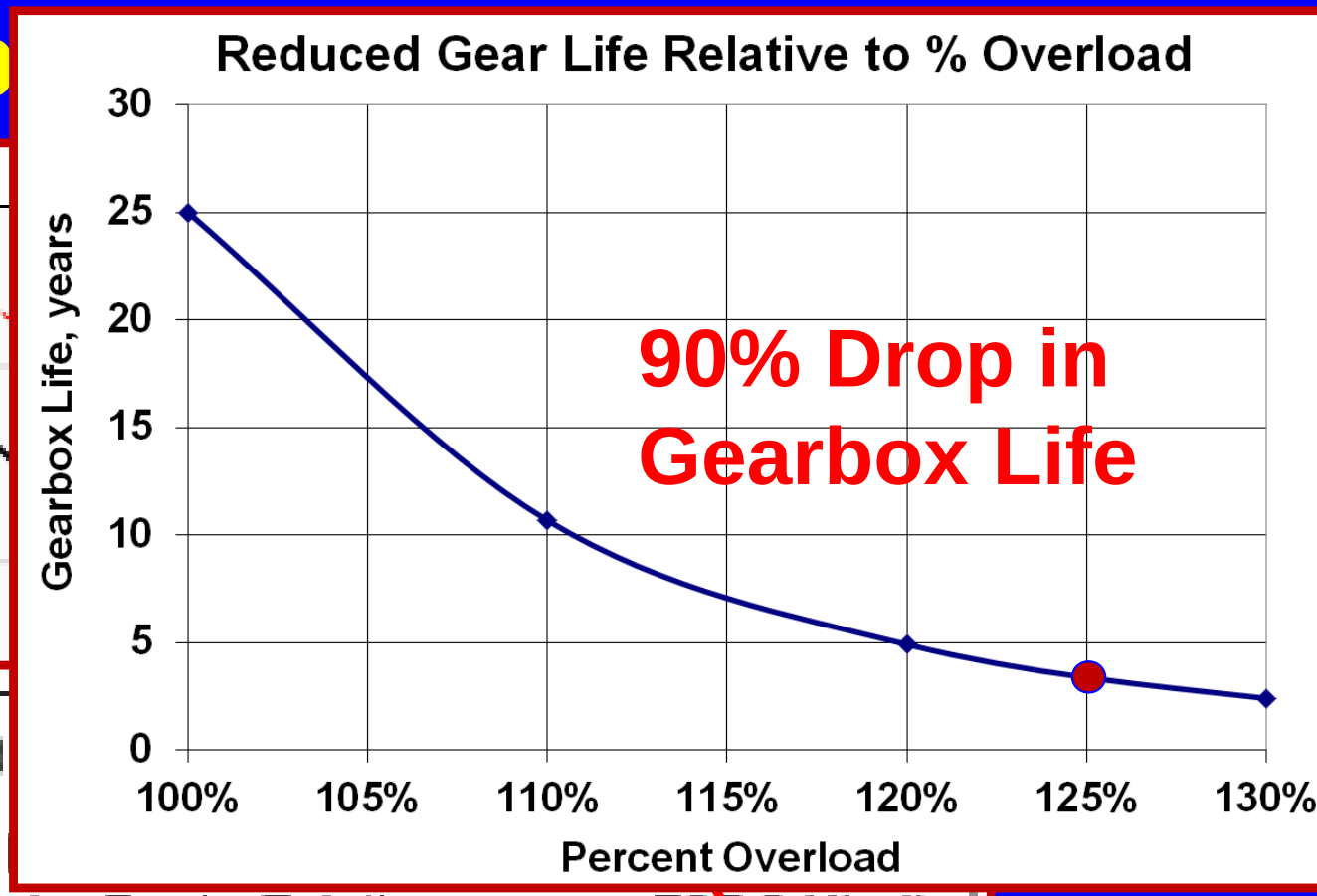
1. Pumping speed
2. Lubrication quality
3. Full pump or pounding conditions (and how badly unit is pounding)
4. Type of prime mover
5. Cyclic load factor
6. Counterbalance

Reduced Gear Life Relative to % Overload



Peak Polished Rod Load Exceeds Permissib





Gea	
Gear	
Upstroke Peak, Existing	797.9 Kin-lb
Downstroke Peak, Existing	436.5 Kin-lb
% Loading (Up), Existing	124.7%
Out of Balance	rod heavy
Move 10.800 Klb of weights	OUT 26.95 in
Balanced Gearbox Loading	617.2 Kin-lb
% Loading, Balanced	96.4%

GearboxBalance

Reasons to Properly Counter Balance Gearbox Loading

1) Reduce Operating Expenses
2) Minimize Torque Loading on Gearbox and Not Exceed Gearbox Load Rating
3) More Uniform Torque Loading through out Stroke
4) Minimize Energy Cost
5) Minimize Prime Mover Requirements
6) Do not Damage Artificial Lift Equipment

Power Measurement Equipment

1. Acquire:
   - RMS (thermal) motor current
   - Average (real) motor current
   - kW during a pump stroke cycle.

2. Three voltage sensing leads "**RIGHT**", "**CENTER**" or "**LEFT**".

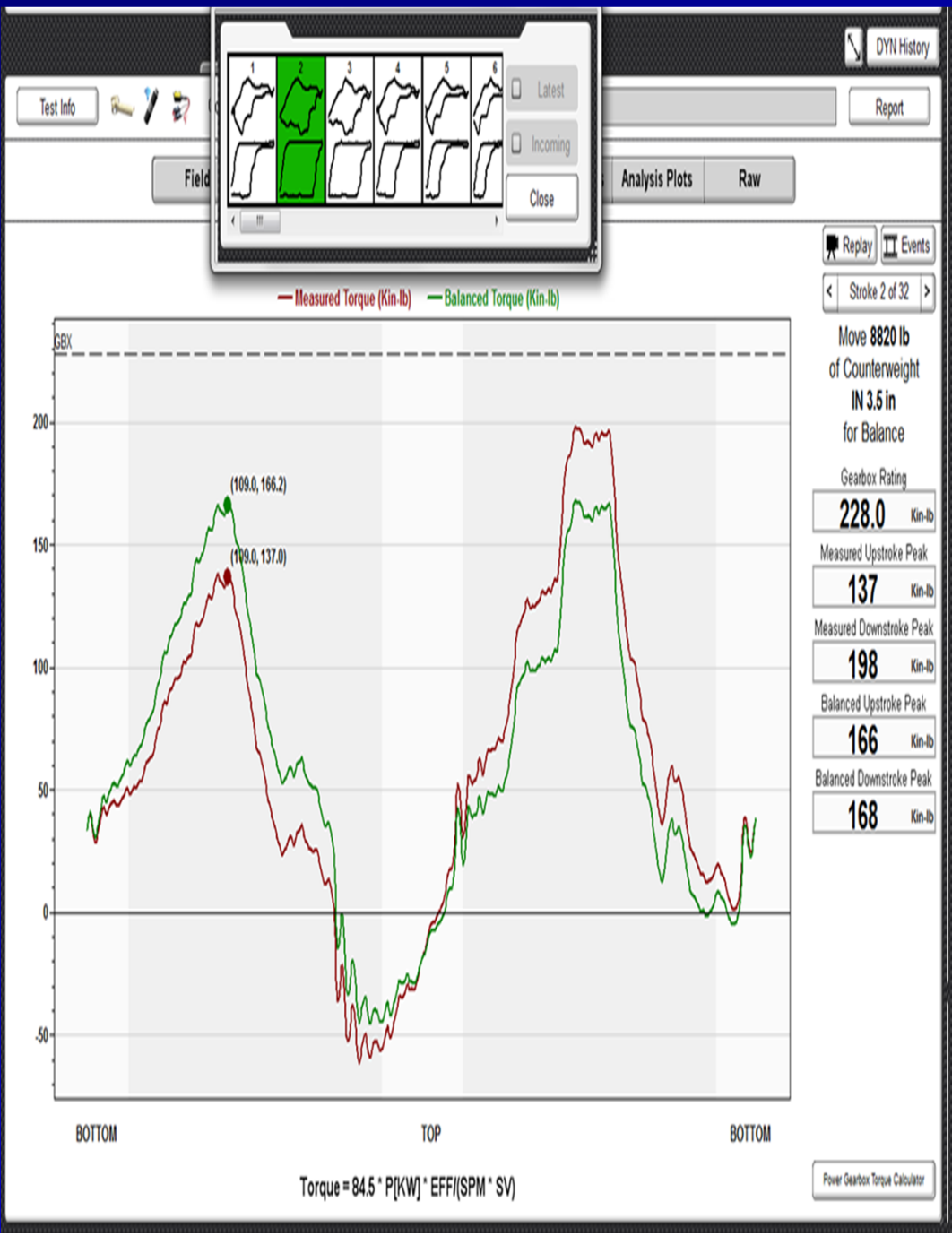
3. Two current sensors.

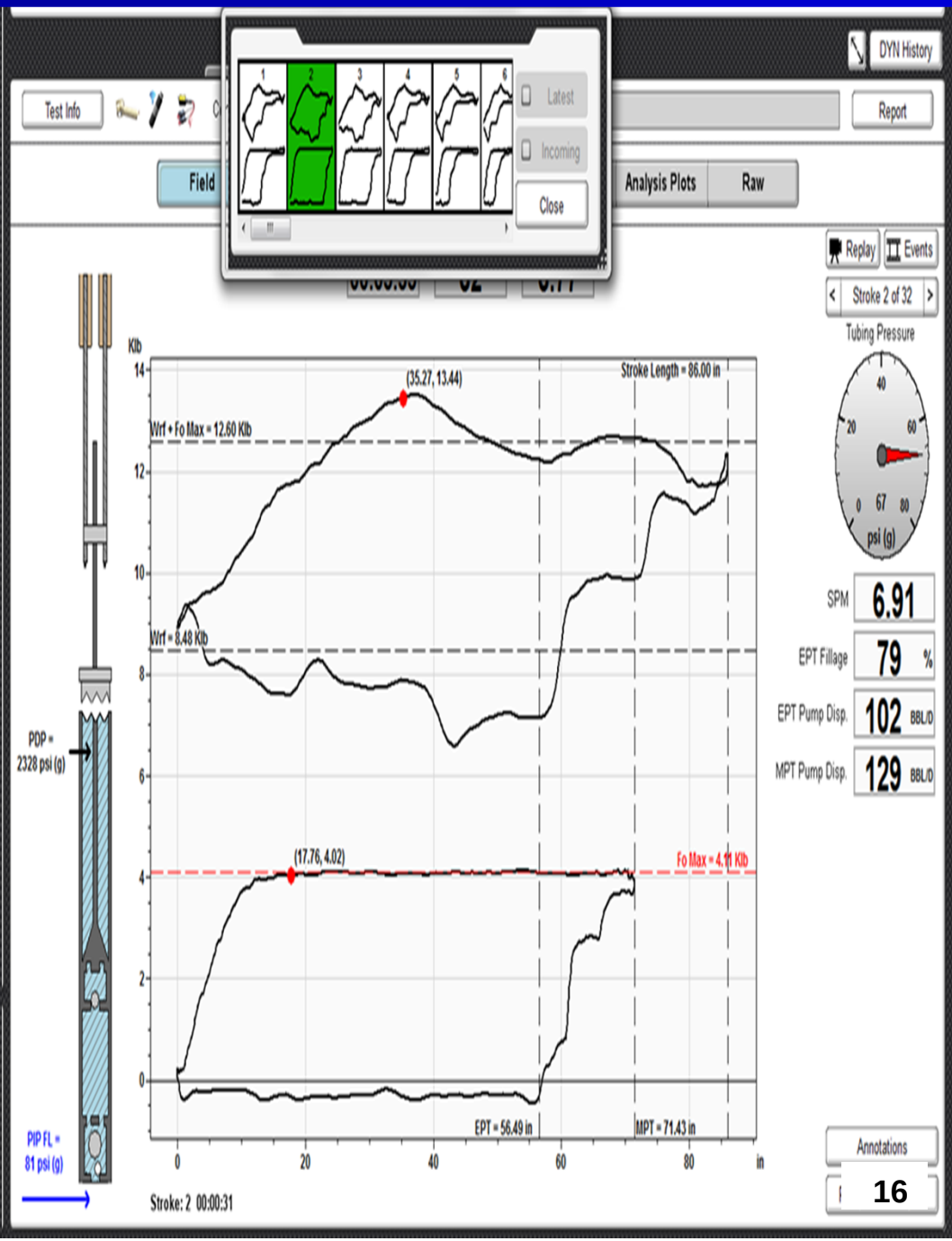
Wireless Power Transmitter with Portable Sensors

