Steps to Perform Counterbalance Effect, CBE, Load Test
+
Compare 3 Methods.

Reference: Well Analyzer QuickRefs, http://www.echometer.com/support/quickrefs/index.html

Use Dynamometer Transducer to Determine Counterbalance Effect Load

Definition of Counterbalance Effect Load (CBE):

Weight at the polished rod that balances the counterweights on the upstroke with cranks level.

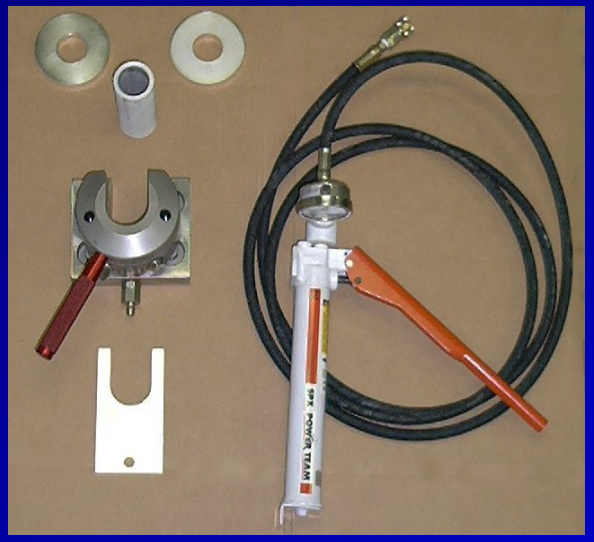
Counterbalance Effect (CBE) Test

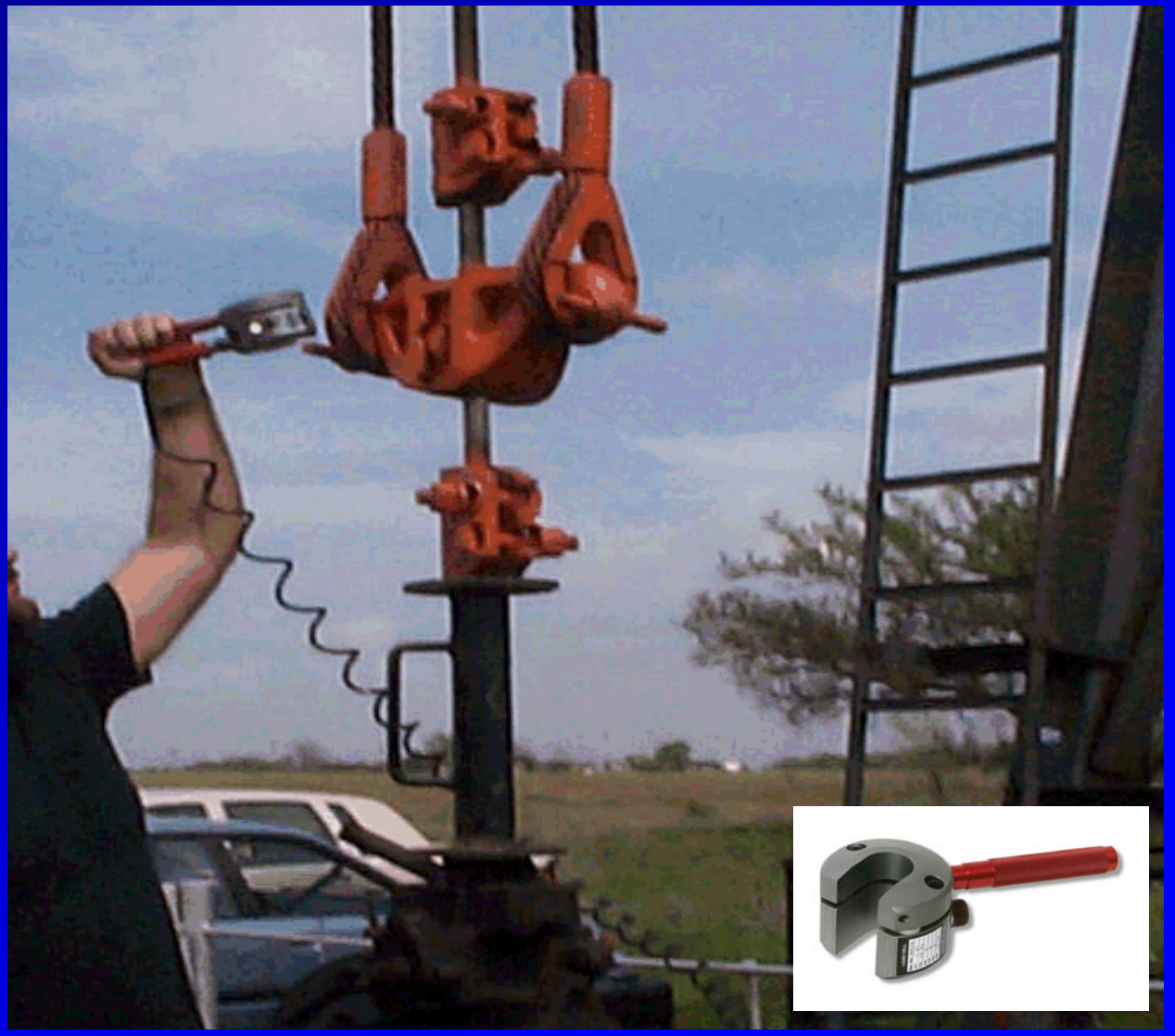
1. Requires a properly functioning brake.

2. Counterbalance effect load must be between the traveling valve load and the standing valve load.

3. Will not work when fluid slippage through the pump is rapid and the fluid load quickly transfers from the rods to the tubing.

Use Any of these Dynamometer Transducers to Determine Counterbalance Effect Load





Connect the cables to Well Analyzer.

Far end on the coiled cable is attached to the 25-foot Y-cable, that is connected into the MAIN INPUT on the Well Analyzer.

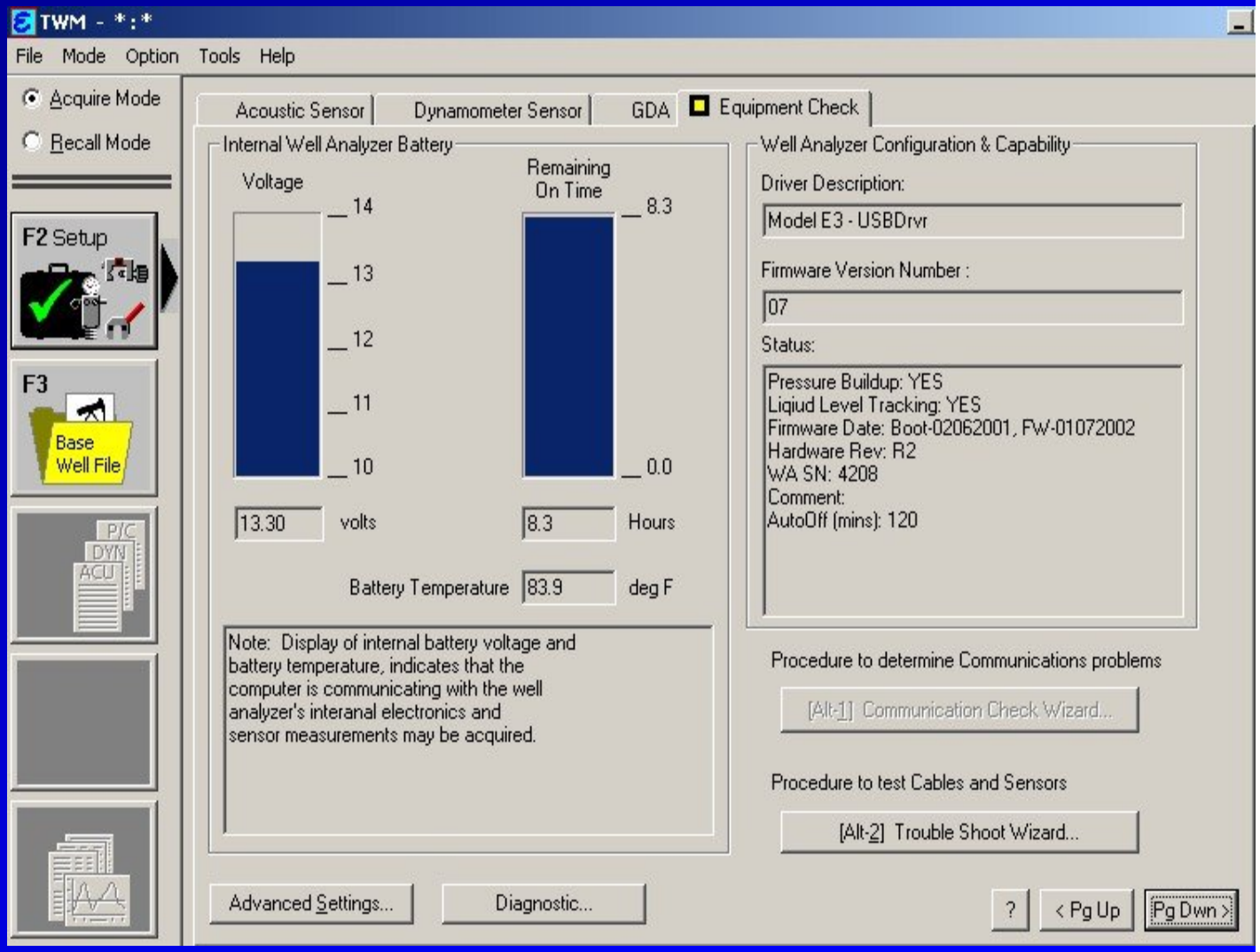
Turn on Well Analyzer and wait for GREEN LED.