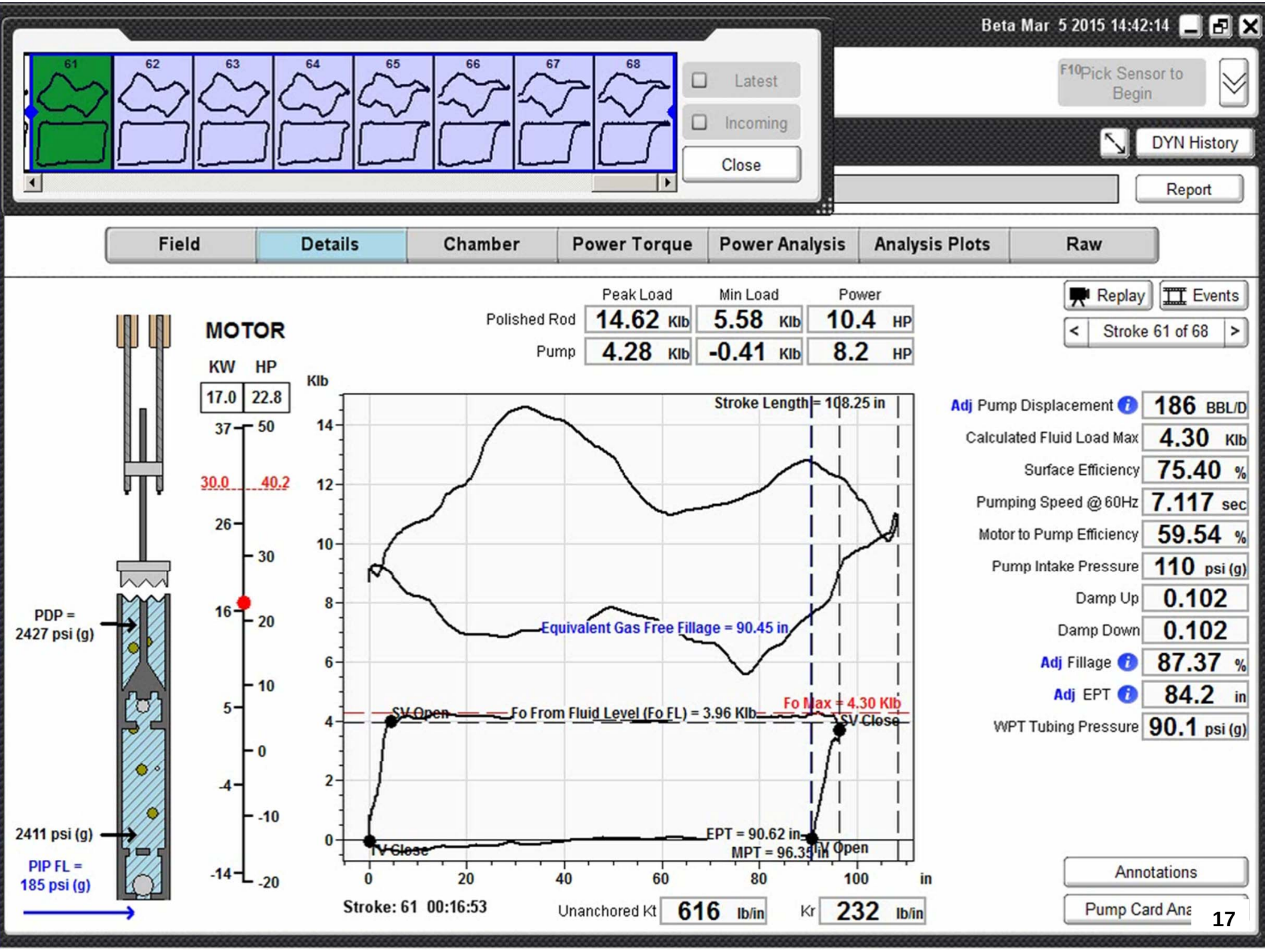
1. Portable transmitter/receiver with voltage and current sensors attached to a convenient place on the panel by magnetic tape.

2. Line of sight with base station is desired.

Wired/Wireless Power is Acquired Simultaneously with Wireless Dynamometer Data






Beta Mar 5 2015 14:42:14
61
62
63
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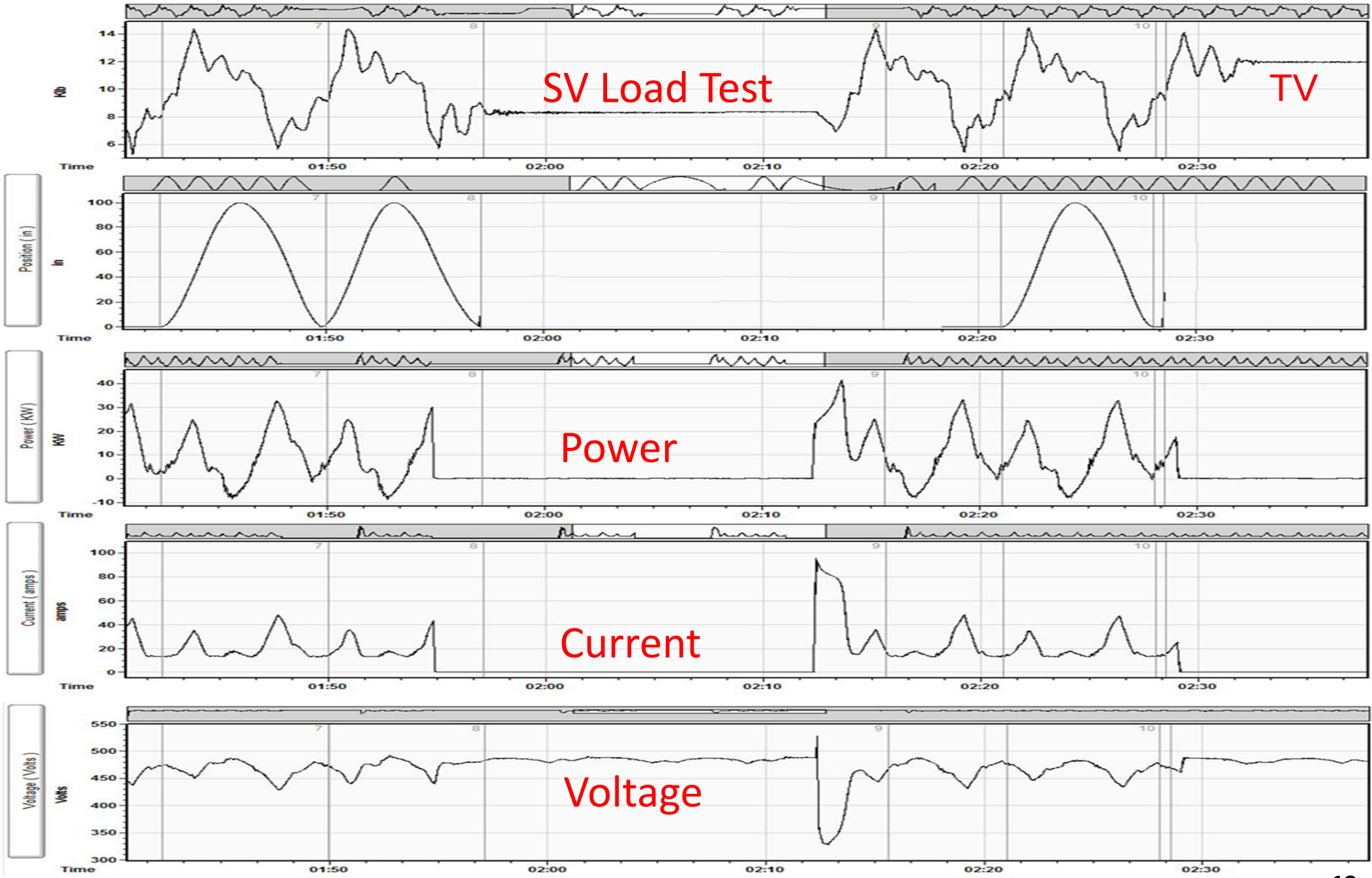
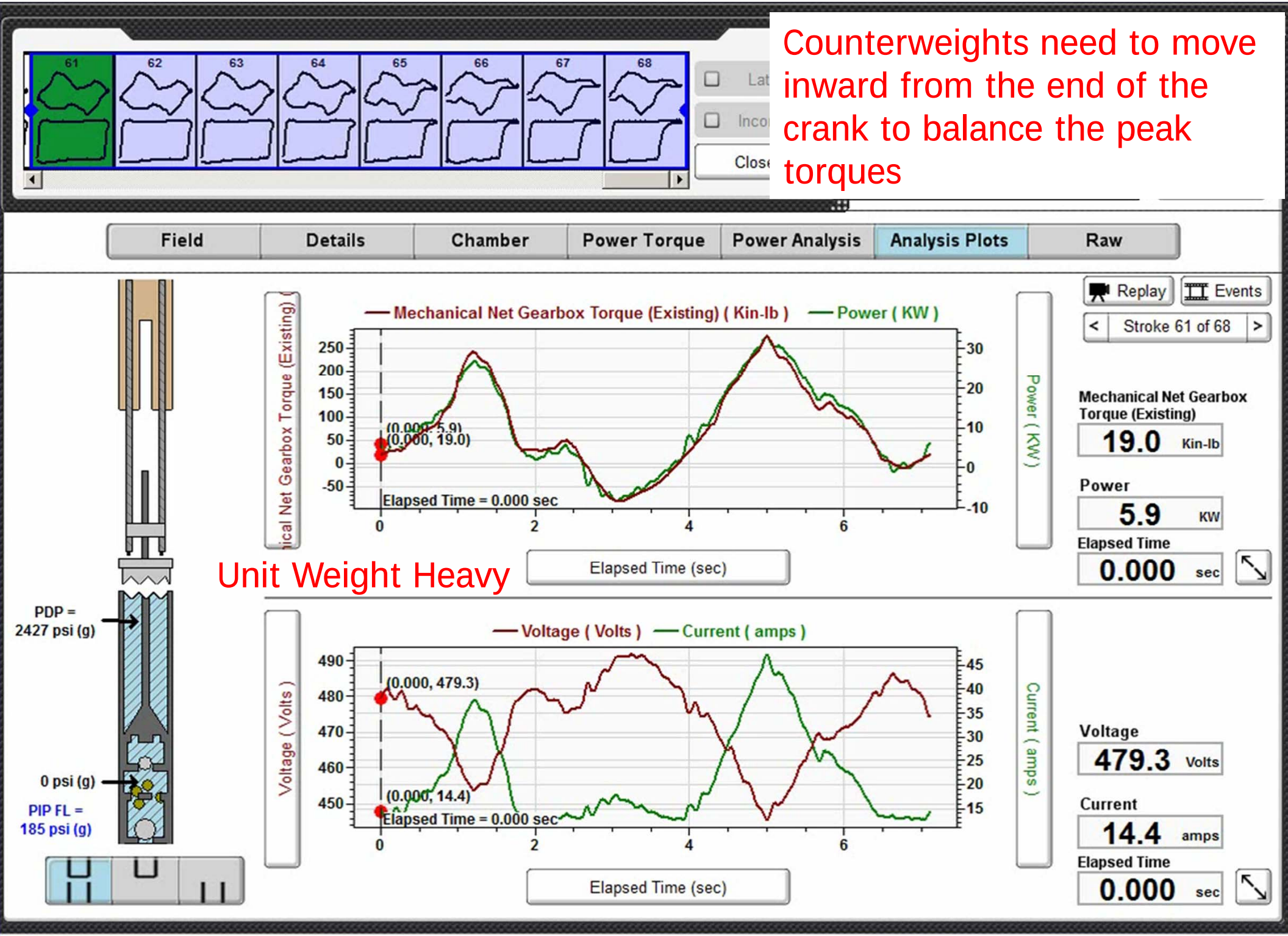
65
66
67
68
Latest
Incoming
Close
F10 Pick Sensor to Begin
DYN History
Report
Field
Details
Chamber
Power Torque
Power Analysis
Analysis Plots
Raw
Replay
Events
Stroke 61 of 68
Peak Load
Min Load
Power
Polished Rod 14.62 Klb 5.58 Klb 10.4 HP
Pump 4.28 Klb -0.41 Klb 8.2 HP
MOTOR
KW HP
17.0 22.8
30.0 40.2
PDP = 2427 psi (g)
2411 psi (g)
PIP FL = 185 psi (g)
Klb
Stroke Length = 108.25 in
Equivalent Gas Free Fillage = 90.45 in
SV Open
Fo From Fluid Level (Fo FL) = 3.96 Klb
Fo Max = 4.30 Klb
SV Close
TV Close
EPT = 90.62 in
MPT = 96.35 in
TV Open
in
Stroke: 61 00:16:53
Unanchored Kt 616 lb/in
Kr 232 lb/in
Adj Pump Displacement 186 BBL/D
Calculated Fluid Load Max 4.30 Klb
Surface Efficiency 75.40 %
Pumping Speed @ 60Hz 7.117 sec
Motor to Pump Efficiency 59.54 %
Pump Intake Pressure 110 psi (g)
Damp Up 0.102
Damp Down 0.102
Adj Fillage 87.37 %
Adj EPT 84.2 in
WPT Tubing Pressure 90.1 psi (g)
Annotations
Pump Card Ana

Simultaneous Wireless Acquisition of Polished Rod Load & Position, Motor Power, Motor Current and Motor Voltage while Acquiring Valve Test.