Turn on the computer.

Start TWM in Acquire Mode

1. Select the **Equipment Check** tab.

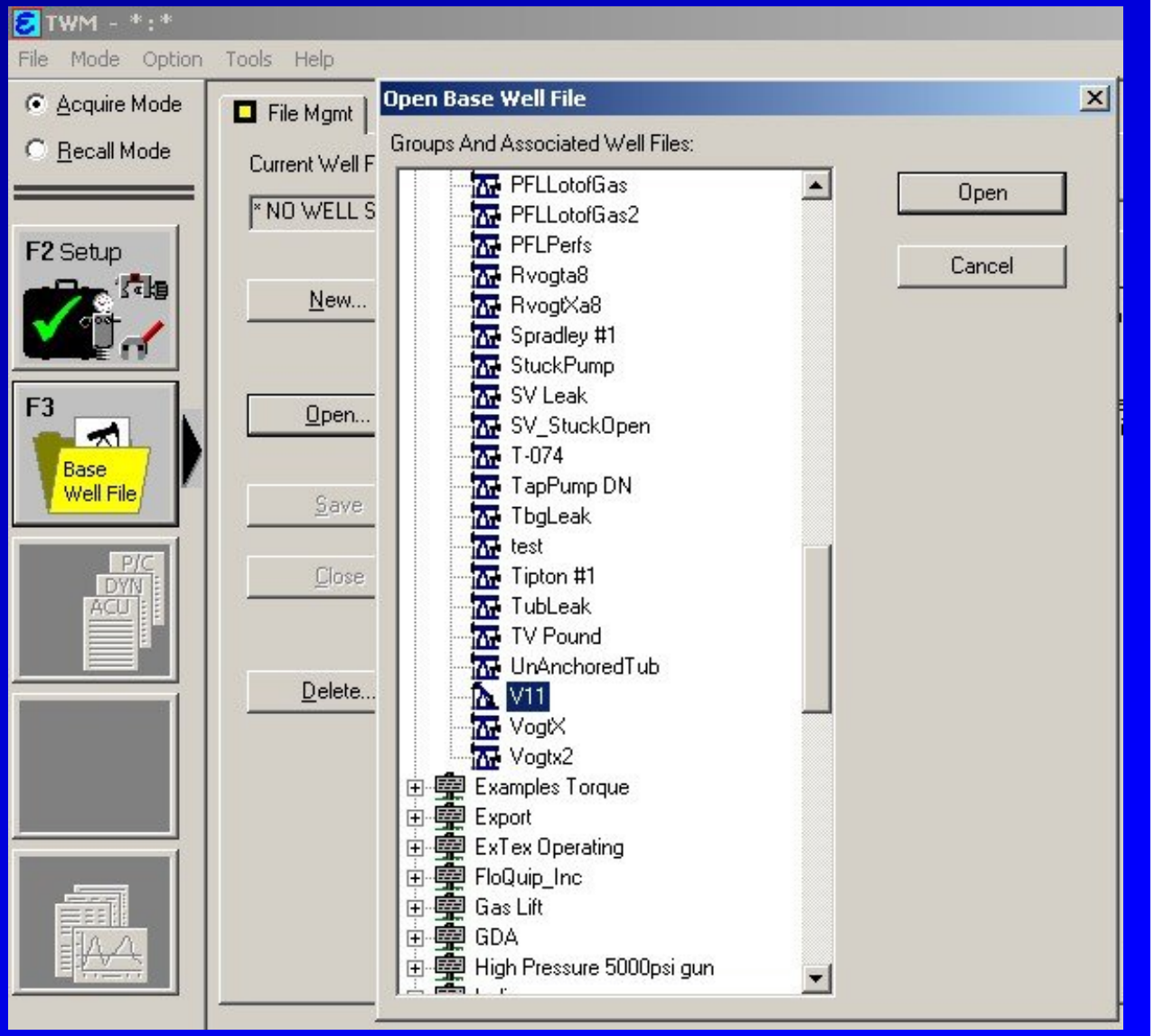
2. The display of internal battery voltage and battery temperature indicate that the computer is communicating with the well analyzer's internal electronics and sensor measurements may be acquired.



TWM Software – F3 to Select Well

1. **Open** Base Well File for the well where data is to be acquired. Use **New**... to create a Base Well File if one does not exist.

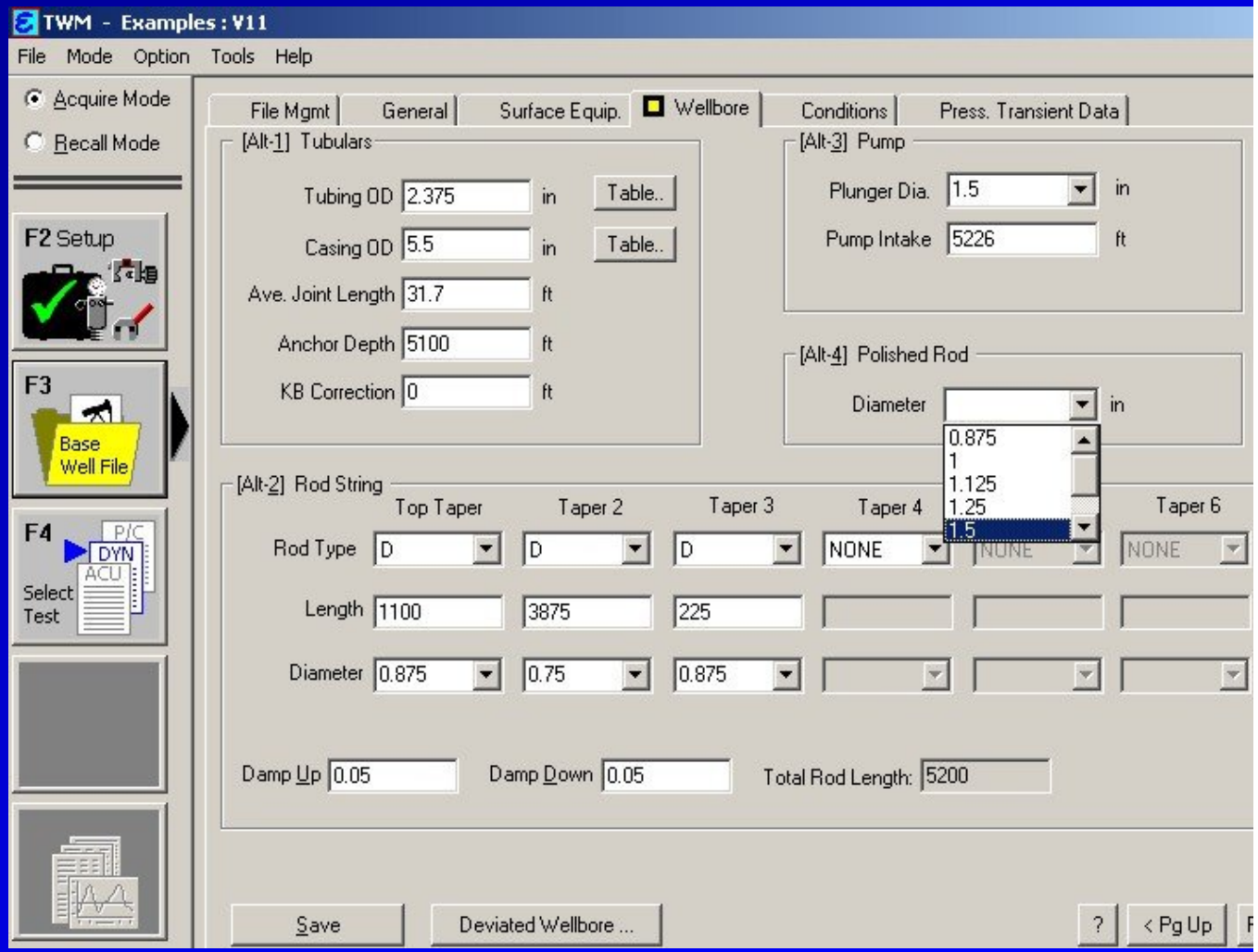
2. For acoustic surveys be sure to enter at least **avg. joint length, pump** and **formation depths**.