Counterweights need to move inward from the end of the crank to balance the peak torques



Minimize Energy and Prime Mover Requirements

If:

Net Gearbox Torque on Pumping Unit Maintained in Balance

Then:

Lower Peak Torques Imposed on Motor

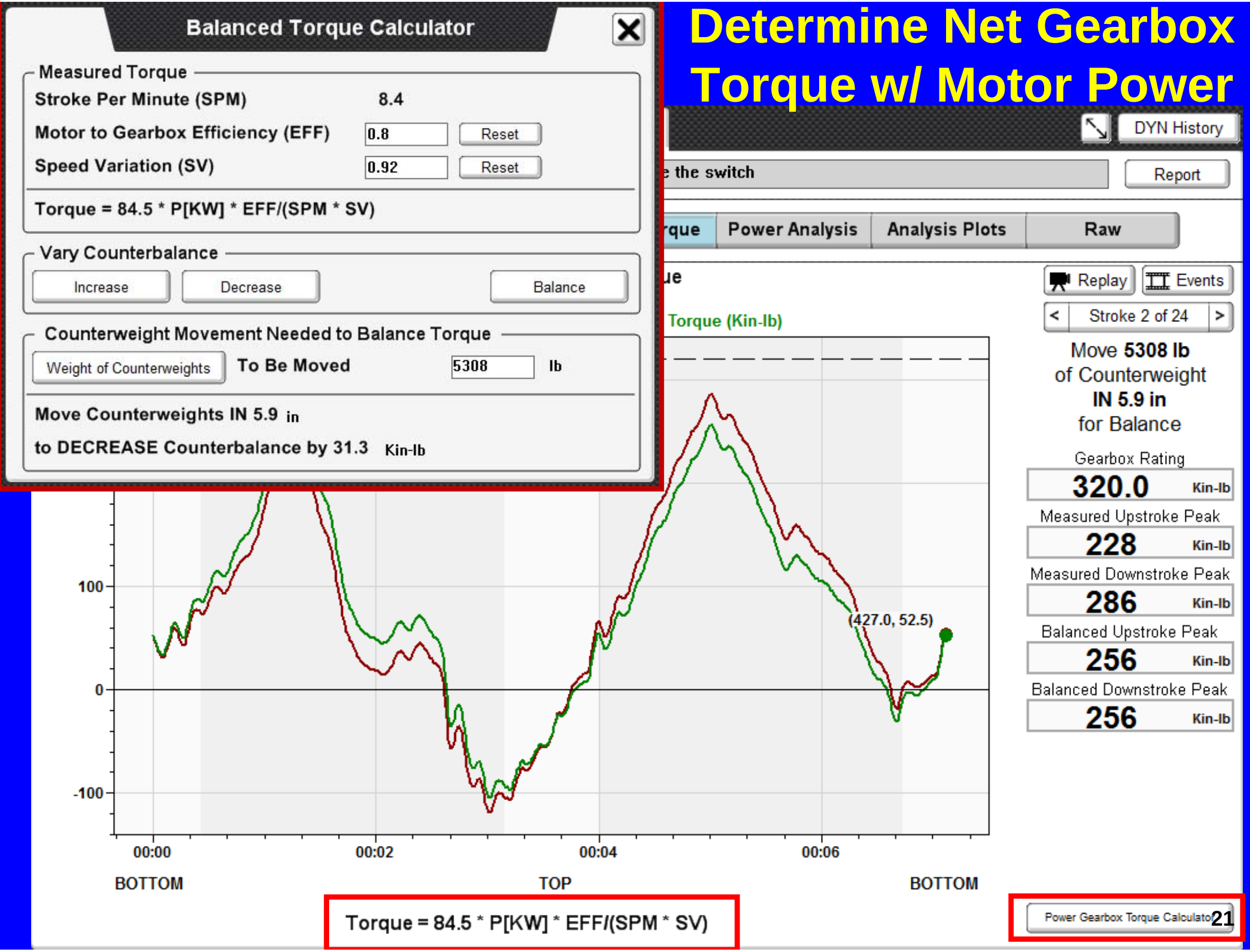
Less Peak Power Delivered by Motor

Less Peak Current Drawn by Motor

Less Power Wasted to Heat Motor

Resulting in Reduced Power Cost

Determine Net Gearbox Torque w/ Motor Power



Power Balancing Considerations

- Measurement of power using the power-current transducer is a quick and easy process
- For more efficient operations power requirement on the upstroke should be balanced against the downstroke
- Operator does not have to know the pumping unit API dimensions, weight of counterbalance, or center of gravities; all that is needed, is to know is the weight of the counterbalance that must be moved

Determine Mechanical Net Gearbox Torque Defined by API Standard 11-E

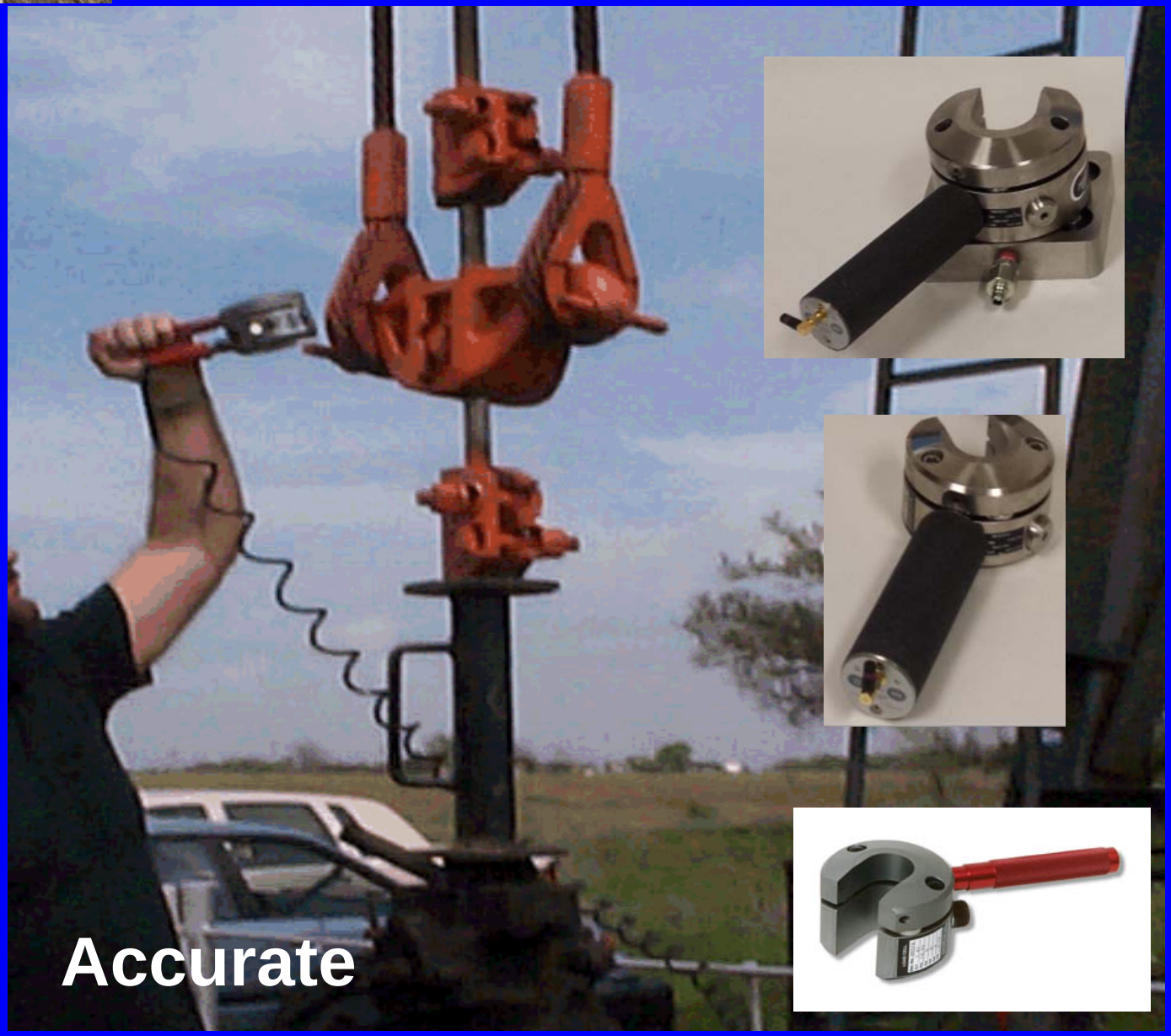
Torque Factor Method is the Standard Method to Determine the Instantaneous Torque Throughout the Pumping Cycle

Use:

- **Polished Rod Load and Position Data**
- **Torque Factors**
- **Together with Counterbalance Moments**

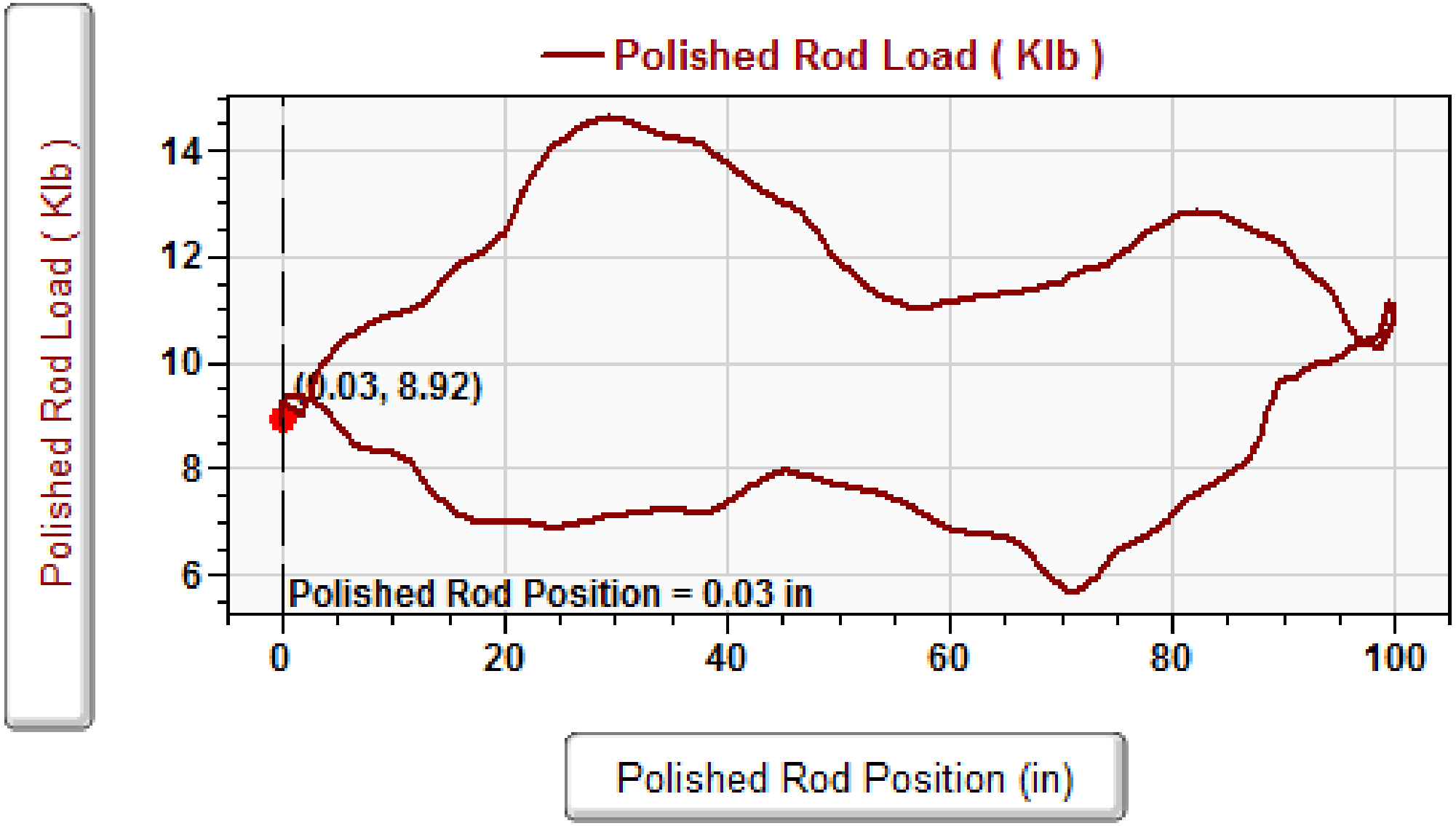
Use Any of these Transducers to Perform a Dynamometer Survey