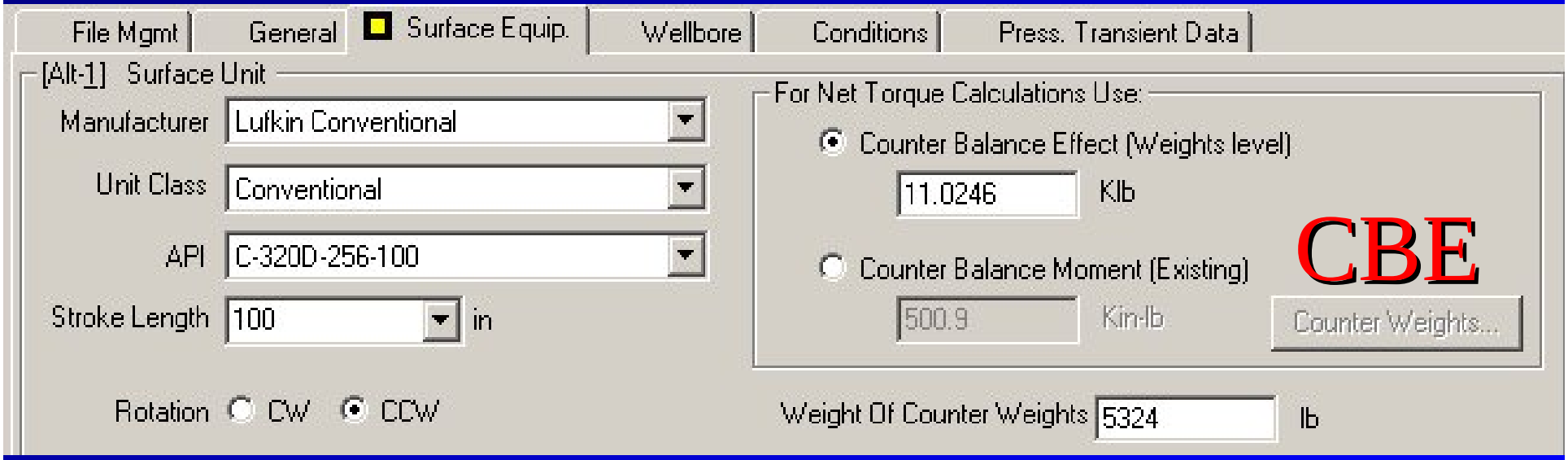
Select Wellbore Tab to Verify Data

1. From the Base Well File select the **Wellbore** Tab and verify the well data is representative.

2. For Dyno surveys be sure to enter **Rod Type, Rod Length, Rod Diameter, Pump Plunger Dia., Pump Intake, Polished Rod Diameter, fluid gravities, and production rates.**



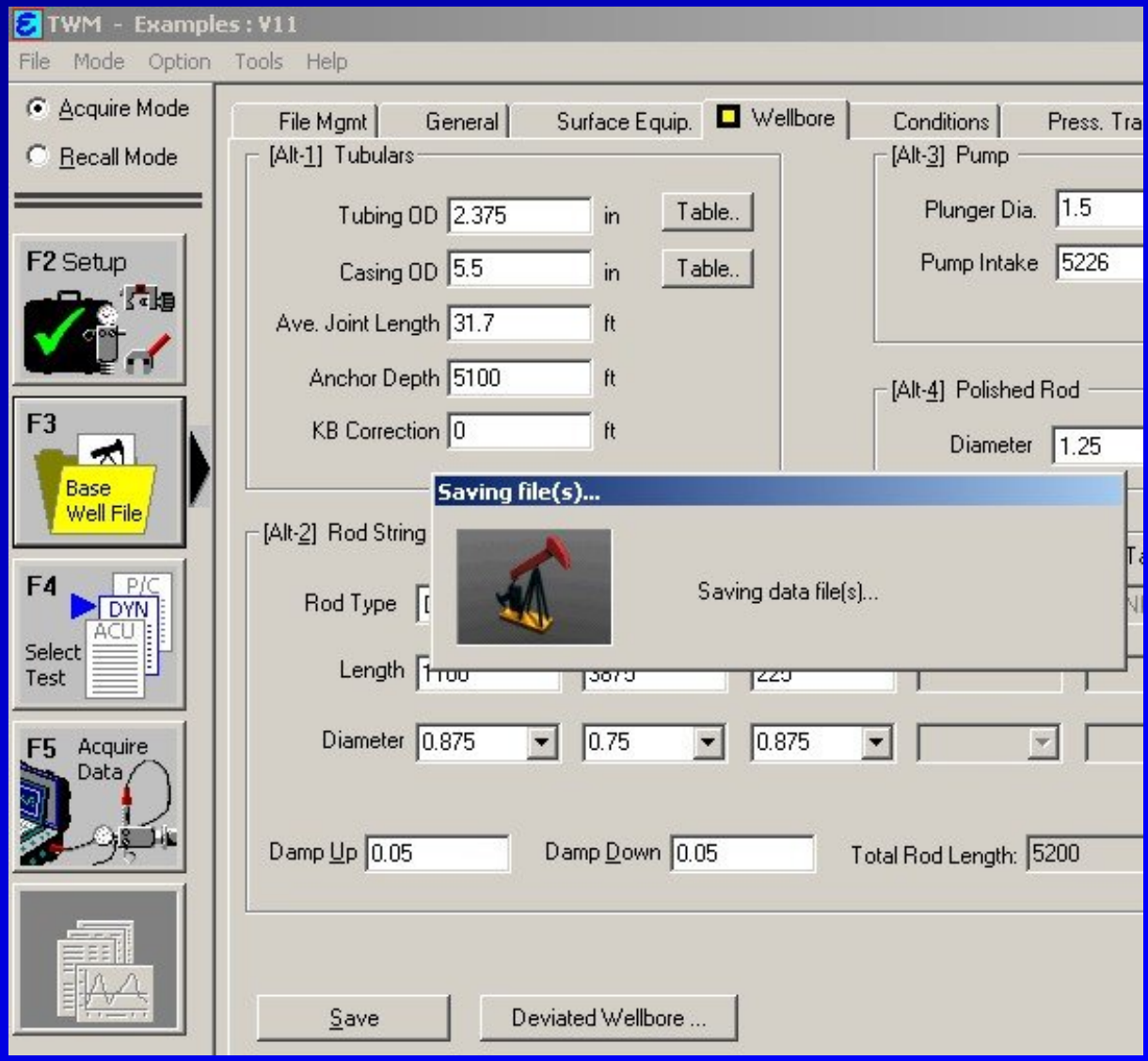
On the Surface Equipment Tab Select Mechanical Torque Method



1. Accurate description of the pumping unit's API geometry is required for a correct analysis.
2. The API dimensions for a pumping unit are either hand entered or selected from the pumping unit library database.
3. It is VERY IMPORTANT that the correct unit API description be selected in the well file.

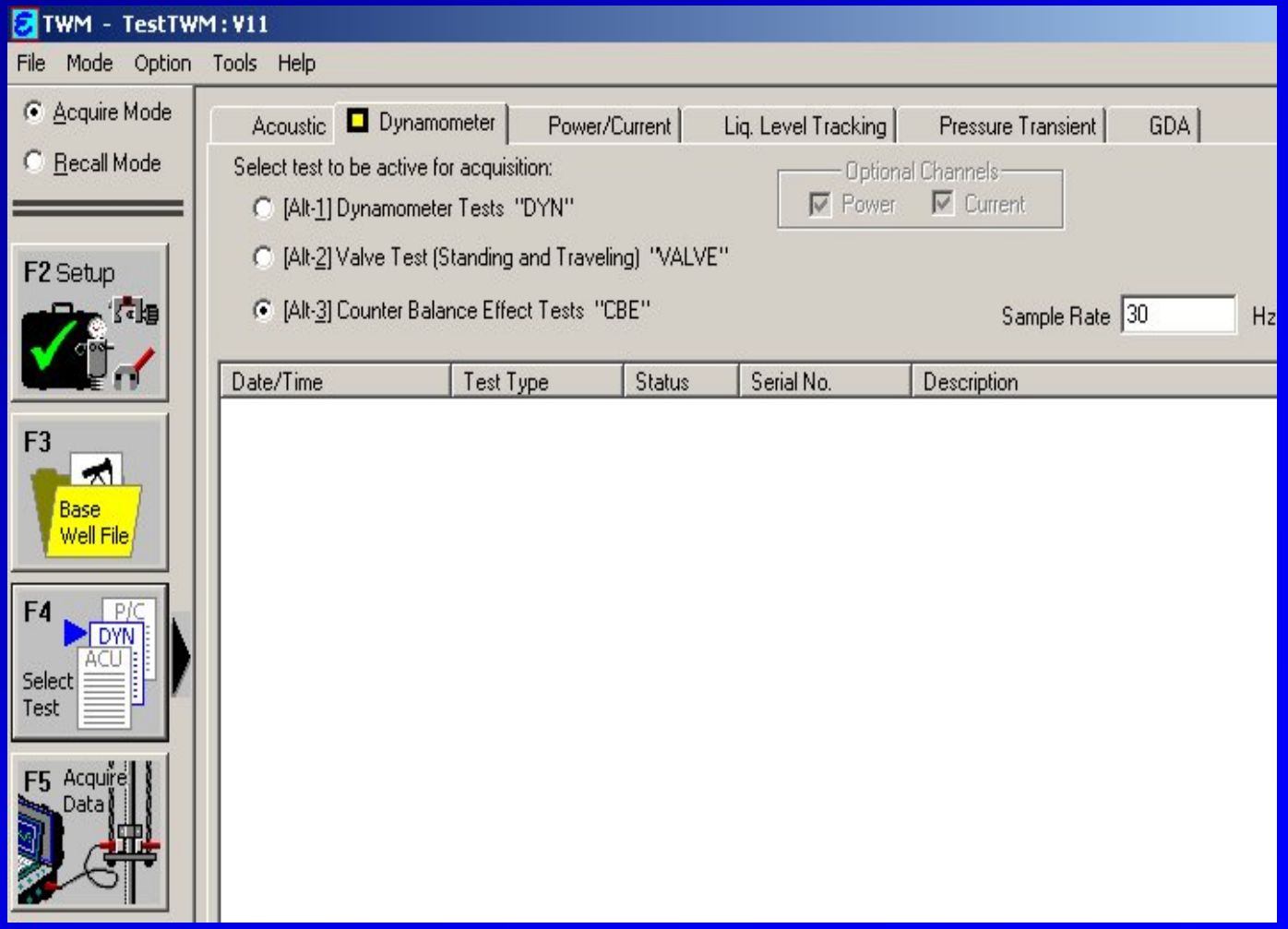
Save Changes to Base Well File

1. Click **Save** button to be sure to save changes to the base well file.



Select Type of Data Acquisition Test

1. Tap **F4** to Select Test type to be acquired.
2. Click the **Dynamometer** Tab to indicate that DYNO data will be acquired.
3. Click **Alt-3** to select Counter Balance Effect Test
4. Select **F5** to Acquire Data

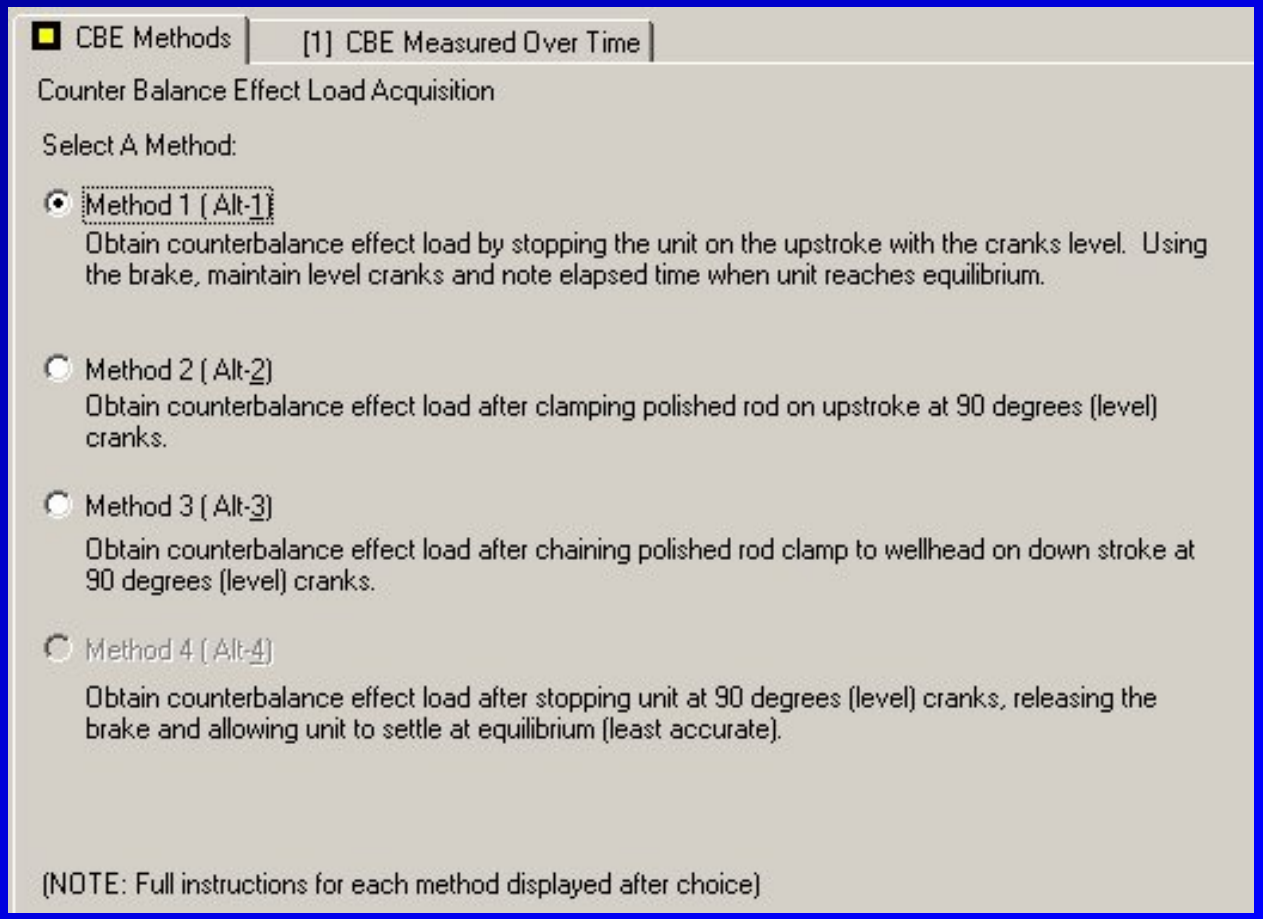


Select CBE Load Acquisition Method

1. After choosing the Select Test option (**F4**) the operator is presented with three methods for performing the counterbalance test