Safe & Quick



Accurate

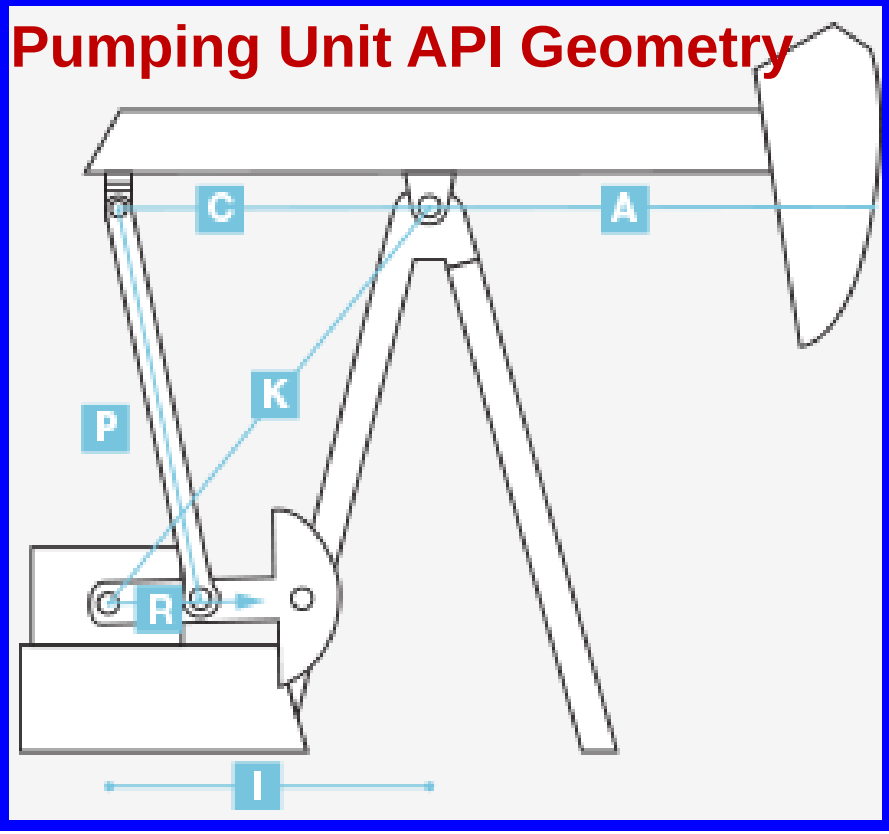
Dynamometer Outputs Polished Rod Load/Position Applied to Unit Over One Complete Stroke



API Torque Factors

1. Unit API Dimensions Hand Entered or Selected From a Data Base
2. Torque factors (TF) are derived from the geometry of the particular pumping unit
3. Used to determine the instantaneous torque due to polished rod load at a given crank position.

Manufacturer		LUFKIN
API Description		C-320D-256-100
Rotation		Counter ClockWise
Gearbox Rating		320.0 Kin-lb
Pumping Speed		8.411 SPM
Polished Rod Stroke		100.00 in
Net Torque Calculations use:		
CBM From counterweights database		
CBM: 503.2 Kin-lb		CBE: 10.525 Klb
Top of Stroke Crank Angle		173.5°
Bottom of Stroke Crank Angle		357.8°
Theoretical Stroke Length		100.00 in
API Dimensions:		
A = 129.00	P = 132.00	C = 111.07
I = 111.00	K = 175.55	R = 42.00
Phase Angle		0 degree
Structural Unbalance		550 lb



API Dimensions in TAM Data Base

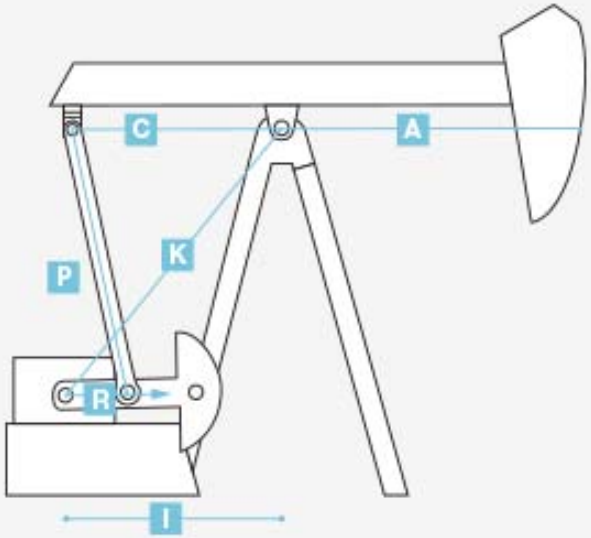
Pumping Unit Library

Class: Conventional | Manufacturer: LUFKIN | API: C-320D-256-100 | Model: <Any>

Class	Manufacturer	API	Model	GearBox	Double Reduction Gear	Structual Load	A	C	P	I	K	M	S	X
				Kin-lb		Klb	in	in	in	in	in	sq in	psi (g)	in
Conventional	LUFKIN	C-320D-256-100		320.0	No	25.60	129.00	111.07	132.00	111.00	175.55			

Class Conventional
Manufacturer LUFKIN
API C-320D-256-100
Model

Structural Load 25600 lb
Structural UnBalance 550 lb
Tau 0 degree
GearBox 320.0 Kin-lb

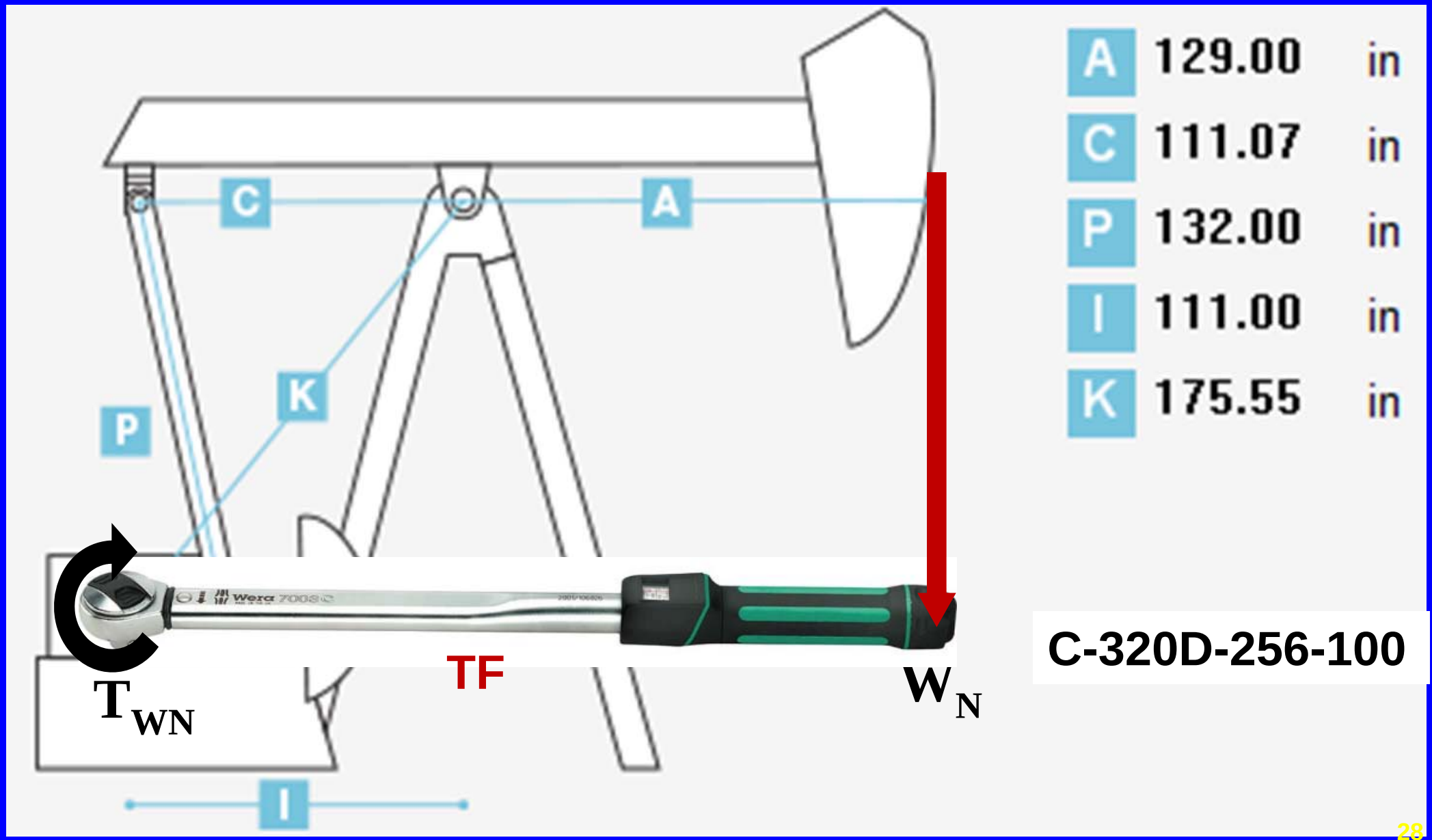


A	129.00	in
C	111.07	in
P	132.00	in
I	111.00	in
K	175.55	in

#	in	stroke length in
R1	42.00	100.00
R2	36.00	85.71
R3	30.00	71.43
R4	24.00	57.14

Comments: C-320D-256-100

Torque Factors, TF, Derived from Geometry of Selected Pumping Unit



Torque due to Polished Rod Load

Net well load is:

W_N = net well load = (W - SU)

Torque due to net well load is:

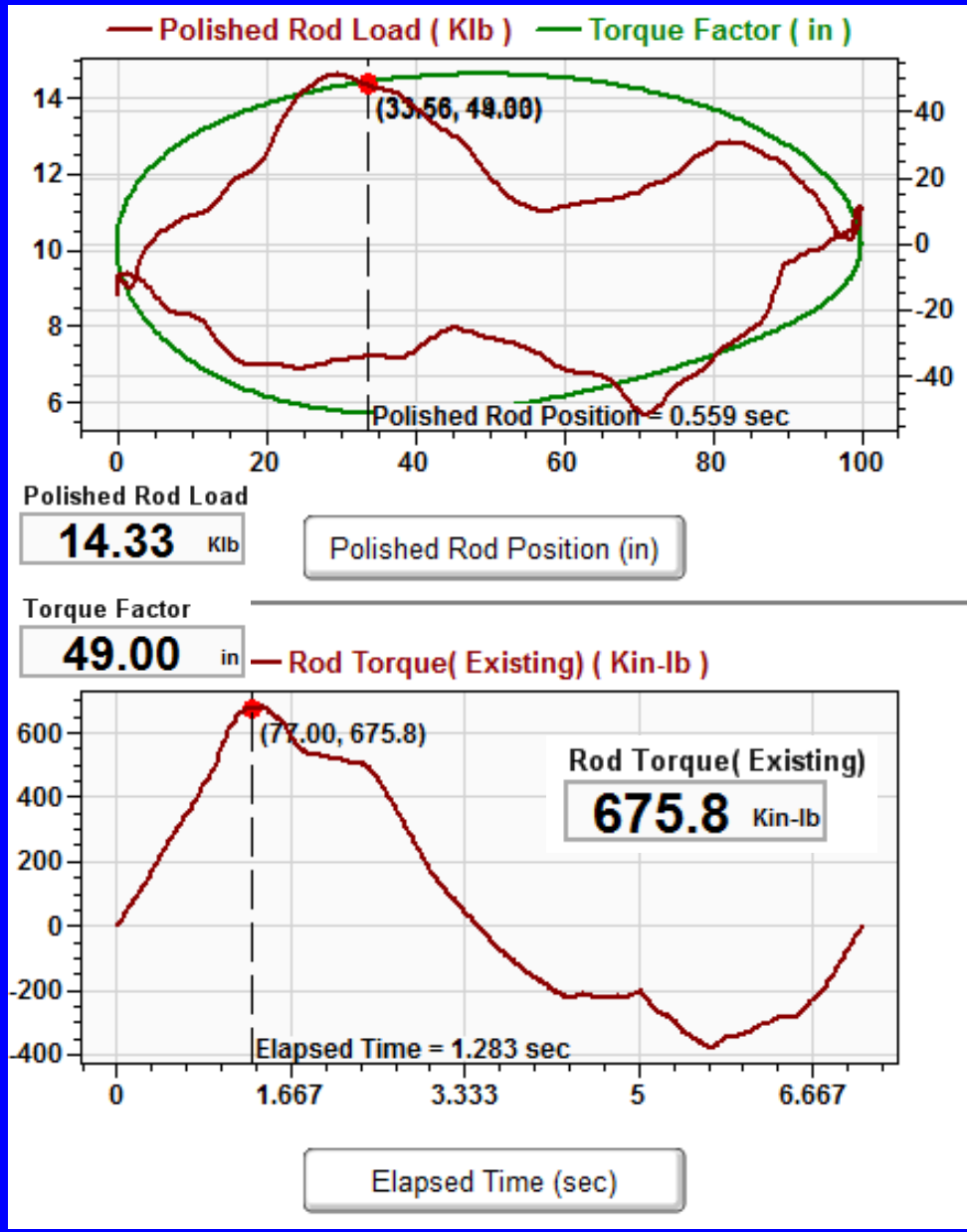
$T_{WN} = TF \times W_N$

Where:

W = well load at a specific crank angle

SU = structural unbalance of the pumping unit (either plus or minus value)

TF = torque factor, inches



$T_{WN} = TF \times W_N$ = 49 in x (14.33-0.55) Klbs = 675.8 Kin-lb

Counterbalance Moment, Me, from CBE

$$Me = TF_{90} \times (\underline{CBE} - SU) / \sin(\theta + \tau)$$

Where:

Me = existing counterbalance moment of the crank and counter weights

CBE = well load at 90 Deg crank angle

SU = structural unbalance of the pumping unit (either plus or minus value)

TF_{90} = torque factor at 90 Deg crank angle

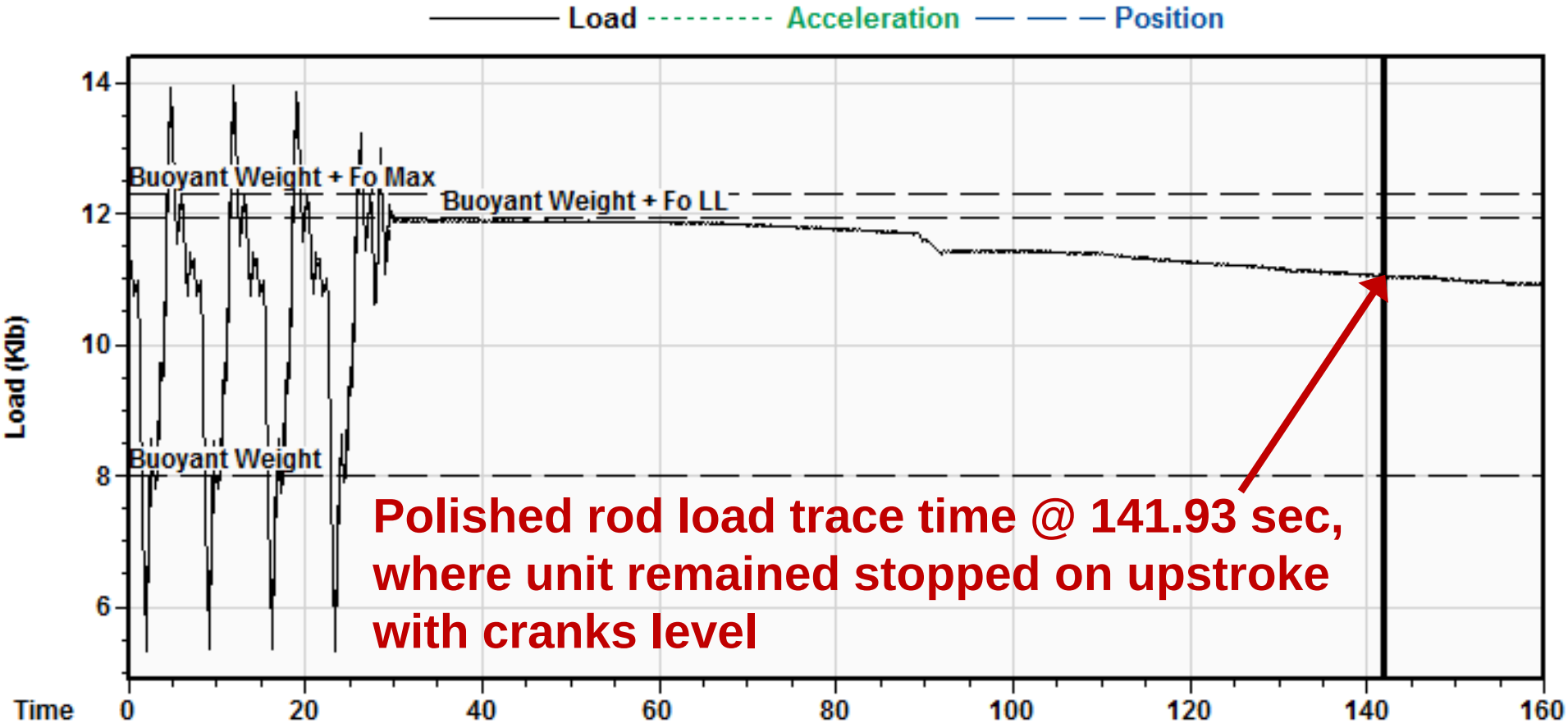
θ = the crank angle (90)

τ = the crank phase angle

Static Counterbalance Effect (CBE) Test

1. Stop the unit on the upstroke with the cranks level.
2. Determine whether the polished rod load is greater or less than the counterbalance effect load
   - As drop in PR load occurs
   - Release the brake periodically to check for movement.
3. Cranks will balance momentarily as the load is equalized due to fluid leakage from the tubing into the pump.
4. CBE load is equal to the buoyant rod weight plus fluid load carried by the pump.

Set Crank Level for Field Measured CBE



CBE Load	11.06 Klb	141.93	sec
CBM Calculated From CBE Load	530.2 Kin-lb		
Bouyant Rod Weight	8.01 Klb		
Bouyant Rod Weight + Fluid Load	12.30 Klb		
Bouyant Rod Weight + Fo Liquid Level LL Test: 03/13/2015 01:48:33	11.94 Klb		

Show Acceleration

Show Position

Counterbalance Effect (CBE) Test

- Requires a properly functioning brake.
- Counterbalance effect load between the traveling valve load and the standing valve load.
- Will not work when fluid slippage through the pump is rapid and the fluid load quickly transfers from the rods to the tubing.

Determine Mechanical Net Gearbox Torque Defined by API Standard 11-E

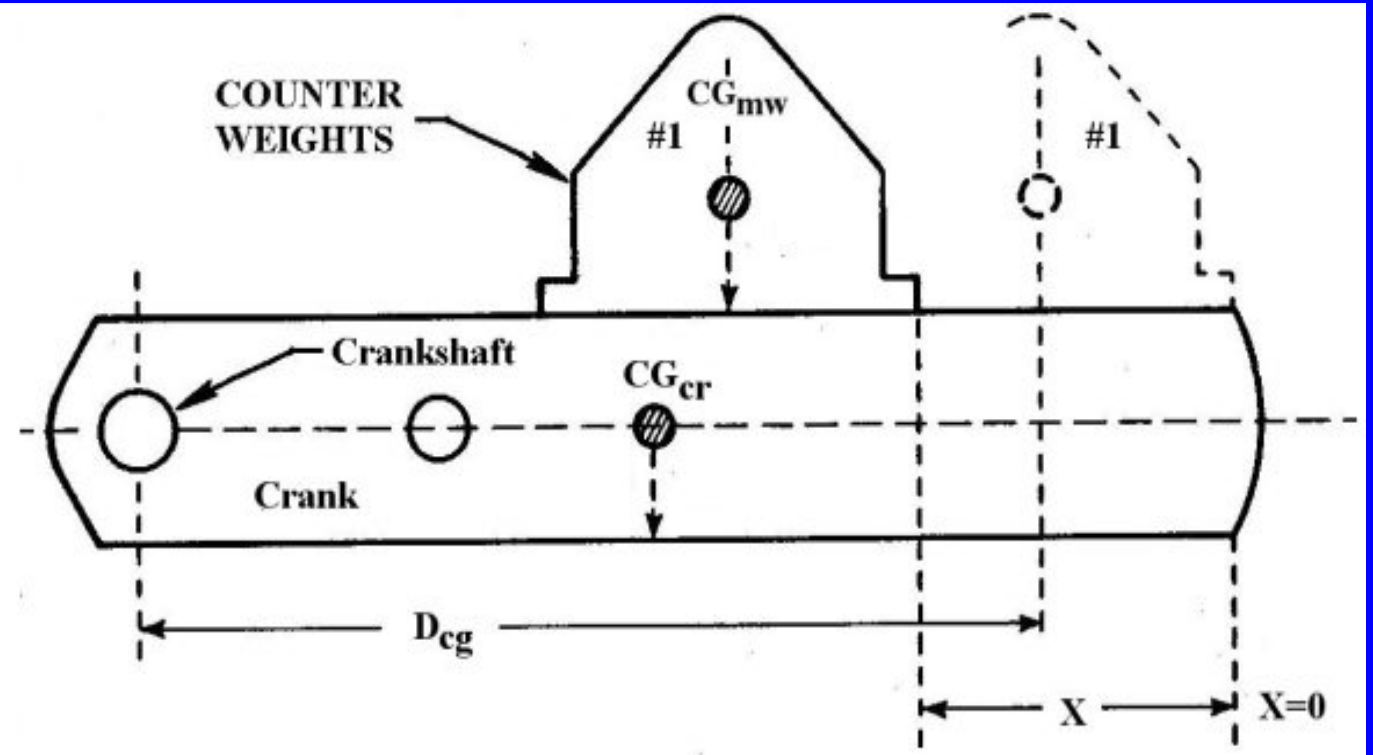
Torque Factor Method is the Standard Method to Determine the Instantaneous Torque Throughout the Pumping Cycle

Use:

- **Polished Rod Load and Position Data**
- **Torque Factors**
- **<u>Together with Counterbalance Moments</u>**

Calculate Counterbalance Moment for Conventional Pumping Units with Crank Mounted Counterweights

$$Me = Mcr + \sum_{i=1}^{Nm} Wm \times (Dcg - X_i) + \sum_{i=1}^{Na} Wa \times (Dcg - X_i)$$



Where:

Me	= Existing counterbalance moment of the crank and counter weights (in-lbs)
Mcr	= Crank counterbalance moment (in-lbs)
Wm_i	= Weight of the master counterweight (lbs)
Wa_i	= Weight of the auxiliary counterweight (lbs)
Dcg_i	= Maximum distance from centerline of the Crankshaft to the counterweight center of gravity (in)
X_i	= Distance from end of the crank to the outside edge of the counterweight
Xmax	= Maximum distance along crank that counterweight can be moved
Nm	= Number of master counterweights
Na	= Number of auxilary counterweights

Note:

For convenience only one Counterweight is shown on the top of the crank (this is the #1 Counterweight).

Counterbalance moment for conventional cranks is the sum of the moments contributed by the cranks themselves (Weight x Center-of-Gravity) plus the moments of the master and auxiliary weights.

Example Well #1 (2 x 8495B Cranks with 4 x 3CRO Master Weights):

	Crank #1	Crank #2
Name	8495B	8495B
Weight - Lbs	3510	3510
Center Gravity (CG) - inches	46.25	46.25
Mcr, Crank Moment (in-lbs):	162,338	162,338

	Master Weight #1	Master Weight #2	Master Weight #1	Master Weight #2
Name	3CRO	3CRO	3CRO	3CRO
Wmi, Weight (Lbs)	1327	1327	1327	1327
Dcgi (inches)	72.2	72.2	72.2	72.2
Xi. (inches)	40	40	40	40
CG - inches	32.2	32.2	32.2	32.2
M. W. Moment (in-lbs):	44,056	44,056	44,056	44,056

Total Moment: 2 x 162,338 + 4 x 44,056 = 500,900 in-lbs

Select Cranks and Counter Weights

Calculate:

Sum the moments contributed by the cranks themselves

(Weight x Center-of-Gravity)

Plus the moments of the master and auxiliary weights.

Counter Balance Moment Existing

Counter Balance Moment Calculation

Currently Selected Unit

Manufactuer: LUFKIN
Unit Class: Conventional
API Description: C-320D-256-100
Unit Description:

Counter Weight Selection

Manufacturer: Lufkin

CRANK #1

Crank No.: 8495B

Master Weight #1
Master Wt. No.: 3CRO
Aux .1 Wt. No.: NONE
Aux .2 Wt. No.: NONE
Distance From End of Crank: 39.50 in

Master Weight #2
Master Wt. No.: 3CRO
Aux .1 Wt. No.: NONE
Aux .2 Wt. No.: NONE
Distance From End of Crank: 40.00 in

CRANK #2

Crank No.: 8495B

Master Weight #1
Master Wt. No.: 3CRO
Aux .1 Wt. No.: NONE
Aux .2 Wt. No.: NONE
Distance From End of Crank: 39.00 in

Master Weight #2
Master Wt. No.: 3CRO
Aux .1 Wt. No.: NONE
Aux .2 Wt. No.: NONE
Distance From End of Crank: 39.75 in

Counter Balance Moment Existing: 503.2 Kin-lb
Weight of Counter Wieghts: 5308.0 lb

Torque due to Counterbalance Moment CBE or CBM

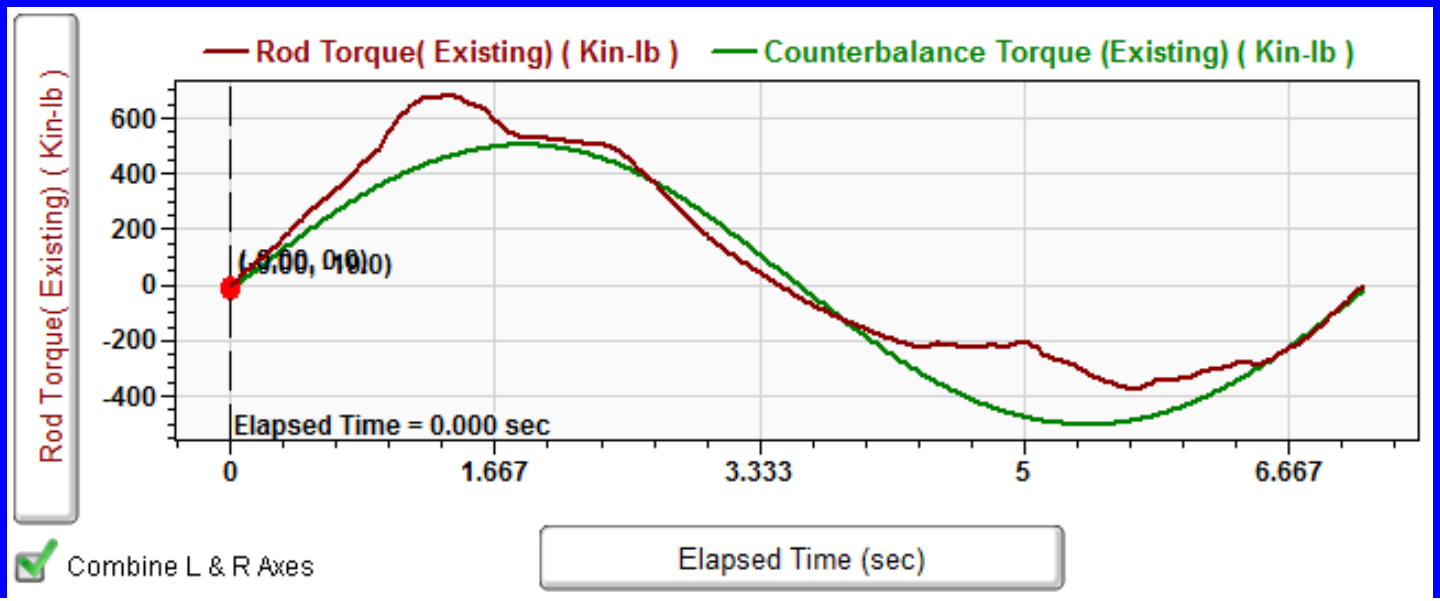
$$T_{CN} = M \times \sin(\theta + \tau)$$

Where:

M = existing counterbalance moment of the crank and counter weights

θ = the crank angle

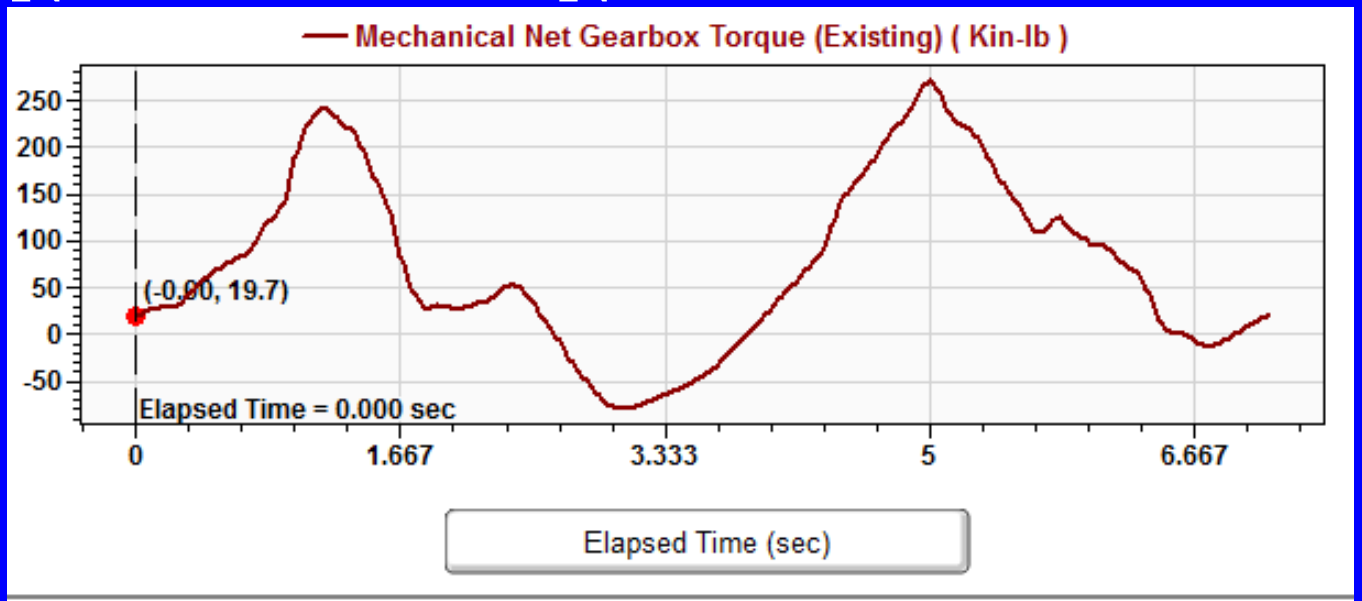
τ = the crank phase angle

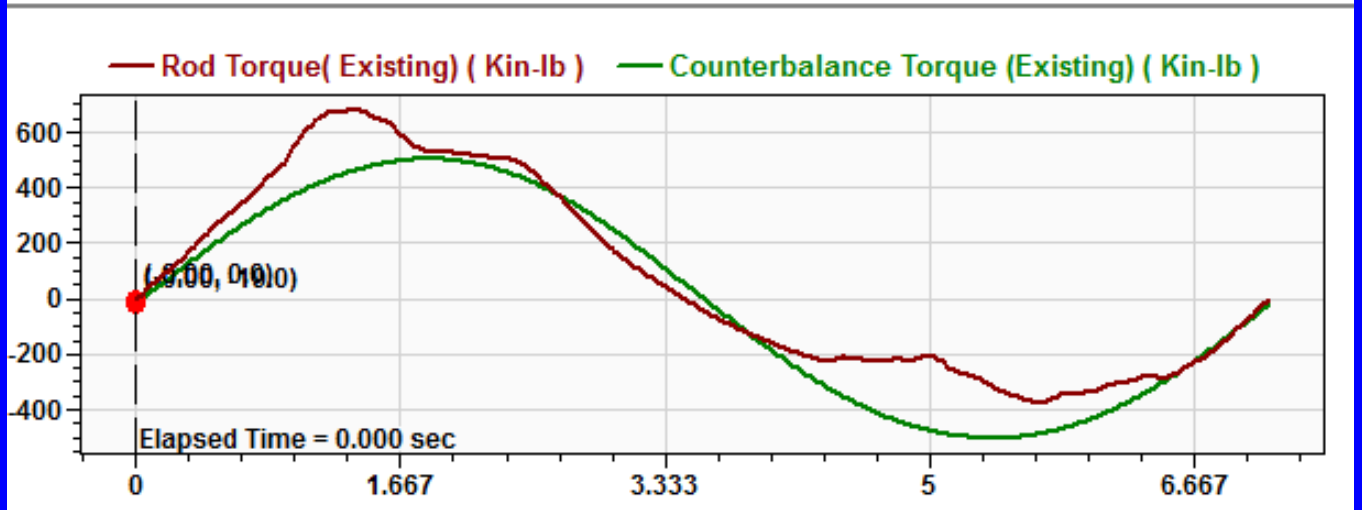


Net Gearbox Torque, T_N

Difference between the torque due to net well load and the torque due to the counterbalance moment of the crank and counterweights:

$$T_N = TF \times W_N - M \times \sin(\theta + \tau)$$





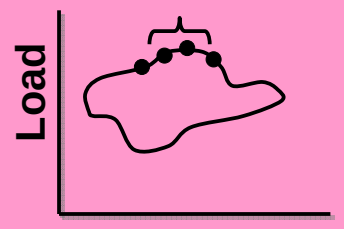
Net Gearbox Torque, T_N

$$T_N = TF(W - SU) - M \sin(\theta + \tau)$$

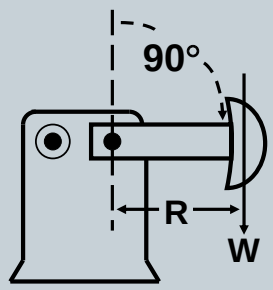
- T_N = net gearbox toque (inch-lbs)
- TF = torque factor at crank angle θ, (in-lbs)/lbs = inch
- W = polished rod load at θ, (lbs)
- SU = structural unbalance of unit (if negative, head falls, lbs)
- M = maximum counter weight moment (in-lbs)
- θ = crank angle (degrees)
- τ = crank offset angle (degrees)

$T_N = TF(W - SU) - M \sin(\theta + \tau)$

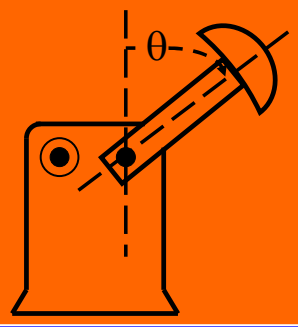
Torque Factor: From tables or calculated, (in-lbf)/lbf, each load & position