2. Method 1 is the simplest and allows the user to acquire the CBE load by setting the break and noting elapsed time.

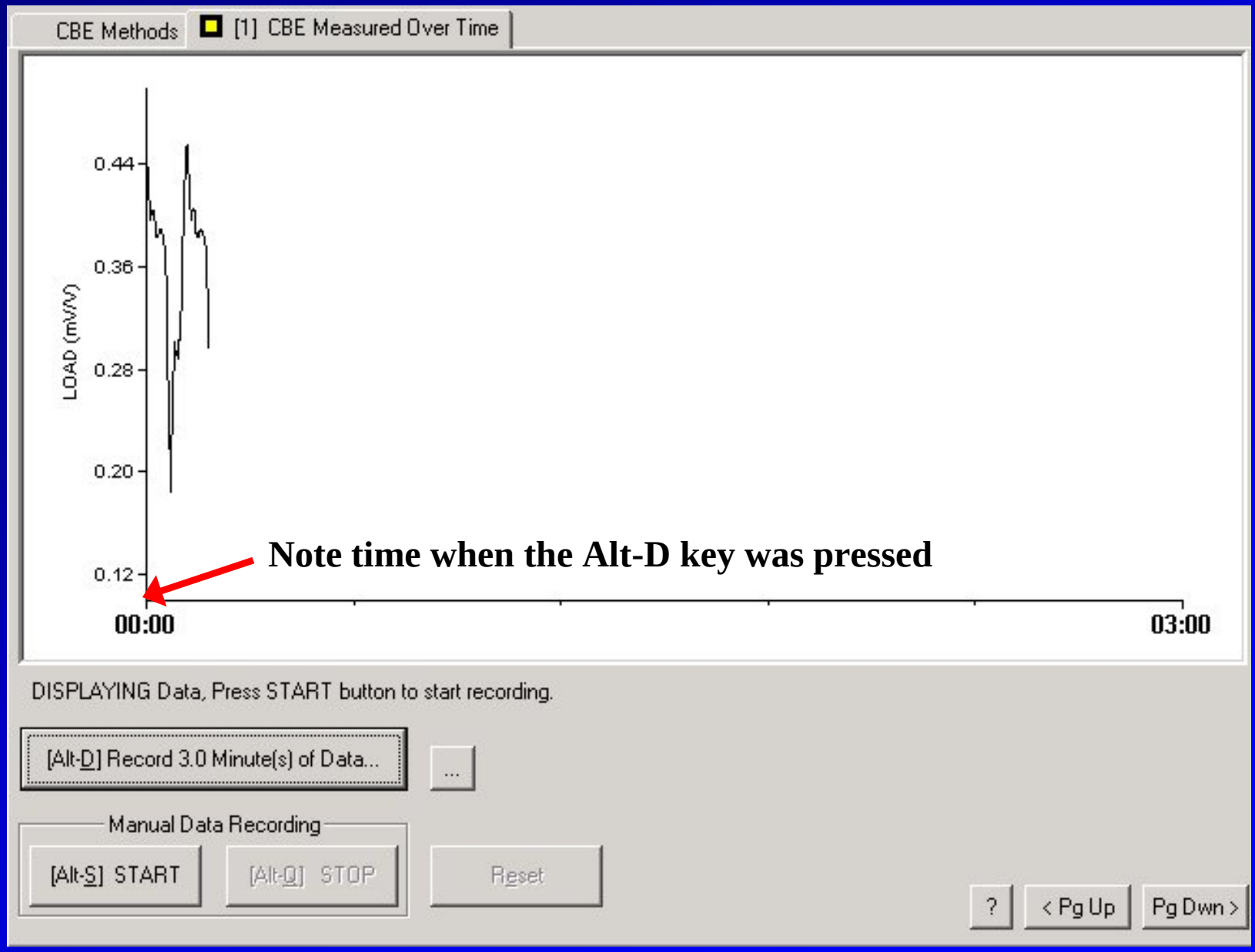
3. Tap **Alt-1** to select Counter Balance Effect Load Acquisition Method.



Static Counterbalance Effect (CBE) Test Procedure

1. Press **Alt D** to start data acquisition and note the precise time when the key was pressed
2. Stop the unit on the upstroke with the cranks level.
3. 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.
4. Cranks will balance momentarily as the load is equalized due to fluid leakage from the tubing into the pump.
5. The operator should record the precise time when the brake can be released without movement of the crank arm.

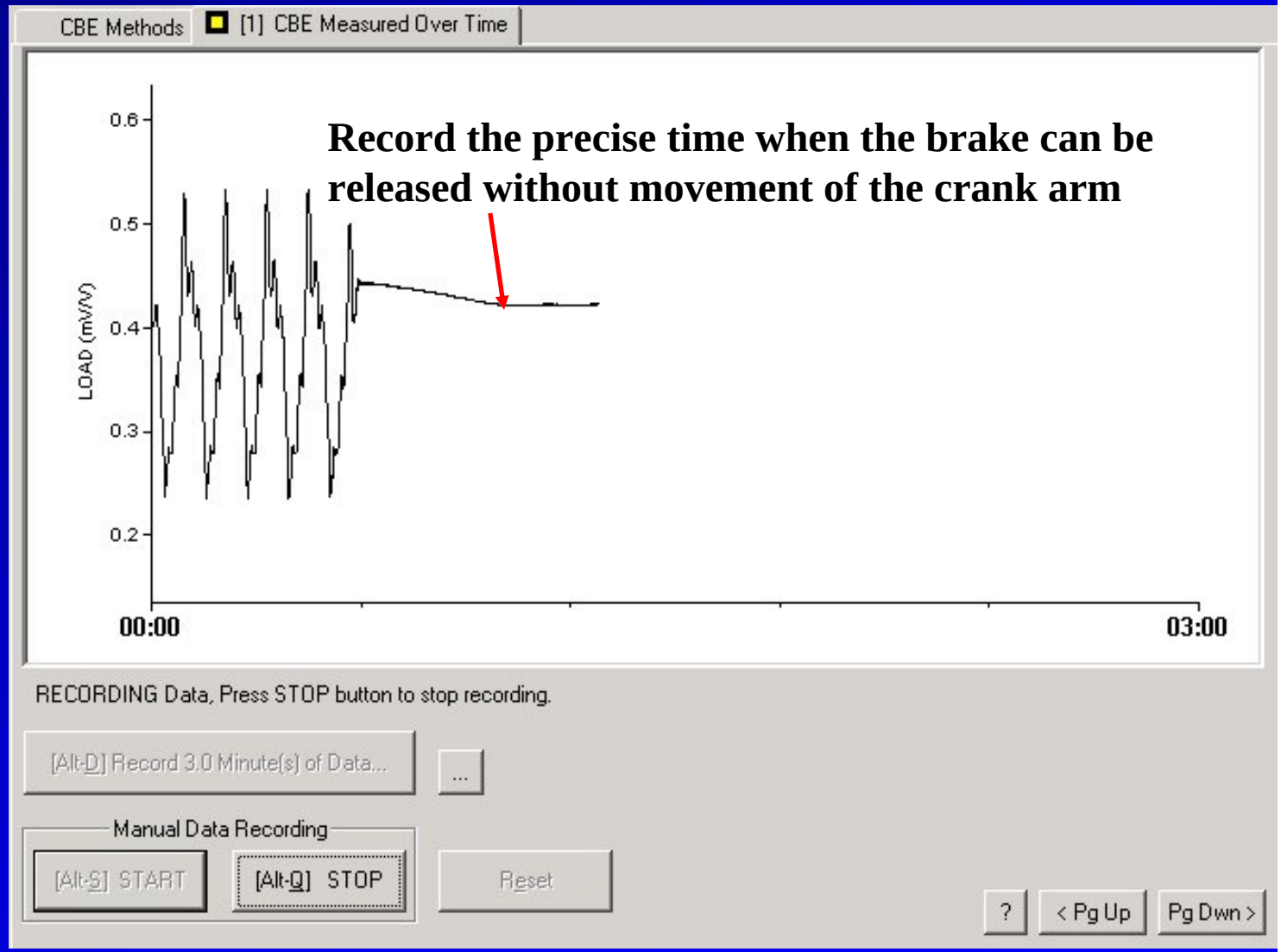
Note Precise Time Alt-D Key Pressed



Stop the Unit on the Upstroke with the Cranks Level

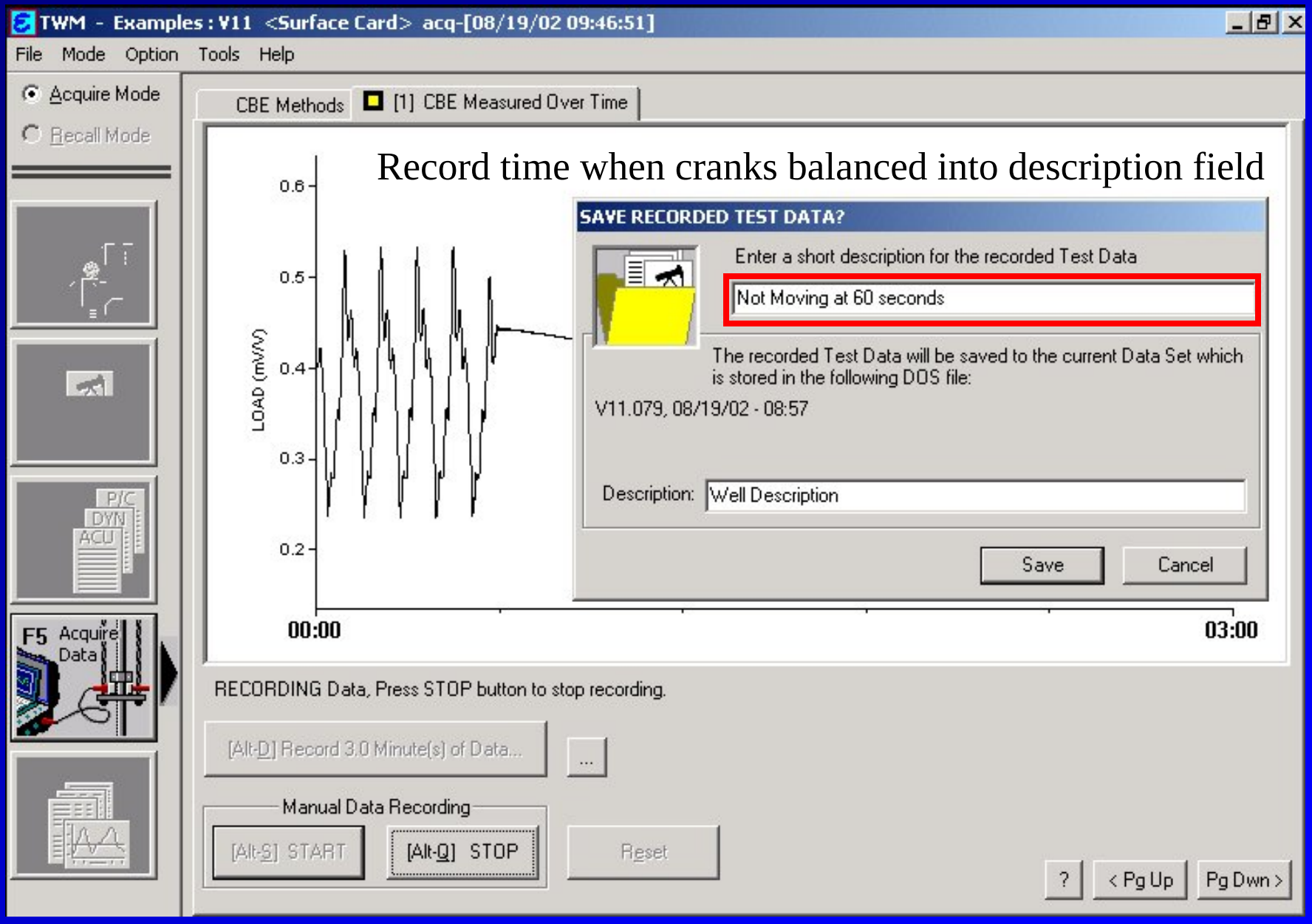
Determine Counterbalance Effect Load

As drop in PR load occurs release the brake periodically to check for movement of the cranks.

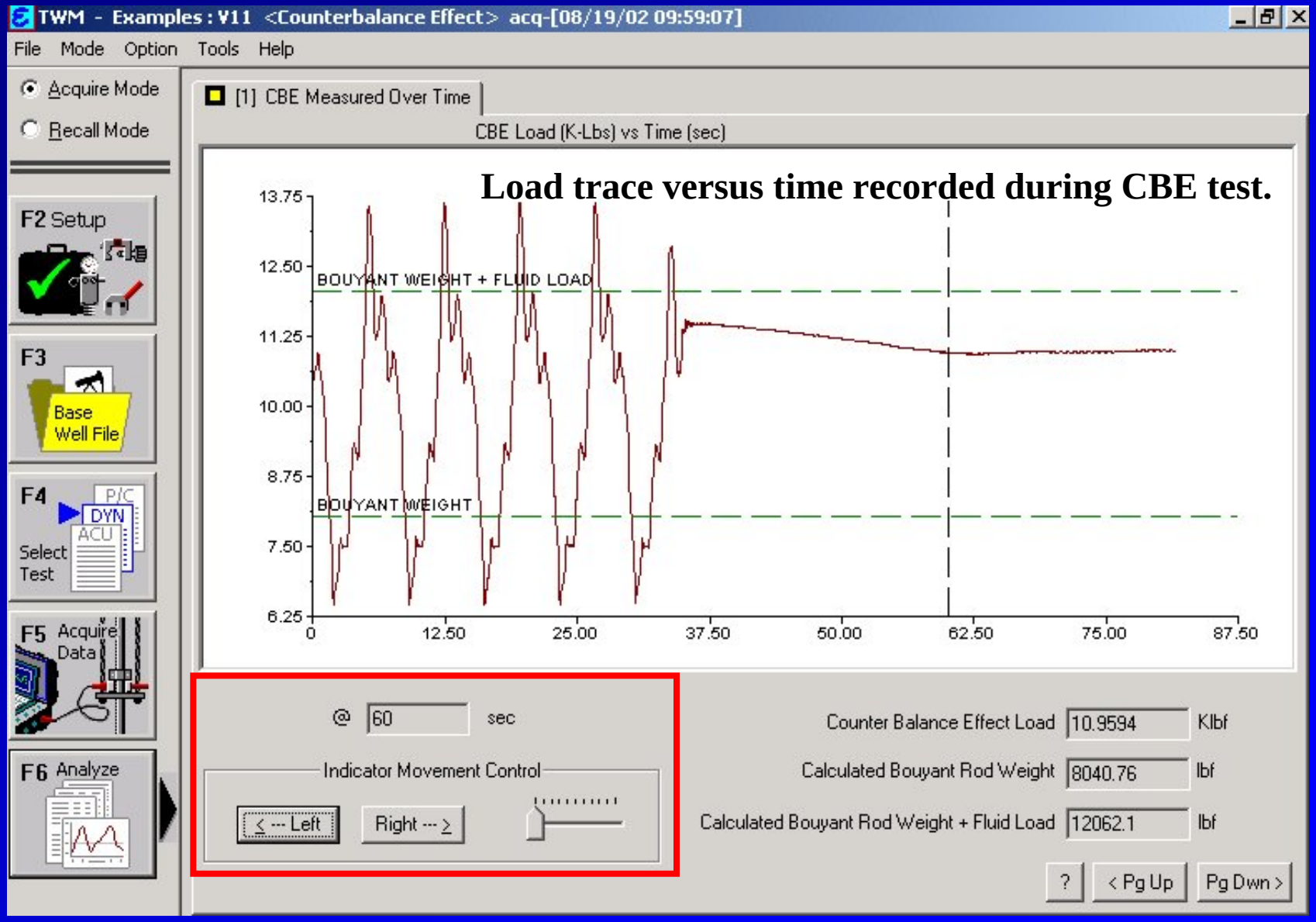


Cranks will balance as the polished rod load due to fluid leakage past the pump.