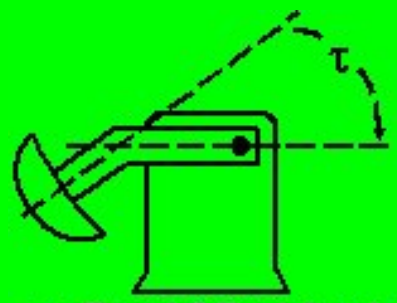


Structural unbalance, Lbf, if negative, head falls



M = RxW @ 90°



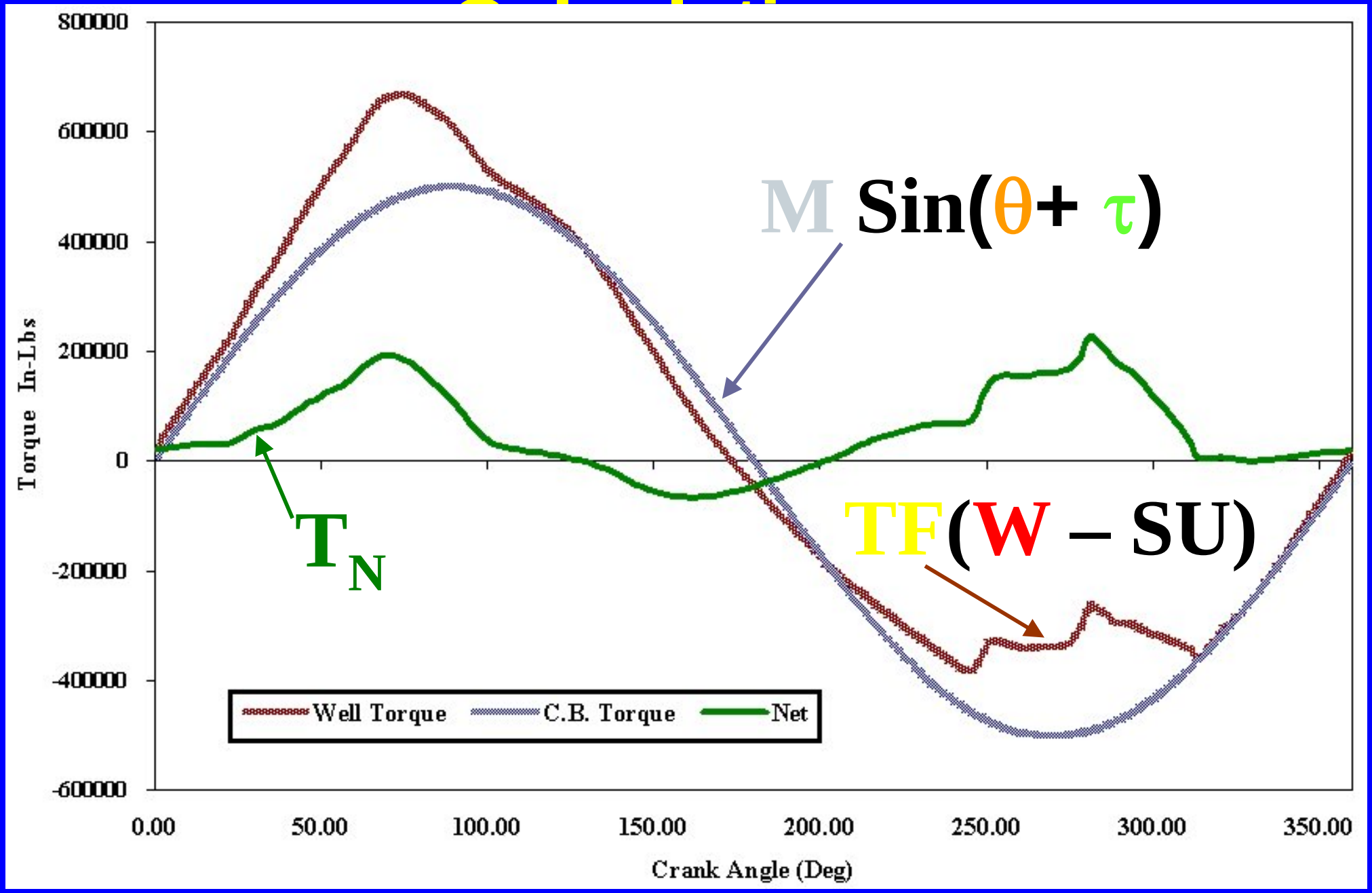


τ=Fixed Offset Angle
ie: Mark Unit

Example of API Standard 11-E Calculations

(1) Crank Angle Deg	(2) Phase Angle Deg	(3) Col.1 + Col.2 Deg	(4) Sin(Col.3)	(5) Well Load (Lbs)	(6) Structural Unbalance (Lbs)	(7) Col. 5-6 Net PRL (Lbs)	(8) Torque Factor (In)	(9) Col. 7x8 Well Torque (In-Lbs)	(10) C.B. Moment (In-Lbs)	(11) Col. 4x10 C.B. Torque (In-Lbs)	(12) Col. 9-11 Net Torque (In-Lbs)
0.0	0	0.00	0.000	8658	550	8108	1.58	12794	500900	0	12794
15.0	0	15.00	0.259	9005	550	8455	18.87	159565	500900	129642	29922
30.0	0	30.00	0.500	10107	550	9557	32.11	306898	500900	250450	56448
45.0	0	45.00	0.707	11423	550	10873	41.87	455190	500900	354190	101001
60.0	0	60.00	0.866	12767	550	12217	48.17	588525	500900	433792	154733
75.0	0	75.00	0.966	13636	550	13086	51.14	669253	500900	483832	185421
90.0	0	90.00	1.000	12485	550	11935	50.76	605893	500900	500900	104993
105.0	0	105.00	0.966	11408	550	10858	46.91	509394	500900	483832	25562
120.0	0	120.00	0.866	11774	550	11224	39.59	444325	500900	433792	10533
135.0	0	135.00	0.707	12189	550	11639	29.35	341568	500900	354190	-12622
150.0	0	150.00	0.500	11761	550	11211	17.59	197159	500900	250450	-53291
165.0	0	165.00	0.259	11113	550	10563	6.01	63476	500900	129642	-66167
173.5	0	173.50	0.113	11131	550	10581	0.00	0	500900	56704	-56704
180.0	0	180.00	0.000	11260	550	10710	-4.28	-45869	500900	0	-45869
195.0	0	195.00	-0.259	11504	550	10954	-13.12	-143701	500900	-129642	-14058
210.0	0	210.00	-0.500	11433	550	10883	-20.87	-227123	500900	-250450	23327
225.0	0	225.00	-0.707	11203	550	10653	-28.04	-298702	500900	-354190	55488
240.0	0	240.00	-0.866	11033	550	10483	-34.96	-366499	500900	-433792	67293
255.0	0	255.00	-0.966	8449	550	7899	-41.64	-328890	500900	-483832	154942
270.0	0	270.00	-1.000	7689	550	7139	-47.52	-339252	500900	-500900	161648
285.0	0	285.00	-0.966	5914	550	5364	-55.48	-297574	500900	-483832	186258
300.0	0	300.00	-0.866	6706	550	6156	-50.99	-313910	500900	-433792	119882
315.0	0	315.00	-0.707	8364	550	7814	-44.72	-349428	500900	-354190	4761
330.0	0	330.00	-0.500	8344	550	7794	-32.18	-250796	500900	-250450	-346
345.0	0	345.00	-0.259	8302	550	7752	-15.34	-118904	500900	-129643	10738
357.8	0	357.80	-0.038	8651	550	8101	0.00	0	500900	-19229	[illegible]
360.0	0	360.00	0.000	8658	550	8108	1.58	12794	500900	0	[illegible]

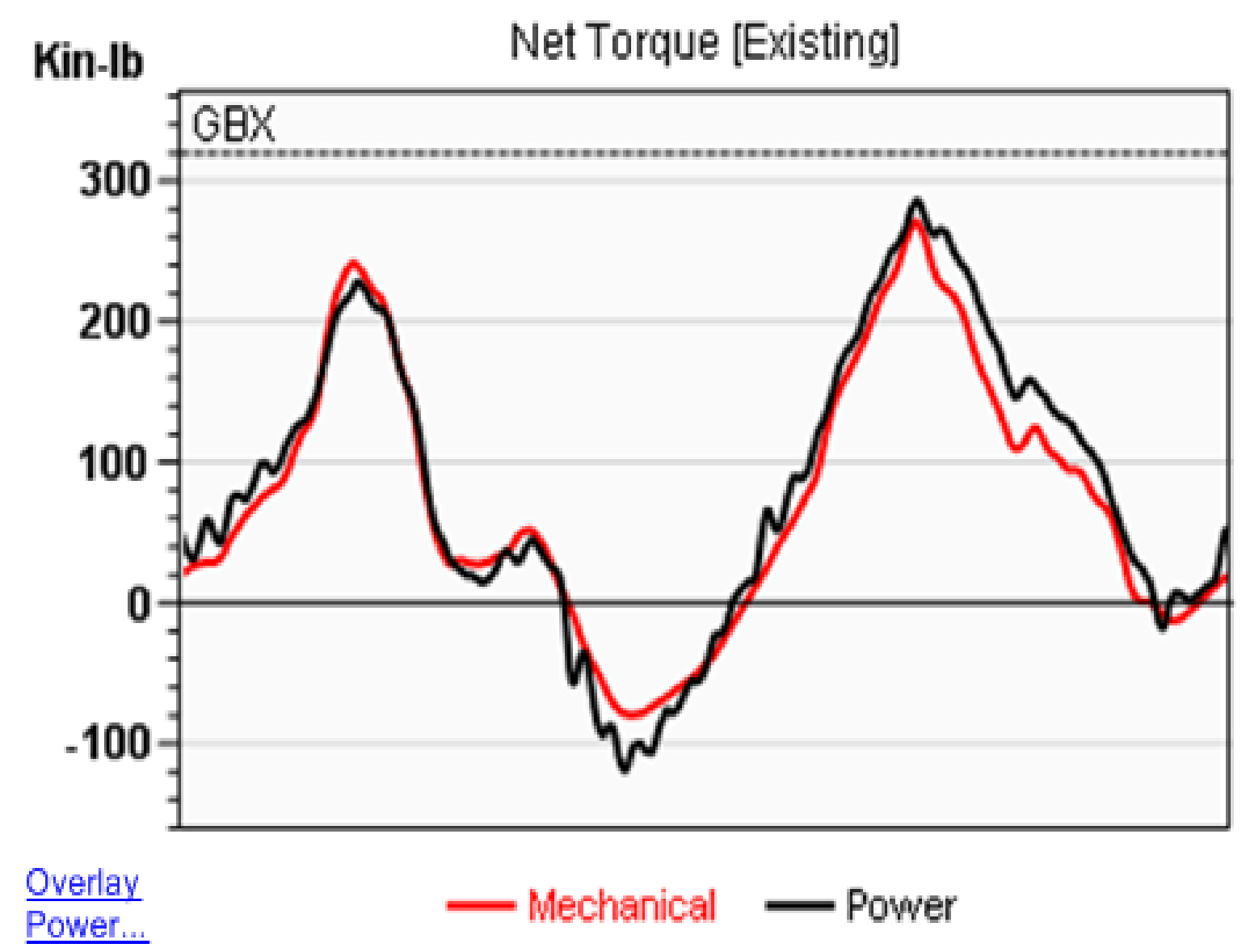
Plot of API Standard 11-E



Both Power and Mechanical Show Gearbox to be Weight Heavy

Plot of Power and Mechanical Torque Data

Counterweights need to move in from the end of the crank to balance the peak torques



Select Mechanical Torque Method

Surface Unit

Manufacturer: LUFKIN

Class: Conventional

API: C-320D-256-100

Model:

Stroke Length: 100.00 in

Rotation: CW CCW

Select Pumping Unit

For Net Torque Calculations Use

CBM

CBM From Counterweights Database

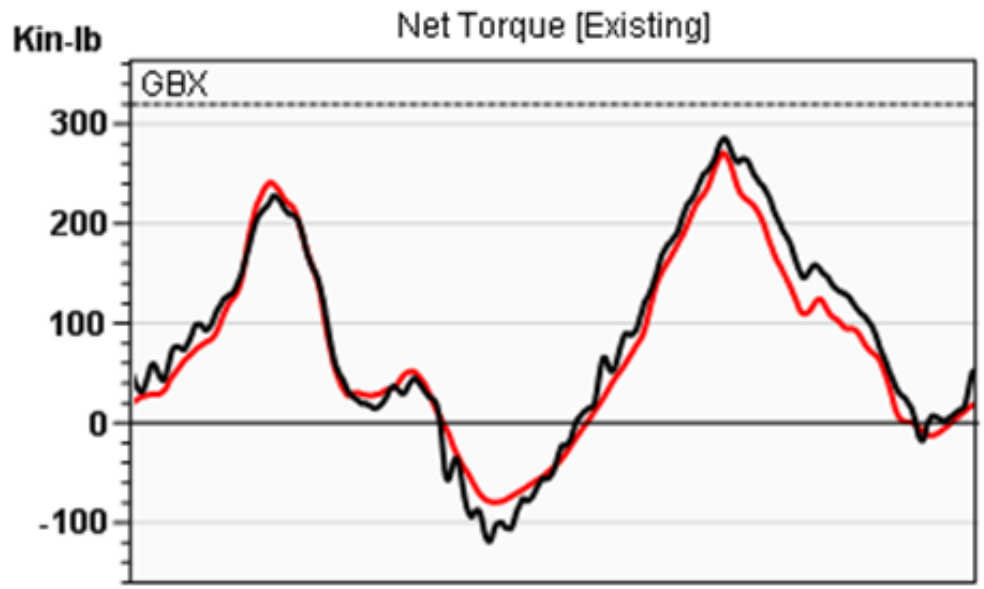
CBM: 503.2 Kin-lb CBE: 10.52 Klb

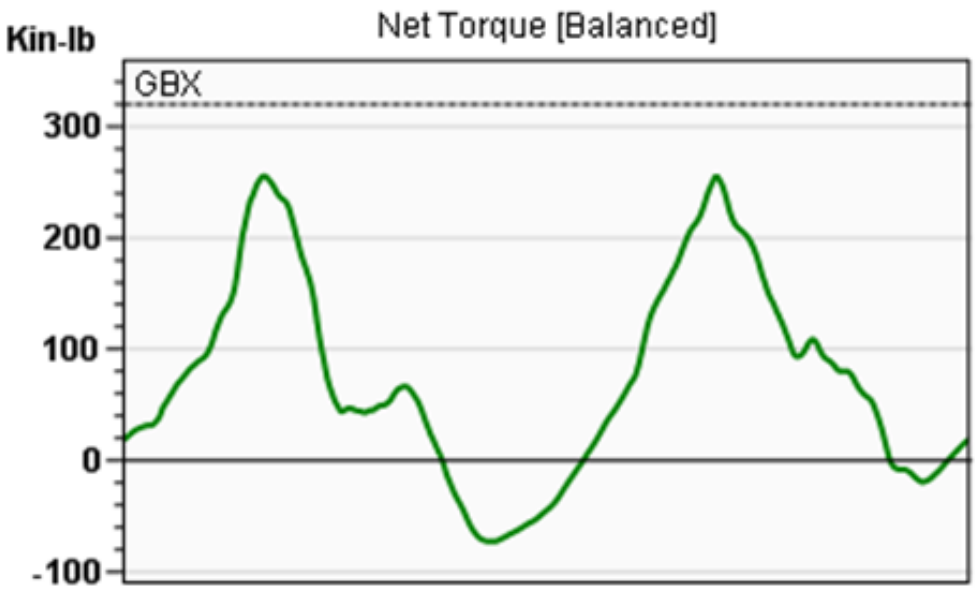
CBE

CBE Manually entered

CBE: 11.29 Klb CBM: 541.7 Kin-lb

Use	Date/Time	CBE	CBM
☐	02/18/2015 04:23:50PM	11.07	530.5
☐	03/12/2015 04:58:41PM	10.79	516.5
☐	03/13/2015 01:38:31PM	11.06	530.2





Overlay Power...

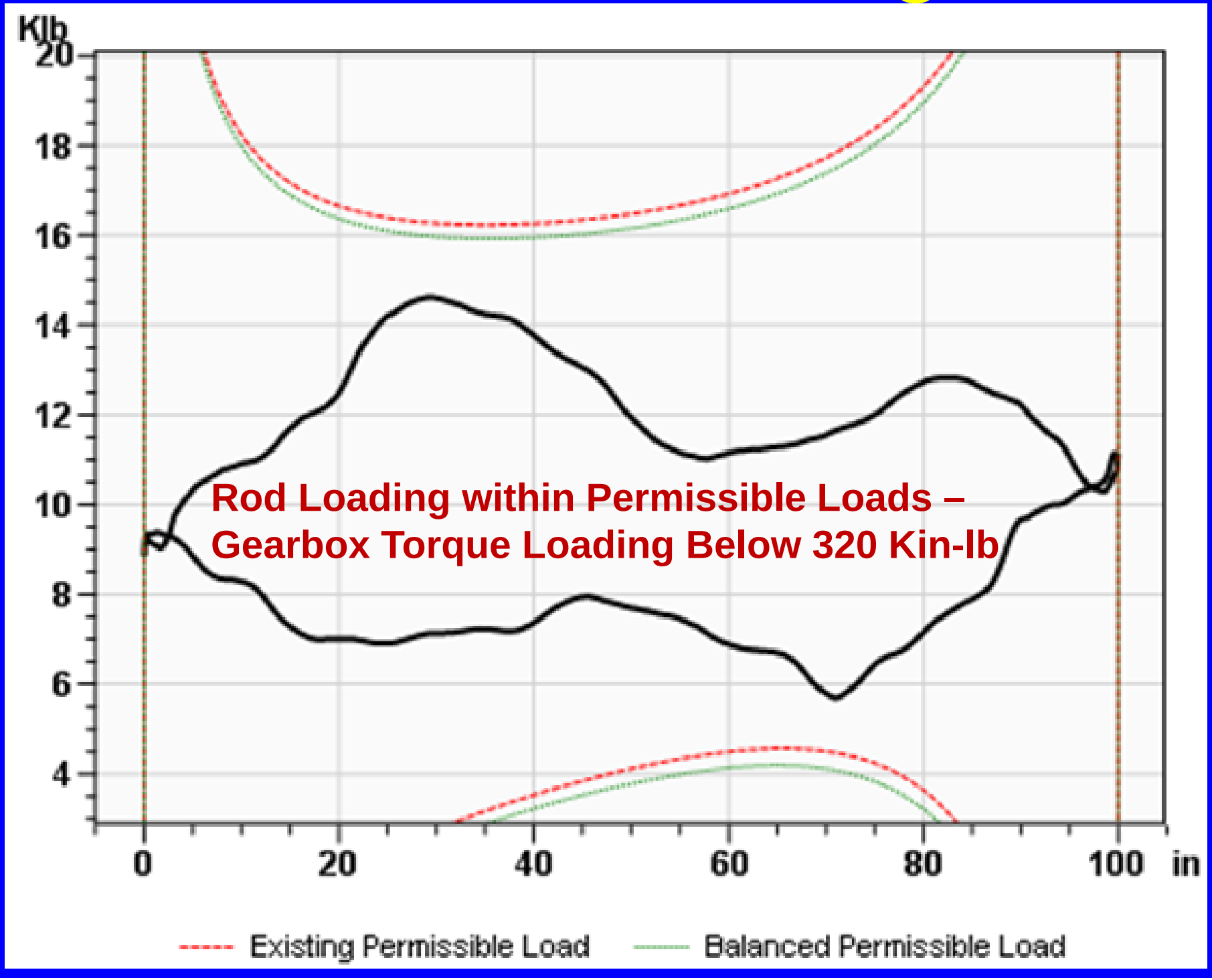
Mechanical Power

Mechanical Gearbox Loads

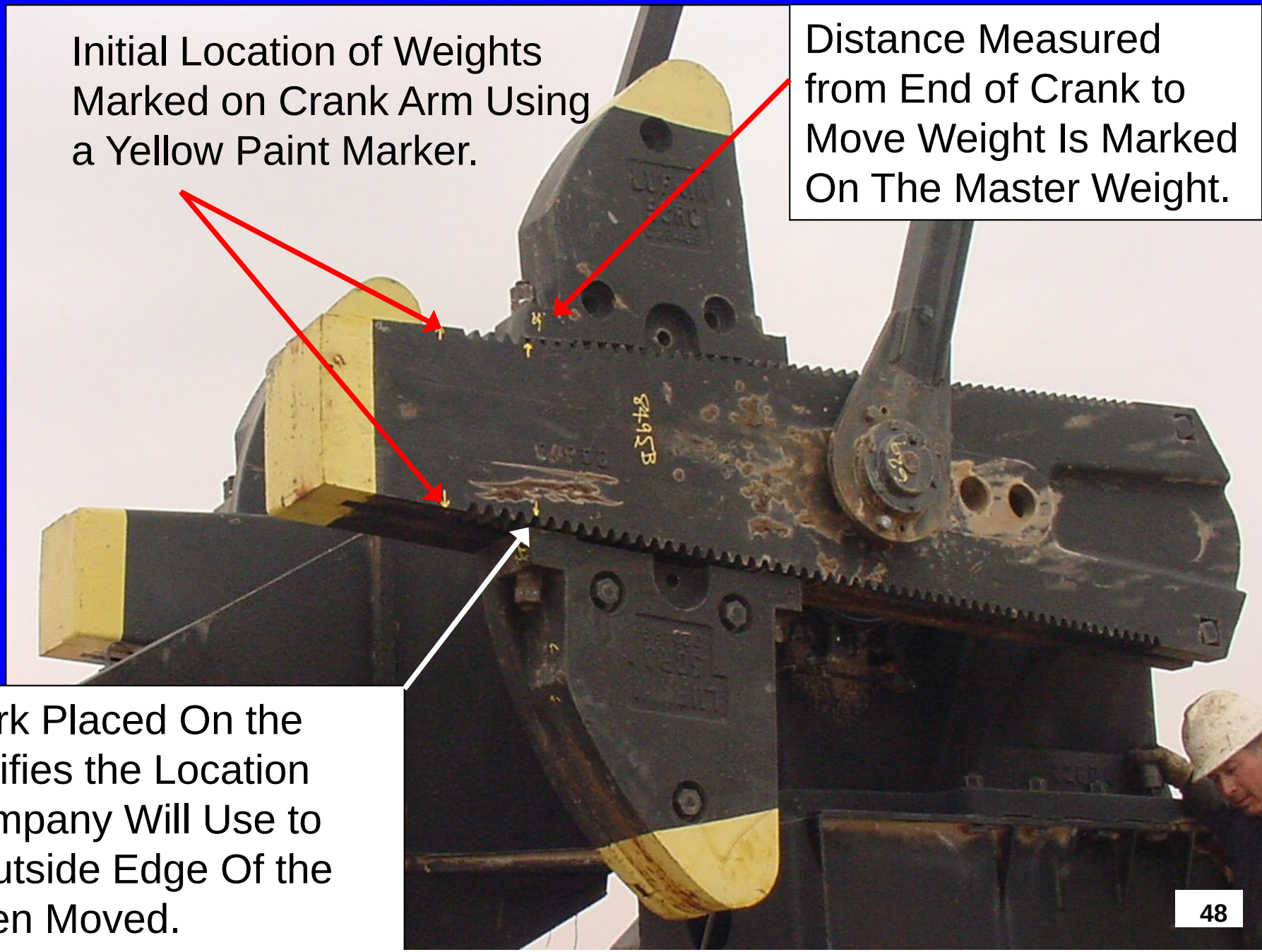
	Existing	In Balance
Min Gearbox Torque, Upstroke	-79.3 Kin-lb	-72.4 Kin-lb
Max Gearbox Torque, Upstroke	241.5 Kin-lb	255.6 Kin-lb
Min Gearbox Torque, Downstroke	-56.9 Kin-lb	-55.0 Kin-lb
Max Gearbox Torque, Downstroke	271.5 Kin-lb	255.6 Kin-lb
RMS Gearbox Torque	118.0 Kin-lb	115.8 Kin-lb
AVG Gearbox Torque	73.6 Kin-lb	73.5 Kin-lb
Cyclic Load Factor	1.602	1.576

Out of Balance	weights heavy
Maximum Counterbalance	713.2 Kin-lb
Existing Counterbalance	503.2 Kin-lb
Required Counterbalance Decrease	16.7 Kin-lb
To Balance Move 5.308 Klb weights IN	3.14 in

Permissible Load Diagram



Distance to be Moved Marked on Crank for "Weight of Counterweights to be Moved"



Using Power to Balance Torque Loadings on the Gearbox

1. Motor and belts efficiency is defaulted to 80%
2. Experience has shown 80% to be reasonably accurate for gearbox torque calculations
3. NEMA D motors operate at anearly constant efficiency over a wide horsepower range, but a lightly loaded motors operate at lower efficiency
4. Rewound motors do not have the same efficiency performance of a new motor
5. Actual lower surface efficiency result in much higher gearbox loads, possibly in excess of gearbox rating
6. Errors affects both peaks same, therefore the distance to move the weights remains same.

Best Method to Balance Pumping Unit Net Peak Torques

1. Mechanical Complicated Vs. Power Simple.
2. Use Both Power and Mechanical Methods at the Same Time
3. View the Plot of net Gearbox Torque from Power Overlain by Plot Mechanical torque
   - Visually compare the plots for discrepancies
4. Move the Counterweights to Balance Net Torques Based on Combination of Both
5. Sometimes Only One Method can be Applied

Previous Balancing Studies Conclusions: Operations

- Smoother operation and increased pumping speed are achieved.
- Power requirements are reduced when operating in vicinity of balance.
- Extensive field measurements have shown that operating cost savings of 10-12% can be achieved.

What Gearbox Demands the Motor Provides

- KW provided electric motor is directly related to the torque required by the Pumping Unit.
- Motor torque characteristics have similar "signatures" to that of the gearbox torque.
- These cyclic loads translate to peaks and valleys in the power demand at the motor.
- Easy to Identify and distinguish between an electrically unbalanced and balanced pumping unit.