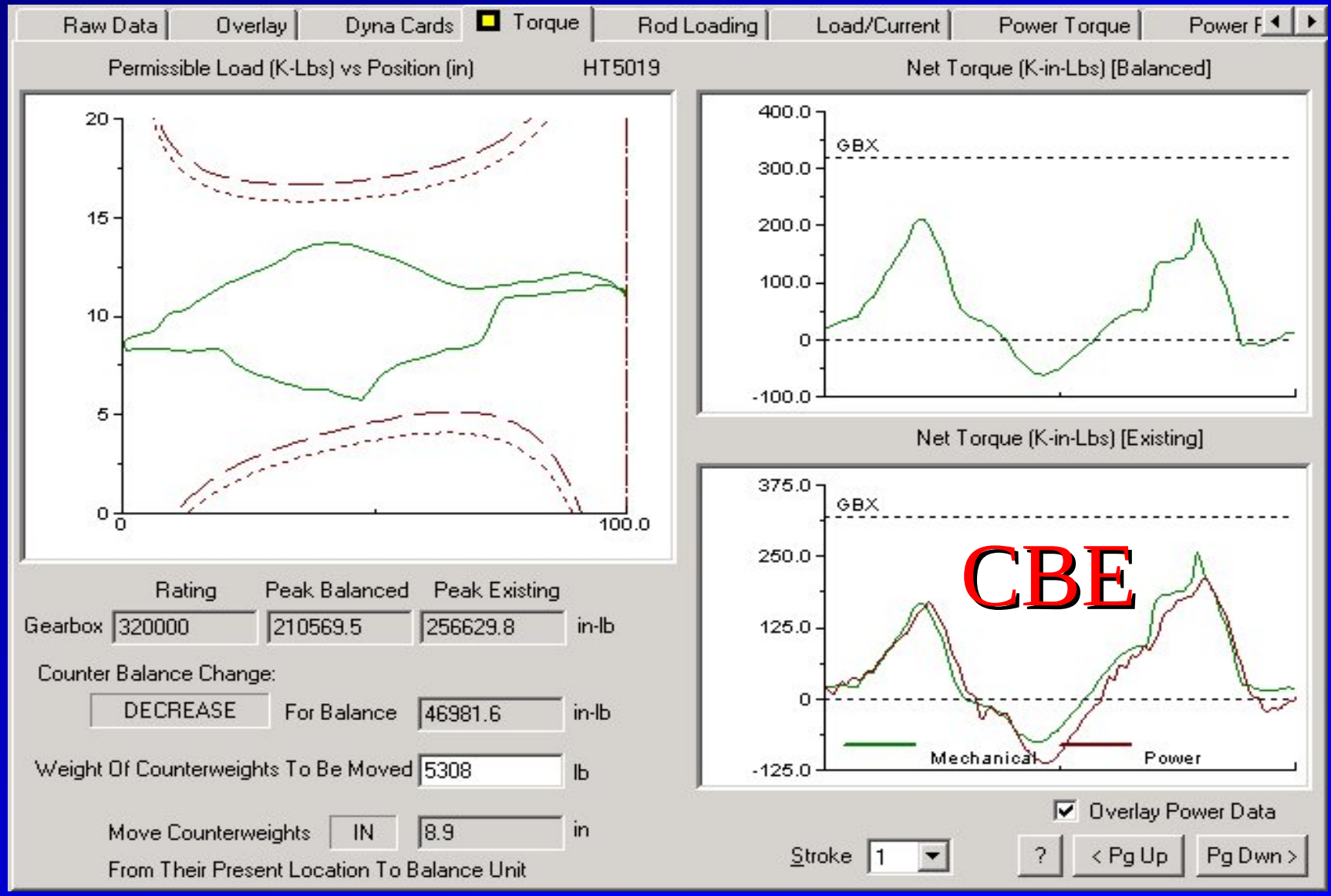
Alt-Q to Stop CBE Data Acquisition



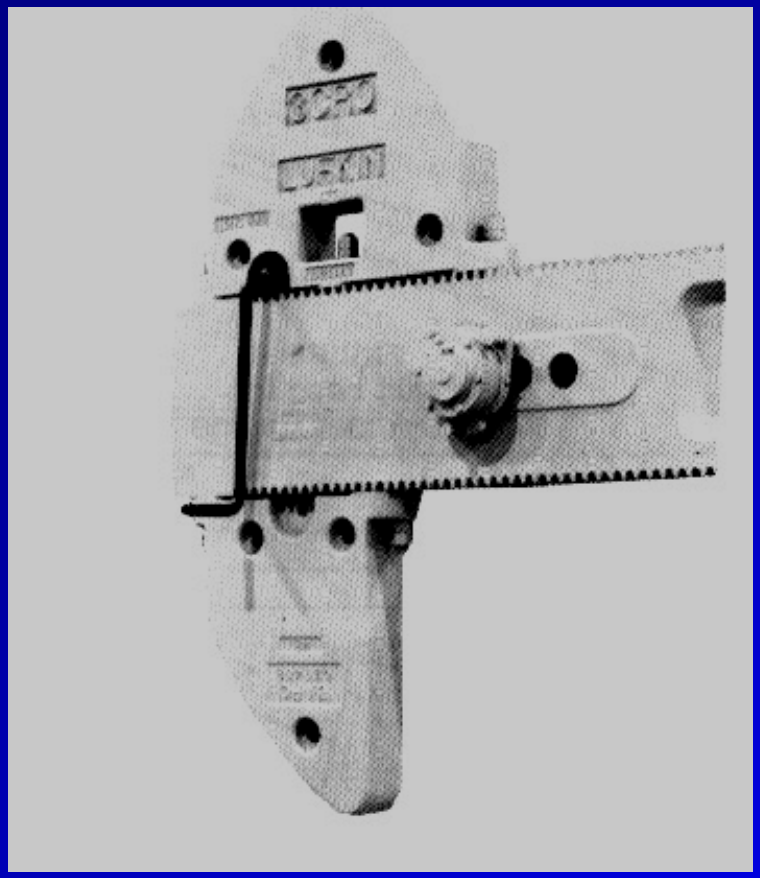
Move Indicator to Elapsed Time Where Cranks Remained Level

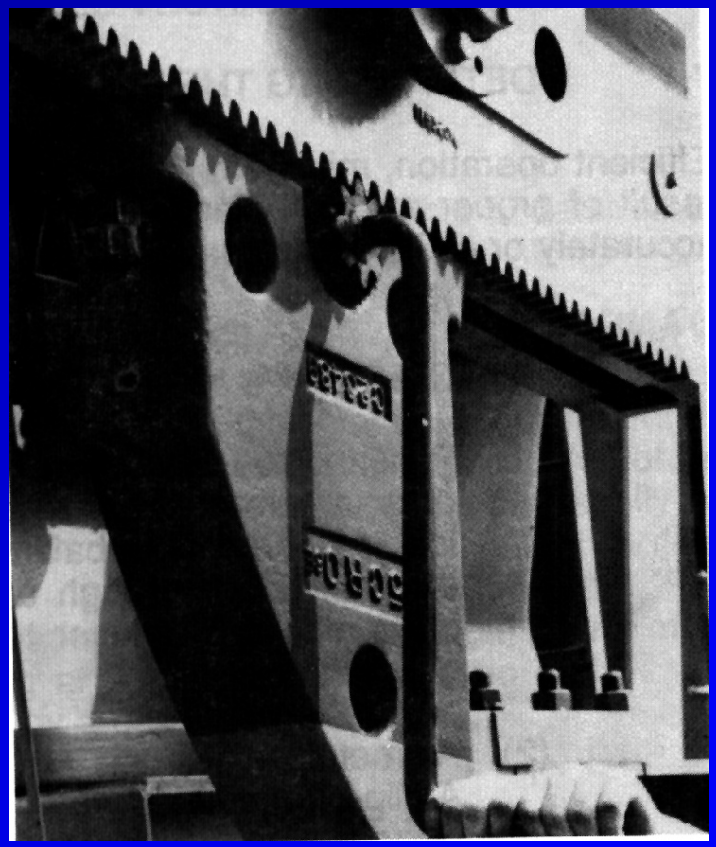


Distance to Move Counterweights Results in Equal Peak Net Gearbox Torques on Upstroke and Downstroke.



Counterweight Adjustment





To balance the gearbox torque the operator should move the counterweights from their current position the distance in inches recommended by the TWM software.

CBE Test Used for Torque Analysis

1. To determine the net gearbox torque loading of the torque reducer

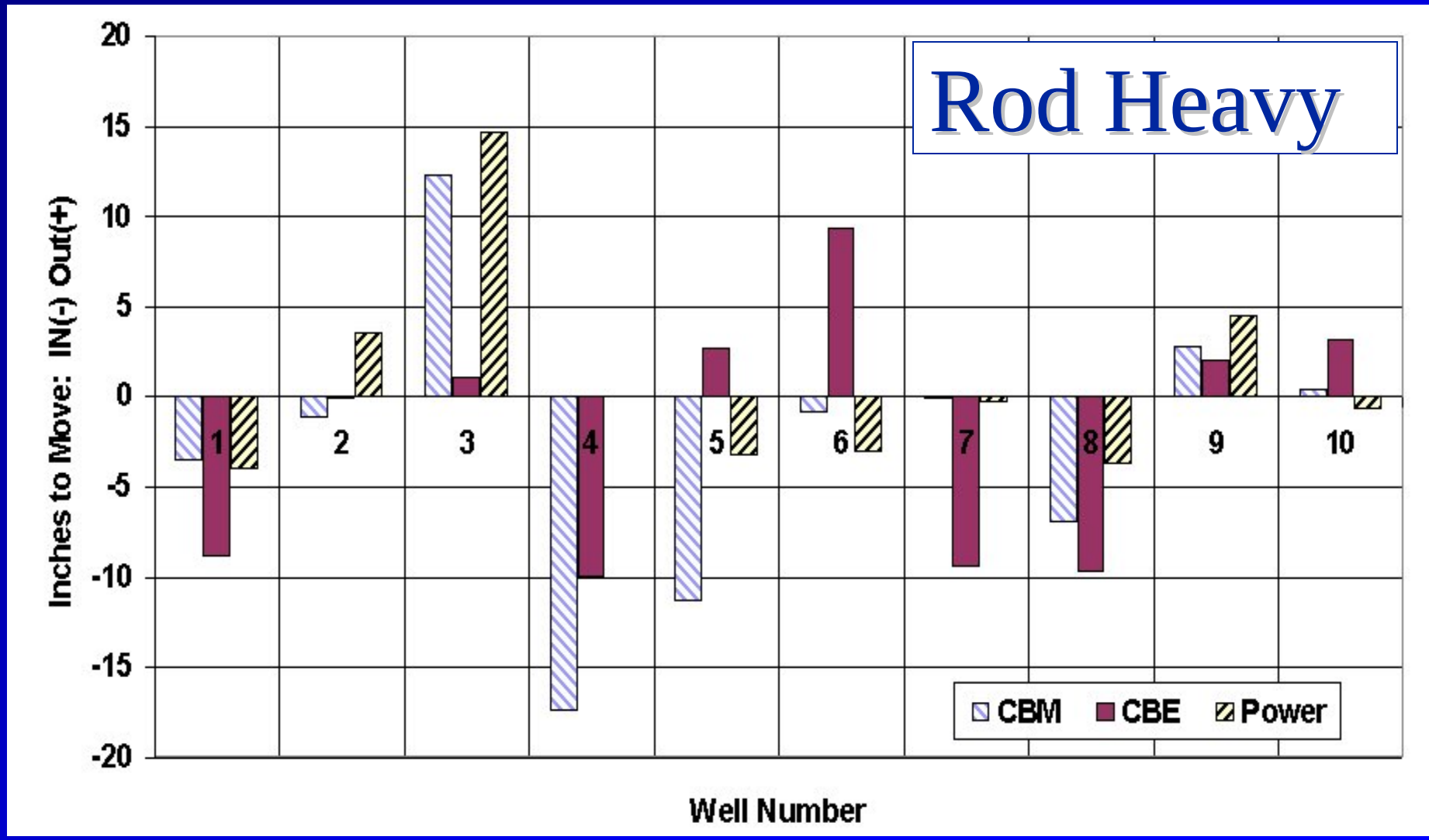
2. To establish whether the unit's gearbox is properly balanced

3. To determine the movement of the counterweights, necessary to achieve a better balanced net gearbox torque on the pumping unit gearbox.

10 Well Comparison of Net Gearbox Calculation Methods

Well	Date	API Pumping Unit Description	Peak Existing Net Gearbox Torque (in-lbs)			Move Counterweights Inches: IN(-) Out(+)		
			CBM	CBE	Power	CBM	CBE	Power
1	09/09/01	C-320D-256-100	229344	256630	209642	-3.6	-8.9	-4
2	12/19/01	M-456D-305-120	261935	251680	313281	-1.2	-0.1	3.6
3	12/19/01	C-640D-305-120	652468	518920	737500	12.3	1.1	14.7
4	10/18/01	RM-640D-405-156	731074	598643	N/A	-17.4	-10	N/A
5	01/12/01	M-640D-305-192	457988	399640	380900	-11.4	2.7	-3.3
6	09/25/00	C-640D-304-144	325000	384284	300900	-0.9	9.3	-3.1
7	09/26/00	M-640D-305-192	413224	484773	353800	-0.1	-9.4	-0.3
8	09/26/00	M-640D-305-192	409029	434129	356400	-7	-9.7	-3.7
9	08/29/00	M-640D-305-168	623343	614192	642800	2.8	2	4.5
10	11/10/00	M-456D-305-168	348207	381389	315300	0.4	3.2	-0.7

10 Well Comparison of Net Gearbox Calculation Methods



10 Wells Comparison of CBM, CBE, & Power Methods

- For 10 wells the distance required to move the counter weights good agreement when balancing with CBM and Power.

- Five wells (1, 2, 8, 9, and 10) required approximately the same movement of the weights to bring the net torque loadings into balance.

10 Wells Comparison of Methods

- More discrepancies from the CBE method in determining the distance required to move the counterweights.
- CBE method for well 5 and 6 said loading rod heavy and to move the weights out from their current position, while the CBM and Power methods calculated to move the weights in.
- Wells 3 and 7 also show much different movement of weights as calculated by the CBE, compared to CBM and Power.
- Power method was not determined for well 4, because the prime move was a gas engine.

10 Wells Comparison of Methods

Which method is More Accurate?

CBM and CBE Methods Use Many of the Same Parameters for Net Gearbox Torque

1. Pumping unit API dimensions are either hand entered or selected from a database.
2. Common sources of error in the torque factor calculations are:
   - Wrong pumping unit is select
   - Pumping unit not in the database .
   - Field assembly of the pumping unit results in dimensions not matching database
   - Wrong radius/stroke length
   - Direction of rotation

Accuracy of Acquired Load Data Depends on Type of Load Cell Used

- Portable load cells are calibrated and accurately determine polished rod loads.
- Error in the measured loads introduced if the carrier bar and clamp do not uniformly contact the load cell.
- Hydraulic type load cells with a piston, usually have hysteresis type of friction that causes an offset and drifting of the loads.
- Donut load cell should have a spacer and spherical washers to ensure the polished rod load is centralized on the load cell.

Permanently Mounted Donut Load Cell Accuracy Considerations

1. Damage to the load cell
2. Calibration of the load cell
3. Not centrally loaded at the top or bottom
4. Calibration of the controller incorrectly converting the mV/V output from the load cell into pounds of load.

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.

The END